

CHAPTER 16

CONFORMITY CONTROL OF PRODUCT

Article 83. General

The Project Manager, acting on behalf of the Owner, is obliged to check compliance of products received at the work site, and in particular those that are to be permanently incorporated in the work, with the provisions in the design.

The activities relating to this control shall be set out in the control plan and shall comply with the provisions of 79.1

Article 84. General criteria for checking the conformity of the component materials of the concrete and its reinforcement

If products require EC marking in accordance with Directive 89/106/EEC, it will be sufficient to check conformity by carrying out a documentary check that the values declared in the documents accompanying the EC marking make it possible to deduce compliance with specifications laid down in the design.

In the exercise of its powers, the Project Manager may provide for the carrying out of checks or tests on materials used in processing the concrete supplied to the work at any time.

In the case of products without EC markings, the compliance check will include:

- a) a documentary control
- b) if appropriate, control by means of quality marks or procedures that guarantee an equivalent additional warranty level in accordance with the provisions of Article 81 and
- c) if appropriate, an experimental control by carrying out tests.

Without prejudice to the provisions in this Code, the specific technical specifications may establish tests considered relevant.

84.1 Documentary control

In general, the supply of materials covered by this Article shall comply with the documentary requirements set out in 79.3.1.

If the supplier of the materials covered by this Article changes, it will be necessary to submit corresponding documentation for the new product.

84.2 Control of installations

The Project Manager shall establish the advisability of carrying out a control visit to the manufacturing installations for materials covered by this Article. This visit shall preferably be made before the start of the supply and its aim shall be to check eligibility for the manufacture and installation of production control in accordance with current legislation and with this Code.

In the same way, tests may be carried out on supplied materials with the aim of guaranteeing compliance with the required specifications.

84.3 Sampling and conduct of tests

If it is necessary to carry out reception tests, these shall be carried out by a control laboratory in accordance with the provisions in 78.2.2.1.

When sampling is not carried out directly on site or in the installation where the material is received, this shall be done through a quality control body or, if appropriate, by means of a test laboratory compliant with 78.2.2.1.

Article 85. Specific criteria for checking the conformity of the component materials of the concrete

For the purposes of this Article, the concrete components are all those materials considered for use in a raw material in the manufacture of concrete under the terms of this Code.

The control shall be carried out for the reception manager in the industrial precasting installation and in the concrete station where the concrete is ready-made or produced on site, except in the case of aggregates for self-consumption in work stations, where the control shall be carried out by the Project Manager.

85.1 Cement

Cement compliance should be checked in accordance with the specific current regulations.

85.2 Aggregates

Except in the case referred to in the above paragraph, aggregates shall be equipped with EC marking and their compliance should therefore be tested by means of documentary verification that the values stated in the document accompanying the EC marking allow compliance with the specifications laid down in the design and in Article 28 of this Code to be deduced.

In the case of self-consumed aggregates, the Manufacturer or, if appropriate, the Supplier of the concrete or precast elements, shall add a test certificate no older than three months, produced by an control laboratory in accordance with section 78.2.2.1 that demonstrated compliance of the aggregate with specifications laid down in the design and in Article 28 of this Code, with a statistical level of guarantee equivalent to that laid down for aggregates with EC marking in standard UNE EN 12620.

85.3 Admixtures

Compliance of admixtures with EC marking shall be checked by means of documentary verification that the values stated in the document accompanying the EC marking allow compliance with the specifications laid down in the design and in Article 29 of this Code to be deduced.

In the case of admixtures that are not equipped with EC marking because they are not included in harmonised standards, the Manufacturer or, if appropriate, the Supplier of the concrete or precast elements, shall add a test certificate no older than six months, produced by an control laboratory in accordance with section 78.2.2.1 that demonstrated compliance of the admixture with specifications laid down in the design and in Article 29 of this Code, with a statistical level of guarantee equivalent to that laid down for admixtures with EC marking in standard UNE EN 934-2.

