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**Steels for the reinforcement of  
concrete — Reinforcement couplers  
for mechanical splices of bars —**

**Part 1:  
Requirements**

*Aciers pour l'armature du béton — Coupleurs d'armature destinés  
aux rabotages mécaniques de barres —*

*Partie 1: Exigences*

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ISO copyright office  
CP 401 • Ch. de Blandonnet 8  
CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Fax: +41 22 749 09 47  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

The committee responsible for this document is ISO/TC 17, *Steel*, Subcommittee SC 16, *Steels for the reinforcement and prestressing of concrete*.

This second edition cancels and replaces the first edition (ISO 15835-1:2009), which has been technically revised with changes made to [Clauses 1, 2, 3, 4](#) and [5, 3.2, 3.5, 5.2, 5.3, 5.5](#) and [5.6, Table 1](#), and Annexes C and D. Clause 6 and Annexes A and B have been revised and have been moved out into a new document: ISO 15835-3.

A list of all the parts in the ISO 15835 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

# Steels for the reinforcement of concrete — Reinforcement couplers for mechanical splices of bars —

## Part 1: Requirements

### 1 Scope

This document specifies requirements for couplers for the mechanical splicing of steel reinforcing bars. More onerous requirements can be specified by the customer.

This document is applicable to the continuous production of coupler components. It is intended to be used with adequate control measures for the processing of reinforcing bars, i.e. the production of the mechanical splice.

This document specifies requirements for couplers used for mechanical splices in reinforced concrete structures under predominantly static loads. It specifies additional requirements for couplers used in structures subject to high-cycle elastic fatigue loading and/or low-cycle elastic-plastic reverse loading.

NOTE ISO 15835-3 specifies the quantity of tests.

Compression-only couplers such as end-bearing sleeves are not covered by the ISO 15835 series.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 15630-1, *Steel for the reinforcement and prestressing of concrete — Test methods — Part 1: Reinforcing bars, wire rod and wire*

ISO 15835-2:2018, *Steels for the reinforcement of concrete — Reinforcement couplers for mechanical splices of bars — Part 2: Test methods*

ISO 16020, *Steel for the reinforcement and prestressing of concrete — Vocabulary*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16020 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

#### 3.1

##### **coupler length**

actual length of the coupler including all load-transferring parts, if more than one, and including lock nuts, if any

3.2

**length of mechanical splice**

coupler length plus two times the nominal bar diameter at both ends of the coupler

Note 1 to entry: This is a theoretical definition aimed at including the length of bar that could have been affected by the bar-end preparation process.

3.3

**mechanical splice**

complete assembly of a coupler, including any additional intervening material or other components providing a splice of two reinforcing bars

3.4

**coupler**

coupling sleeve or threaded coupler for mechanical splicing of reinforcing bars for the purpose of providing transfer of axial tension and/or compression from one bar to the other where

- coupling sleeve is a device fitting over the ends of two reinforcing bars,
- threaded coupler is a threaded device for joining reinforcing bars with matching threads

3.5

**slip**

relative displacement between the components of a mechanical splice while being loaded to a defined load level

3.6

**slip measurement device**

ensemble constituted by the extensometer and any system used to fasten it to the mechanical splice

3.7

**batch**

number of couplers of the same type and diameter, manufactured from the same cast of incoming material, as a discrete unit defined by the manufacturer

3.8

**lot**

number of couplers of the same type and diameter, of various batches, delivered at the same time to the same purchaser

4 Symbols

Table 1 — Symbols

Symbol	Unit	Designation
$A_{gt}$	%	Percentage total elongation at maximum tensile force, $F_{max}$
$d$	mm	Nominal diameter of the reinforcing bar
$F_{max}$	kN	Maximum tensile force
$N$	—	Specified number of load cycles in high cycle fatigue test
$R_{eH, spec}$	MPa <sup>a</sup>	Specified characteristic (or nominal) yield strength value of the reinforcing bar
$R_{eH}$	MPa	Yield strength value of the reference bar
$R_{m, spec}$	MPa	Specified (or nominal) tensile strength value of the reinforcing bar
$(R_m/R_{eH})_{spec}$	—	Specified minimum tensile/yield strength ratio of the reinforcing bar
$u_{20}$	mm	Residual elongation after 20 cycles

<sup>a</sup> 1 MPa = 1 N/mm<sup>2</sup>.

