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Fork-lift trucks — Fork-arm extensions and telescopic fork arms — Technical characteristics and strength requirements

Chariots élévateurs à fourche — Extensions de bras de fourche et bras de fourche télescopiques — Caractéristiques techniques et prescriptions de résistance

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 13284 was prepared by Technical Committee ISO/TC 110, *Industrial trucks*, Subcommittee SC 2, *Safety of powered industrial trucks*.

Introduction

This International Standard was developed in response to worldwide demand for specifications for fork-arm extensions and telescopic fork arms.

Fork-arm extensions are used as an economic means of extending the effective blade length of fork arms on fork-lift trucks. They are available with either a closed rectangular cross-section or an open inverted-channel cross-section.

Where possible, preference should be given to using a longer fork rather than an extension. If extensions have to be used, preference should be given to the closed cross-section rather than an open type of extension.

Telescopic fork arms replace standard fork arms and provide the truck operator with the means of adjusting the fork-arm blade length. They are available either as simple variable-length fork arms for handling loads of varying dimensions or, alternatively, for reaching out or retracting palletized loads in double-deep stacking and destacking operations.

Fork-lift trucks — Fork-arm extensions and telescopic fork arms — Technical characteristics and strength requirements

1 Scope

This International Standard specifies technical characteristics and strength requirements for fork-arm extensions and telescopic fork arms for fork-lift trucks. It applies to fork-arm extensions and telescopic fork arms designed for use on stacking lift trucks, as defined in ISO 5053, having fork-arm carriers and, in the case of fork-arm extensions, hook-on fork arms conforming to ISO 2330.

This International Standard does not apply to integral transverse telescopic fork devices or scissor-action reach devices.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2330:2002, *Fork-lift trucks — Fork arms — Technical characteristics and testing*

ISO 3691, *Powered industrial trucks — Safety code*

ISO 5053, *Powered industrial trucks — Terminology*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

3.1
parent fork arm
fork arm having the rated capacity at the rated load centre distance, blade length and blade cross-section for which a fork-arm extension is specifically designed

3.2
test load
F_{EX} and F_{T}
applied load for verifying the strength of fork-arm extension and telescopic fork arms by physical testing or calculation

4 Symbols

b Fork arm blade width (mm)

C Rated capacity of each parent fork arm (kg)

C_{E} Rated capacity of each fork-arm extension (kg)

C_R Rated capacity of each retracted telescopic fork arm (kg)

D Rated load centre distance of each parent fork arm (mm)

D_E Rated load centre distance of each fork-arm extension (mm)

D_R Rated load centre distance of each retracted telescopic fork arm (mm)

F_{Ex} Test/design load for open- and closed-section extensions

F_T Test/design load for telescopic fork arms

l Blade length of the parent fork arm or of the fully retracted telescopic arm (mm)

l_1 Blade length of the fork-arm extension or of the fully extended telescopic arm (mm)

l_2 $= 0{,}9\, l_1 - l$ (mm)

M Stress modulator

R Safety factor

S Total lateral clearance between the parent fork and the fork-arm extension (mm)

Y_a Actual material yield of extension material

Y_m Minimum specified material yield of extension material

Z Section modulus of the extension of the fork-arm tip

5 Requirements for rated capacity and rated load centre distance

5.1 The rated capacity (C) and rated load centre distance (D) for the parent fork arm shall comply with ISO 3691. For rated capacities of 5 500 kg and above, the rated load centre distance shall be as specified in ISO 3691.

5.2 The rated capacity (C_E) and rated load centre distance (D_E) for each fork-arm extension shall be proportional to the rated capacity (C) and rated load centre distance (D) for the parent fork arm, i.e:

$$C_E \leqslant \frac{C \cdot D}{D_E}$$

5.3 The rated capacity (C_R) and rated load centre distance (D_R) for each telescopic fork arm shall both be as specified in ISO 3691, in kilograms and millimetres respectively, when the telescopic fork arm is in the fully retracted mode. In extended mode, the rated capacity should be specified by the manufacturer.

6 Requirements for fork-arm extensions

6.1 Unless otherwise agreed, the blade length l of the parent fork arm for open-section and closed-section fork-arm extensions shall conform to the following formulae:

$$l \geqslant 750 \text{ mm}$$

$$l \geqslant 0{,}6\, l_1$$

where l_1 is the blade length of the fork-arm extension.