85.4 Additions

Compliance of additives with EC marking shall be checked by means of documentary verification that the values stated in the document accompanying the EC marking allow compliance with the specifications laid down in the design and in Article 30 of this Code to be deduced.

85.5 Water

Exemption may be granted from tests when using potable water from the mains.

In other cases, the Project Manager or the Reception manager in the case of ready-made concrete or precasting installation stations shall carry out tests in a laboratory as those included in 78.2.2.1, in order to check compliance with specifications set out in Article 27 with a periodicity of six months.

Article 86. Control of the concrete

86.1 General criteria for the conformity control of concrete

Conformity of a concrete with that laid down in the design shall be checked during reception at the work and include its performance in relation to workability, strength and durability, in addition to any other characteristic laid down in the special technical specifications.

The reception control shall be applied to ready-made concrete as well to that manufactured in the work site station and shall include the set of documentary and experimental checks as indicated in this Article.

86.2 Sampling

Sampling should be carried out in accordance with UNE EN 12350-1 and may be attended by representatives of the Project Manager, the Constructor and the concrete Supplier.

Except in the above cases, the sampling shall be carried out at the concrete pouring point (work or precasting installation), at the corresponding transport and output and between $\frac{1}{4}$ and $\frac{3}{4}$ of the load.

The laboratory representative shall issue one certificate for each sample, which shall be signed by all parties present, a copy of the certificate being given to each. The certificate shall be drawn up in accordance with a model approved by the Project Manager at the beginning of the work, whose minimum contents are set out in Annex 21.

The Constructor or concrete Supplier may require a countersample to be taken at its own expense.

86.3 Testing

In general, the specification in this Code for set concrete shall be checked by means of tests carried out after 28 days of ageing.

Any concrete tests other than those laid down in this section shall be carried out in accordance with provisions laid down for this purpose in the technical specifications or in accordance with instructions of the Project Manager.

For the purpose of this Code, any measurable property of a mixture shall be expressed by the average value of a number of measurements greater than or equal to two.

86.3.1 Tests on the workability of the concrete

Concrete workability shall be checked by measuring the consistency of fresh concrete by the slump method in accordance with UNE EN 12350-2. In the case of self-compacting concretes, this shall be as indicated in Annex 17.

86.3.2. Tests on the strength of the concrete

The strength of concrete shall be checked by means of compressive strength tests carried out on specimens manufactured and cured in accordance with UNE-EN 12390-2.

All the calculation methods and specifications in this Code shall refer to the properties of set concrete obtained by means of tests on cylindrical specimens measuring 15x30cm. Despite this, also may be used to determine compressive strength:

- cubic samples measuring 15 cm per side, or

- cubic samples 10 cm per side, in case of concretes with $f_{ck} \geq 50 \text{ N/mm}^2$, provided maximum size of aggregate being below 12 mm.

In these cases, the results shall be adjusted by the corresponding conversion factor in accordance with:

$$f_c = \lambda_{cil,cub15} \cdot f_{c,cúbica}$$

where:

- f_c Compressive strength in N/mm^2 , with cylindrical specimen measuring 15x30cm.
- $f_{c,cúbica}$ Compressive strength in N/mm^2 , with cubic samples measuring 15 cm per side.
- $\lambda_{cil,cub15}$ Conversion coefficient obtained from Table 86.3.2.a

Table 86.3.2. Conversion coefficient

Strength of cubic specimen, f_c , (N/mm^2)	$\lambda_{cil,cub15}$
$f_c < 60$	0.90
$60 \leq f_c < 80$	0.95
$f_c \geq 80$	1.00

The compressive strength shall be measured in accordance with UNE EN 12390-3. In the case of cylindrical specimen, it will only be necessary to reface samples with faces whose surface irregularities are greater than 0.1 mm or showing deviations in relation to the specimen centre line that are greater than 0.5° , when it will be generally sufficient to reface only the coating face.