Table 1 (continued)

Symbol	Unit	Designation
$2\sigma_a$	MPa	Stress range for high-cycle fatigue test
$\sigma_{\max}$	MPa	Maximum stress in axial load fatigue test
$\sigma_{\min}$	MPa	Minimum stress in axial load fatigue test
<sup>a</sup> 1 MPa = 1 N/mm <sup>2</sup> .		

## 5 Requirements

### 5.1 General

The requirements apply to the coupler even though the verification of the properties of the coupler is performed on a mechanical splice.

The technical requirements for couplers are related to the following properties where a) and b) are mandatory while c) and d) are related to categories defined in 5.2:

- a) strength and ductility under static forces;
- b) slip under static forces;
- c) properties under high-cycle fatigue loading in the elastic range;
- d) properties under low-cycle reverse loading in the elastic-plastic range.

Testing of these properties shall be performed in accordance with ISO 15835-2.

Further requirements are specified for:

- e) identification and marking;
- f) installation instructions.

Additional requirements can exist in the reference standard for the steel reinforcing bars to be connected in the mechanical splice. In this case, the purchaser and the supplier should agree on any additional technical requirements.

If a material other than steel is used in a coupler, the suitability for use of such material in fire-rated structures as well as any health and safety implications should be evaluated.

### 5.2 Categories of mechanical splices

Table 2 provides a summary of the categories of mechanical splices specified in this document, with reference to the subclauses where the requirements and test methods for their properties are given.

**Table 2 — Categories of mechanical splices<sup>a</sup>**

Category designation	Properties tested	Requirement subclauses in this document	Testing subclauses in ISO 15835-2
B (Basic)	Strength, ductility and slip under static forces	<a href="#">5.3</a> , <a href="#">5.4</a>	5.1, 5.2, 5.3, 5.4
F (Fatigue)	As for B + High-cycle fatigue	As for B + <a href="#">5.5</a>	As for B + 5.5
S (Seismic)	As for B + Low-cycle loading	As for B + <a href="#">5.6</a>	As for B + 5.6

<sup>a</sup> If the coupler in a mechanical splice has been tested according to both class F and class S, it can be classified as FS.

### 5.3 Strength and ductility under static forces

#### 5.3.1 General

Strength and ductility of the mechanical splice shall be verified by testing to satisfy the requirements of both [5.3.2](#) and [5.3.3](#). A reference bar from the same heat of steel shall be tested to verify that its measured strength and ductility satisfy the minimum values specified in the product standard of the bar.

It is preferable that the test splice and the reference bar come from the same length of reinforcing bar.

NOTE 1 A tensile strength and ductility level higher than specified at [5.3.2](#) and [5.3.3](#) could be required in cases where the development of the full ductility of the parent reinforcing bar material is necessary. This would be specified separately by the purchaser.

For surveillance testing, if all samples of the mechanical splice tensile strength tests fail outside the length of the mechanical splice and the mode of failure of the bar is ductile (including necking), and the measured tensile strengths comply with the product standard of the bar, no verification of the ductility of the mechanical splice is required.

NOTE 2 The purpose of this provision is to save the time of marking the specimens for the  $A_{gt}$  measurement, when the manufacturer is confident that the tensile failure will occur outside the mechanical splice.

If couplers are used to connect bars of different sizes, the strength and ductility requirements shall be based on the smaller reinforcing bar diameter.

#### 5.3.2 Strength

The tensile strength of the mechanical splice shall be at least  $R_{eH} \times (R_m/R_{eH})_{spec}$ .