Extensions beyond this limit shall be agreed between the truck or fork-arm manufacturer and the user, and be subjected to hazard analysis. Such fork-arm extensions shall be marked accordingly (see 9.1).

6.2 Fork-arm extensions shall be designed to prevent accidental disengagement from the parent fork arm.

6.3 The yield strength of fork-arm extensions shall be tested using a safety factor R as specified in 6.1 of ISO 2330:2002.

6.4 For open-section and closed-section fork-arm extensions, a test/design load 0,5F_{Ex} shall be applied two times as shown in Figure 1. The extension shall show zero permanent deflection after applying the appropriate yield-test load (0,5F_{Ex}) a second time at the distance l_2 from the tip of the parent fork arm. See clause 8.

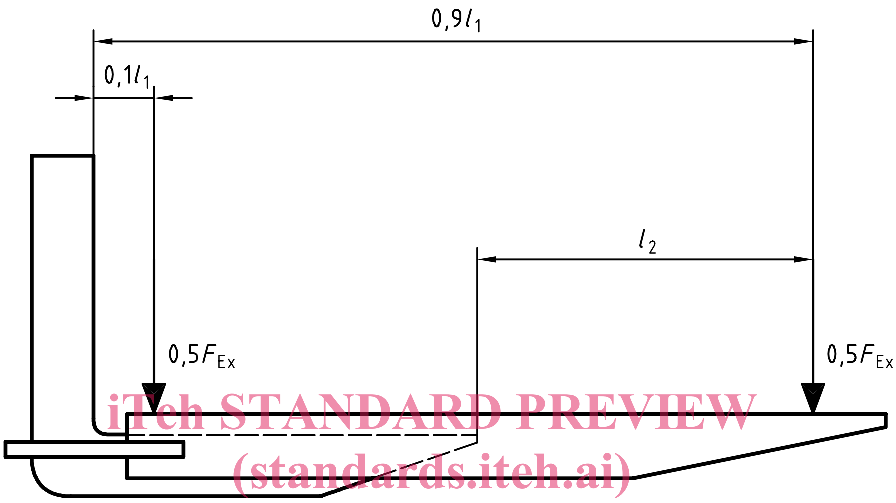


Figure 1 — Test/design load (applied twice) for open-section and closed-section fork-arm extensions

To determine the actual yield point, a preliminary test shall be conducted.

$$F_{Ex} = \frac{R \cdot C \cdot D}{0{,}5 \cdot l_1} \cdot \frac{Y_a}{Y_m}$$

where

Y_a is the actual material yield;

Y_m is the minimum material yield;

R is the safety factor, in this case $\geqslant$ 3.

Prior to testing the extensions, an equivalent sample shall be tensile-tested. The resulting yield value shall be compared to the minimum yield specified for the material used. This factor shall be used to increase the test load to ensure that a minimum-yield material will provide the safety factor R.

The design of the fork-arm extension shall be based on the extension's ability to withstand the 0,5F_{Ex} load over the distance of l_2. From this, the stress shall be calculated from the formula:

$$\sigma = \frac{0{,}5F_{Ex} \cdot l_2}{Z \cdot M}$$

where

σ is the stress;

Z is the section modulus of the extension at the fork tip;

M is a stress modulator which is $\leqslant 1$ and usually between 0,4 and 0,8, depending upon the material thickness and the design parameters.

NOTE 1 The modulator is required due to the buckling which promotes stresses higher than calculated using the standard formulae. The value of the modulator can be determined by comparing the actual load required to promote yielding to the theoretical load.

NOTE 2 The yield point is that point at which bending accelerates. This usually occurs after the tip shows a permanent deformation of approximately 6 mm over a length of 1 200 mm. The extension will show various levels of minor permanent set throughout the test where the load is applied by a series of 50 kg increments.

6.5 For open-section fork-arm extensions, the strength of the retaining system specified in 6.2 shall sustain the test/design load 0,5F_{Ex} shown in Figure 2. The extension-retaining device shall also limit the vertical movement of the fork-arm extension, at the heel end, to 20 mm, and shall show no permanent deformation. Open-section extensions shall not be used for load only at the tip.