Once these specimens have been manufactured, they should be maintained in the mould, appropriately protected, for at least 16 hours and no more than three days. During their stay on site, they shall not be struck or moved from their position and they shall be kept out of the wind and direct sunlight. During this period, the temperature of the air around the specimen shall be maintained within the limit laid down in Table 86.3.2.b. If other environmental conditions could affect the work, the Constructor shall prepare an enclosure that maintains the following conditions.

Table 86.3.2.b

Temperature range	f_{ck} (N/mm^2)	Maximum period during which the specimen stay in the work
15°C -30°C	<35	72 hours
	≥ 35	24 hours
15°C-35°C	Any	24 hours

When applying the concrete strength acceptance criteria laid down in section 86.5.3, the range relating to a group of three specimens obtained by taking the difference between the highest result and the lowest and divided by the average value of the three taken from the same mix, shall not exceed 20%. In the case of two specimens, the range may not exceed 13%.

86.3.3 Tests on the water penetration of the concrete

The checks to establish the depth to which pressurised water penetrates the concrete, if required, shall be carried out in accordance with UNE-EN 12390-8. Before beginning the test, the specimen shall be submitted to a preparatory drying period of 72 hours in a forced draft oven at a temperature of $50\pm 5^{\circ}\text{C}$.

86.4 Control prior to supply

The aim of checks prior to the supply of concrete is to check compliance of the composition and installations where they are to be used for manufacture.

86.4.1 Checking of documents prior to supply

In addition to the general documentation referred to in section 79.3.1, which is applicable to concrete, in the case of concretes without an officially recognised quality mark in accordance with Annex 19, the Supplier or if applicable the Manufacturer, shall submit a copy commissioned by a natural person to the Project Manager that sufficiently represents the dosing certificate referred to in Annex 22 and also the remaining preliminary test and characteristics if issued by one of the control laboratories laid down in 78.2.2, with a maximum age of six months.

If the concrete supplier changes during the work, it will be necessary to submit documentation for the new concrete to the Project Manager.

86.4.2 Checking of installations

The Project Manager shall assess the advisability of carrying out an control visit to the concrete plants with the aim of checking its eligibility for manufacturing the concretes required for the work directly or through a quality control body and preferably before the supply starts. In particular, compliance with the requirements laid down in Article 71 will be observed.

If applicable, a check will be carried out to ensure that production control has been introduced in accordance with the current applicable rules and that this is correctly documented by recording the checks and test results in the corresponding self-control documents

The control will also check that the concrete plant possesses a management system for component material stocks as established in 71.2.2 that makes it possible to establish traceability between concrete supplies and materials used for its manufacture.

86.4.3 Experimental checks prior to supply

Experimental checks prior to supply shall consist, if appropriate, in the conduct of preliminary tests and characteristic tests as specified in Annex 22.

The aim of the preliminary test shall be to check the eligibility of the component materials and dosing to be used by determining the compressive strength of concrete manufactured in the laboratory.

The aim of the characteristics test will be to check the eligibility of components materials, composition and installations to be used in the manufacture of concrete, with regard to its mechanical capacity and durability. Compressive strength tests shall be carried out for this purpose and, if appropriate, tests on pressurised water penetration depth for concretes manufactured under the same conditions as the plant and using the same means of transport used to supply materials to the site.

86.4.3.1 Possible exemption from testing

Preliminary tests or strength characteristics tests shall not be necessary in the case of a ready-made concrete with documented earlier experiment of its use in other work, provided it is manufactured using component materials of the same nature and origin and the same manufacturing plant and processes are used.

The Project Manager may also exempt the products from the conduct of the characteristic dosing tests referred to in Annex 22 when any of the following circumstances apply:

- a) the concrete to be supplied possesses an officially recognised quality mark,
- b) a dosing certificate is available with the provisions of Annex 22 that is no more than six months old.

86.5 Control during supply:

86.5.1 Control of documents during supply:

Each batch of concrete used in the work shall be accompanied by a supply sheet with a minimum content laid down in Annex 21.