If  $R_{m, spec}$  is the value specified in the reinforcing bar standard, the tensile strength of the mechanical splice shall be at least  $R_{m, spec}$ .

#### 5.3.3 Ductility

Requirements for the ductility of spliced bars are to ensure that the use of the mechanical splice maintains a minimum ductility in the reinforcement. The ductility of the coupler itself is not subject to testing.

The minimum  $A_{gt}$  measured in accordance with ISO 15630-1 on the reinforcing bar outside the length of the mechanical splice shall not be less than  $0,7A_{gt}$ , where  $A_{gt}$  is the specified characteristic value of the reinforcing bar taken from the product standard of the reinforcing bar.

Where  $A_{gt}$  is not specified for the reinforcing bars, a minimum value of 3 % shall be attained in the bar outside the mechanical splice before failure of the test piece.

NOTE 1 The  $A_{gt}$  specified for reinforcing bars is normally a characteristic value. Since it is not practical to specify a characteristic  $A_{gt}$  value for mechanical splices, a minimum value for the bar is specified.

NOTE 2 If the elongation after fracture is specified for the reinforcing bars instead of an  $A_{gt}$  value, this value cannot be used for evaluation of mechanical splices since the failure could occur within the mechanical splice; the elongation after fracture cannot then be determined.

## 5.4 Slip under static forces

### 5.4.1 Testing requirements

The slip under static forces shall be measured by one of the following two testing options.

**Option 1:** The slip across the mechanical splice shall be determined as the measured change in length of the mechanical splice under a force corresponding to  $0,6R_{eH, spec}$ , minus the calculated change in length of an unspliced bar under similar force.

**Option 2:** The slip across the mechanical splice shall be determined as the measured length of the mechanical splice after unloading from a load level of  $0,6R_{eH, spec}$ , minus the length measured prior to loading.

### 5.4.2 Slip requirement

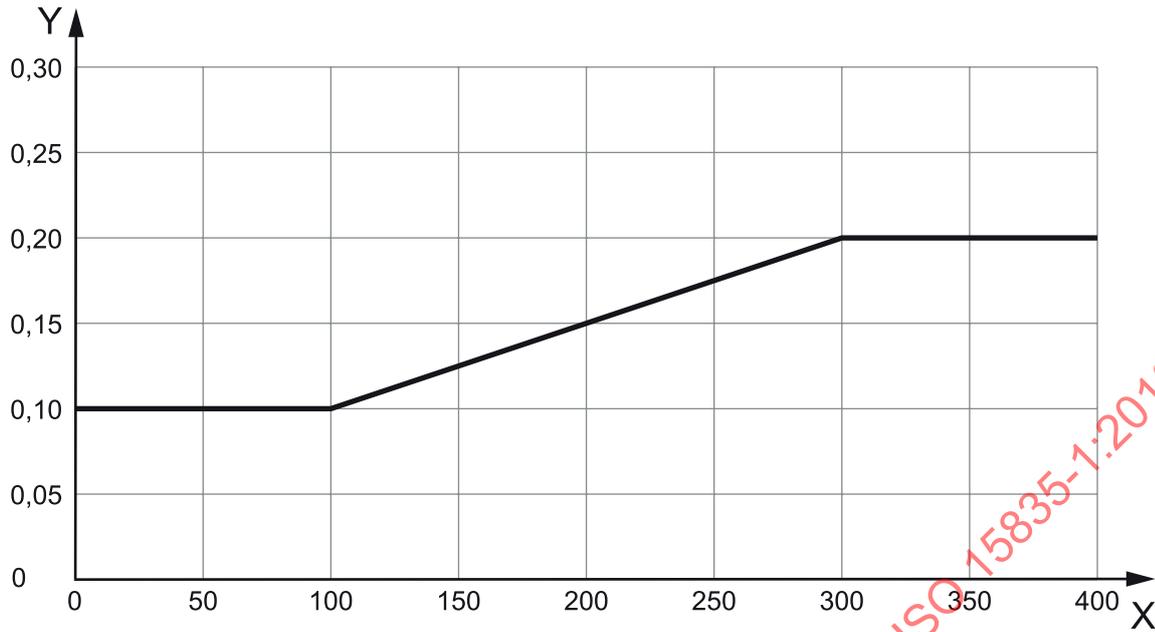
The median value of all test results shall not exceed 0,10 mm. The outlier values shall, however, not exceed the maximum allowable slip by more than 0,05 mm.