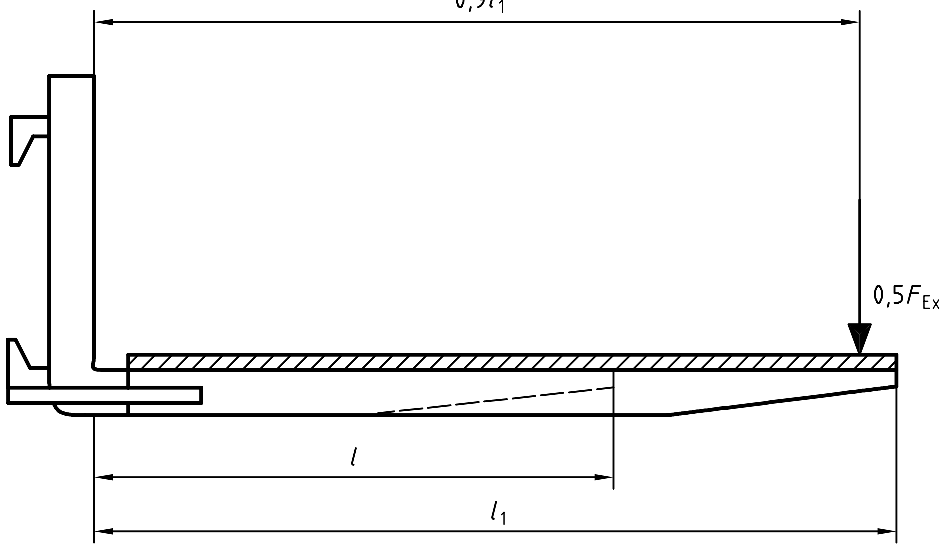
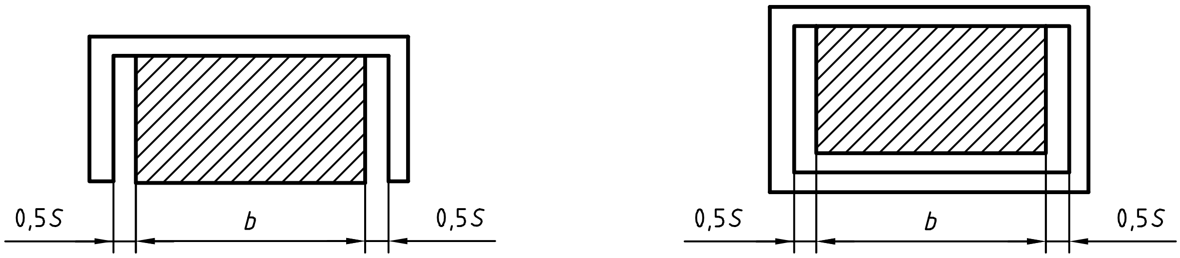


Figure 2 — Test/design load for open-section fork arms

6.6 Lateral clearance between the fork-arm extensions and parent fork arms shall satisfy the following requirement.

The total lateral clearance S shall not exceed 0,1 times the blade width b, and shall be not less than 10 mm. This is shown in Figure 3 a) and b).



a) **Open section** b) **Closed section**

Figure 3 — Fork-arm extensions

7 Requirements for telescopic fork arms

7.1 The strength of telescopic fork arms in the retracted position, using a safety factor of $R \geqslant 3$, shall satisfy the requirements of 6.3.

The strength of the extended portion of telescopic fork arms, in the extended position, shall satisfy the requirements of 6.3.

7.2 For telescopic fork arms in the fully retracted mode, the test/design load F_T shall be applied as shown in Figure 4, for which:

$$F_T = R \cdot C_R$$

7.3 For telescopic arms in the fully extended mode, the test/design load F_T shall be applied as shown in Figure 5, for which:

$$F_T = \frac{R \cdot C_R \cdot D_R}{0{,}9 \cdot l_1} \cdot \frac{Y_a}{Y_m}$$

where

D_R is normally 0,5 l;

Y_a is the actual average yield of material;

Y_m is the minimum specified yield of material;

R is the safety factor, in this case $R \geqslant 3$.

If the yield factor is not calculated, then a higher safety factor of 1,8 shall be applied. This accentuates the normal maximum difference between actual and minimum yields.

NOTE For theoretical purposes, a value of M may be determined by experimentation.

8 Testing

8.1 General

The strength requirements of clauses 6 and 7 shall be verified either by calculation, to show that load F_T does not produce stresses in excess of the yield stress of the component parts, or by physical testing. In the latter case, the procedure indicated in 7.1 shall be followed and the requirements of 7.2 satisfied.