Project Manager shall accept the concrete batch documents after checking that the values shown in the supply sheet comply with the specifications in this Code and do not show any discrepancies with the composition certificate supplied previously.

86.5.2 Conformity control of the workability of the concrete during supply

86.5.2.1 Testing

The fresh concrete consistency tests shall be carried out in accordance with the provisions in section 86.3.1 when one of the following circumstances arises:

- a) when specimens are manufactured for checking strength,
- b) In al mixtures laid on site with indirect strength control as laid down in section 86.5.6, and
- c) provided that it is indicated by the Project Manager or established in the Specific Project Technical Specifications

The consistency specification shall be that laid down, in accordance with 31.5, in the Specific Project Technical Specifications or, if applicable, as indicated by the Works Management.

The consistency comply the requirements if the settlement obtained in the tests are inside the limits defined in table 86.5.2.1

Table 86.5.2.1 Tolerances for concrete consistency

Consistency defined by type		
Type of consistency	Tolerance in cm	range
Dry	0	0 - 2
Plastic	±1	2 - 6
Soft	±1	5 - 10
Fluid	±2	8 - 17
Liquid	±2	14 - 22
Consistency defined by the slump		
Slump in cm	Tolerance in cm	range
Between 0 - 2	±1	A±1
Between 3 - 7	±2	A±2
Between 8 - 12	±3	A±3
Between 13 - 18	±3	A±3

In the case of self-compacting concrete, the concrete compliance with regards to workability shall be determined in accordance with the provisions in Annex 17

86.5.2.2 Acceptance or rejection criteria

When consistency has been defined for its type, in accordance with 31.5, the concrete shall be accepted when the arithmetic means of the two values obtained is within the corresponding range.

If the consistency has been defined for its slump, the concrete shall be accepted when the average of both values is within the tolerance defined in 31.5.

Failure to meet reception criteria will involve rejection of the mixture.

86.5.3 Methods of conformity control of the strength of the concrete during supply

The aim of the concrete strength control is to check that the strength of concrete actually supplied to the work complies with the characteristic strength defined in the design, in accordance with user safety and guarantee criteria defined for this Code.

The compressive strength test should be carried out in accordance with section 86.3.2. Their frequency and the applicable reception criteria shall be dependent on:

- a) if applicable, possession of a quality mark and guarantee level applied during official recognition of the mark, and
- b) the control procedure adopted in the design, which may be
- c) :
 - Method 1. Statistical control, in accordance with 86.5.4,
 - Method 2. 100% control, in accordance with 86.5.5, and
 - Method 3. Indirect control, according to 86.5.6.

86.5.4 Statistical control of the strength of the concrete during supply

This control method is applied generally to all structural concrete works.

86.5.4.1 Strength control batches

In order to check its strength, the concrete used in the work shall be divided into two batches before the start of the supply, in accordance with the provisions of Table 86.5.4.1, except for well-founded exceptions under the responsibility of the Project Manager. The number of batches shall be at least three. If possible, each batch shall correspond to elements shown in each column of Table 86.5.4.1.

All mixtures from one batch shall come from the same supplier, shall be processed using the same component materials and shall have the same nominal composition. Concretes shown in different columns of Table 86.5.4.1 shall not be mixed in a batch.

Table 86.5.4.1

Maximum size of strength control batches for concretes without officially recognized quality marks

Upper limit	TYPE OF STRUCTURAL ELEMENTS		
	Elements or group of elements that operate fundamentally by compression (pillars, piles, load-bearing walls, columns, etc.)	Elements or group of elements that operate fundamentally by bending (beams, concrete floors, bridge decks, containing walls, etc.)	Solid (ground plates, bridge buttresses, blocks, etc.)
Volume of concrete	100 m ³	100 m ³	100 m ³
Concrete pouring time	2 weeks	2 weeks	1 week
Built areas	500 m ²	1.000 m ²	—
Number of floors	2	2	—

When a batch consists of concrete mixes holding an officially recognised mark, their size may be increased by multiplying the values in Table 86.5.4.1 by five or two depending on the level of guarantee for which the recognition was conducted complies with section 8 or section 7 of Annex 19, respectively. In these extended batch size cases, the minimum number of batches shall be three with each batch corresponding, if possible, to elements included in each column of Table 86.5.4.1. In no case may a batch be made up of mixtures supplied to the work during a time period greater than six weeks.