NOTE 1 Slip requirement is important for limitation of crack widths in exposed reinforced concrete structures.

NOTE 2 The purpose of using the median value for the evaluation of results is to filter-out questionably high and low values, as this test is performed by a multitude of measurement devices and fixtures that are not yet covered by a standard.

For couplers longer than 100 mm, a slip greater than 0,10 mm may be accepted as per [Figure 1](#).

NOTE 3 The reason for this provision is that, the longer the coupler, the larger the volume of concrete through which the coupler slip will dissipate.



**Key**

- X length of the mechanical coupler, in mm
- Y slip, in mm

**Figure 1 — Maximum allowable median value**

**5.5 Properties under high-cycle fatigue loading (optional)**

**5.5.1 Testing programme**

The largest diameter of mechanical splices of category F shall be tested in fatigue. The manufacturer may sub-divide the product range in several groups of diameters, and test the largest diameter of each group in order to characterize the performance.

NOTE 1 When tested in air, the worst fatigue results normally occur on the largest diameter.

NOTE 2 The fatigue performance of a mechanically spliced bar will usually be lower than that of the unspliced bar.

**5.5.2 Fatigue performance**

Mechanical splices of category F shall sustain a fatigue loading of at least 2 million cycles with a stress range,  $2\sigma_a$ , of 60 MPa without failure. The maximum stress,  $\sigma_{max}$ , in the test shall be  $0,6R_{eH, spec}$ .

The tests shall comply with the following acceptance criteria.

- If all test pieces do not fail before reaching two million cycles, the test is passed.
- If one test piece fails the test, three additional test pieces from the same batch shall be tested. If all three additional test pieces pass, the test is passed.
- If two or more test pieces fail the fatigue test, the test is failed.

### 5.5.3 S-N diagram (optional)

The performance of a mechanical splice under high-cycle stresses of different stress ranges can be characterized by an *S-N* diagram. If an *S-N* diagram is determined, the provisions in ISO 15835-2:2018, 5.5.4, shall be applied.

## 5.6 Properties under low-cycle reverse loading (optional)

Mechanical splices of category S shall be tested in reverse elastic-plastic loading.

The performance requirements for mechanical splices subject to tension and compression tests simulating an earthquake are

- the average residual elongation after the first 20 cycles  $u_{20}$  shall not exceed by more than 0,3 mm the equivalent residual elongation of an unspliced reference length from the same bar, measured on the same gauge length,
- the mechanical splice shall survive the strain cycles in stages 2 and 3 of the test, and
- the ultimate tensile strength shall exceed the value specified at 5.3:  $R_{m, spec}$  or  $R_{eH} \times (R_m/R_{eH})_{spec}$ .

The requirement on  $u_{20}$  may be disregarded if allowed in national provisions and agreed between the purchaser and the supplier.

NOTE 1 of 5.3.1 is also applicable for this requirement.

## 5.7 Marking and traceability

Each coupler shall be legibly and durably marked (e.g. hard stamped) with the identification of the manufacturer, the nominal bar size for which it is intended, and a batch mark for traceability purpose. Each coupler shall be traceable back to its production data and to its raw material properties.

NOTE A model of coupler can be designed to suit several bar sizes. (For example, a coupler for 25 mm bars can also fit 24 mm bars and 26 mm bars.) The manufacturer can then select which nominal bar size to mark and will indicate clearly in the product documentation which bar sizes each coupler is designed for.

## 5.8 Installation instructions

The supplier shall provide clear written installation instructions. The described installation procedure for the couplers shall be achievable under construction site conditions.