If the product is non-compliant when the corresponding reception criterion is applied, the Project Manager shall not apply the size increase referred in the previous paragraph for the following six batches. From the seventh successive batch, if the mark requirements have been met in the six previous batches, the Project Manager may opt to return to the originally defined control. In case of a new non-compliance, the conformity checking in the rest of the consignment as if the concrete had not a quality mark.

86.5.4.2 Testing

Before starting to supply the concrete in a batch, the Project Manager shall notify the Constructor, who shall notify the Supplier, of the applicable acceptance criterion.

Batch compliance as regards to strength shall be tested using the average values of results obtained from two specimen taken from each one of the N batches inspected in accordance with Table 86.5.4.2.

Table 86.5.4.2

Characteristic strength specified in the design f_{ck} (N/mm ²)	Concretes with officially recognised quality marks with guarantee level compliance with section 8 of Annex 19	Other cases
$f_{ck} \leq 30$	$N \geq 1$	$N \geq 3$
$35 \leq f_{ck} \leq 50$	$N \geq 1$	$N \geq 4$
$f_{ck} > 50$	$N \geq 2$	$N \geq 6$

Sampling shall be carried out on a random basis between mixtures of the work subject to control. When the batch includes concretes from more than one concrete plant, the Project Manager shall opt for one of the following alternatives:

- a) subdivide the batch into sub-batches to which the required acceptance criteria shall be applied independently,
- b) consider the batch as a whole, so that the controlled mixtures correspond to those of mixed origins and apply the control criteria corresponding to the least favorable case.

The average values, x_i , of the strength measurements obtained from each one of the N mixtures checked shall be ordered:

$$x_1 \leq x_2 \leq \dots \leq x_N$$

86.5.4.3 Acceptance or rejection criteria for the strength of the concrete

The concrete strength acceptance criteria for this control method shall be defined on the basis of the following cases:

- Case 1: concretes holding an officially recognized quality mark with a level of guarantee compliant with section 5.1 of Annex 19 of this Code,
- Case 2: concretes without a mark,
- Case 3: concretes without a mark, manufactured continuously in the work plant, or supplied continuously by the same ready-mix plant, where more than 36 mixtures of the same concrete type are inspected.

For each case, the batch shall be accepted if it meets the criteria laid down in Table 86.5.4.3.a

Table 86.5.4.3.a

Statistical control case	Acceptance criterion	Remarks
Identification control		
1	$x_i \geq f_{ck}$	
Reception control		
2	$f\left(\bar{x}\right) = \bar{x} - K_2 r_N \geq f_{ck}$	
3	$f\left(x_{(1)}\right) = x_{(1)} - K_3 s_{35}^* \geq f_{ck}$	From the 37th mixture $2 \leq N \leq 6$ A mixture before the 37th, criterion no. 2 shall be applied

where:

$f(\bar{X}); f(X_i)$: Acceptance functions.

x_i , Each one of the average values obtained in the strength determination for each one of the mixtures,

x Average value of the results obtained in the N mixtures tested,

- σ Standard deviation values corresponding to production of the concrete type supplied, in N/mm^2 , and certified for the quality mark, where applicable
- δ Value of coefficient of variation in the production of the type of concrete supplied and certified, where applicable, for quality mark,
- f_{ck} Value of characteristic strength specified in the design,
- K_2 y K_3 Coefficients that take the values shown in Table 86.5.4.3.b

$x_{(1)}$ Minimum value of results obtained in the last (1) N mixtures,

$x_{(N)}$ Value of sample run defined as

$$r_N = x_{(N)} - x_{(1)}$$

s Value of typical sample deviation, defined as

$$s_N = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (x_i - \bar{x})^2}$$

s^*_{35} Value of typical sample deviation, corresponding to the last 35 mixtures.

Table 86.5.4.3.b

Coefficient	Number of mixtures checked (N)			
	3	4	5	6
K_2	1.00	0.82	0.72	0.66
K_3	0.85	0.67	0.55	0.43

As a temporary arrangement, up to 31 December 2010, the case of concretes with an officially recognised quality mark with a level of guarantee compliant with section 6 of Annex 19 of this Code may be considered. In this case, the acceptance criterion to be used shall be

$$f\left(\frac{-}{x}\right) = \bar{x} - 1,645 \sigma \geq f_{ck}$$

where:

x Average value of results obtained in these N mixtures tested,

σ Value of typical deviation corresponding to production of the type of concretes supplied in N/mm^2 and certified by the quality mark

86.5.5 Control of the strength of the concrete at 100%

86.5.5.1 Testing

This control method may be applied to any structure, provided this is adopted before the beginning of the concrete supply.

The concrete strength compliance shall be tested by measuring this strength in all mixtures inspected and calculating the value of the true characteristic strength from the results, $f_{c,real}$, as described in 39.1.

86.5.5.2 Acceptance or rejection criteria

For elements manufactured with N mixtures, the value of $f_{c,real}$ corresponds to the strength of the mixture which, once the N measurements have been sorted from lowest to highest, occupy position $n = 0.05 N$, rounding up n .

When the number of mixtures to be inspected is less than or equal to 20, $f_{c,real}$ shall be the lowest mixture strength value in the series.

The acceptance criterion for this acceptance method shall be defined by the following equation:

$$f_{c,real} \geq f_{ck}$$

86.5.6 Indirect control of the strength of the concrete

In the case of structural concrete elements, this control method may only be applied for concretes with an officially recognised quality mark that is used in one of the following cases:

- one or two-storey dwelling building elements, with spans less than 6.00 metres, or
- up to four-storey dwelling building elements, which work by flexure, with spans less than 6.00 metres.

The following two conditions shall also be met:

- a) area in which the element is located shall be I or II as indicated in section 8.2,
- b) the theoretical compressive strength adopted in the design should be with f_{cd} no greater than 10 N/mm².

This control procedure shall also be applied in the case of non-structural concretes in the sense shown in Annex 18.

86.5.6.1 Testing

At least four measurements of consistency shall be carried out spaced out through each day of supply, and also when indicated by the Project Manager or laid down in the Specific Project Technical Specifications.

In order to conduct these tests, it will be sufficient for them to be carried out under the supervision of the Project Manager and filed on site in corresponding logs that also include values obtained and decisions taken in each case.

86.5.6.2 Acceptance or rejection criteria

The supply of concrete shall be accepted if it simultaneously meet the three following conditions:

- a) the consistency test results comply with the provisions of 86.5.2.
- b) the quality mark for the concrete used throughout the period of supply of the work remains in force.
- c) the quality mark official recognition remains in force, where applicable.

86.6 Certification of the concrete supplied

When supply of concrete to the work is completed, the Constructor shall provide the Project Manager with a certificate of concrete supplied indicating the concrete types and quantities,

processed by the Manufacturer and signed by a natural person with sufficient powers of representation, with content compliance with the provisions of Annex 21 of this Code.

86.7 Decisions arising from the control

The decision to accept the concrete shall be dependent on the check on its compliance, applying the criteria laid down for this purpose in this Code or, if applicable, by means of conclusions drawn from special studies that are carried out in accordance with the provisions of this section if the said criteria are not complied with.

86.7.1 Decisions arising from the control prior to supply

Before it is agreed that supply of a concrete to the work should begin, a check should previously be carried out to ensure that the following conditions are met:

- a) the contents of the concrete documentation referred to in section 86.4.1. allows it to be assumed that the concrete supply meets the requirements laid down in the design and also those laid down in this Code.
- b) if applicable, previous tests and characteristics tests on strength and composition comply with the requirements laid down in 86.4.3.

86.7.2 Decisions arising from the control before placing

The Project Manager or its representative shall accept the placing of a concrete mixture after checking that:

- a) the contents of the accompanying supply sheet comply with the provisions laid down in this Code and
- b) If appropriate, after checking that it consistently complies with the criteria laid down in section 86.5.3.

86.7.3 Decisions arising from the experimental control following placing

86.7.3.1 Decisions arising from the control of strength

The Project Manager shall accept the batch with regard to strength when the acceptance criteria selected from among those defined in sections 86.5.4, 86.5.5 and 86.5 or 86.5.6 is complied with, according to the control method applied.

In the case of concretes with a quality mark whose guarantee level complies with section 5.1 of Annex 19 of this Code, not complying the acceptance criteria defined in the table 86.5.4.3.a for the identification check, the Project Manager shall accept the batch when the individual values obtained in these tests being greater than $0,90.f_{ck}$ and provided that after reviewing the production control results corresponding to the period closes to the concrete pouring date and provided the following equation is met:

$$\bar{x} - 1,645.\sigma \geq 0,90. f_{ck}$$

where:

- \bar{x} Average value of a set of values obtained when the non-compliant result is incorporated within the 14 production control result that are temporarily closest to the result, and
- σ Value corresponding to standard deviation in the production of the supplied concrete type, in N/mm^2 , and certified by a quality mark, if appropriate

In other cases, the Project Manager, without prejudice to the contractually applied sanctions and in accordance with the provisions laid down in the corresponding Specific Project Technical

Specifications shall evaluate the acceptance, reinforcement or demolition of elements built using the concrete in the batch from information obtained through the gradual application of the following procedures:

- a) firstly, on its own initiative or at the request of any of the parties, the Project Manager shall order the conduct of complementary informative tests as laid down in section 86.8 with the aim of checking whether the characteristic strength of the actual concrete in the structure corresponds to that specified in the design. The said tests may be carried out by a laboratory agreed between the parties and compliant with section 78.2.2,
- b) if the informative test confirms the results obtained in the control, the Project Manager, acting on its own initiative or on the request of one of the parties, shall commission a specific safety study on the elements affected by the concrete in the batch subject to acceptance control, which shall check that the level of safety achieved with the strength values of the concrete actually laid in the work is acceptable. To do this, the characteristic strength of the concrete shall be estimated on the basis of the control results or, if applicable, using complementary informative tests,
- c) if applicable, the Project Manager may order testing of the structural behaviour of the actually constructed elements by carrying out load tests in accordance with Article 79.

The Project Manager may also consider, if appropriate, the results obtained from tests carried out on specimens over and above those ordered, provided that they have been manufactured in the same sampling run as the control specimens and obtained from the same mixtures as those that are being analysed.

If an indirect control of concrete strength is carried out and the results obtained are not compliant with the requirements set out in 86.5.6, the Project Manager shall evaluate the acceptance of elements built using the concrete in the batch from information on the concrete production control provided by the supplier without prejudice to financial penalties and penalties of any other type that may be contractually applicable according to the requirements set out in the special technical specifications.

86.7.3.2 Decisions arising from the control of durability

If it is found that a concrete placed in the work fails to meet any of the durability requirements specified in this Code, the Project Manager shall evaluate the conduct of specific experimental checks and, if applicable, the adoption of superficial protection measures to make up for any possible potentially unfavourable effect of the breach.

In particular, the Project Manager shall carefully evaluate any deviations that arise between the results of tests carried out during the reception control and the values shown in the dosing certificate to see if any possible alterations in the composition may be deduced.

86.8 Tests on additional information for the concrete

These tests are only required in cases foreseen by this Code in section 86.7, when covered by the Specific Project Technical Specification or when required by the Project Manager. Their aim is to estimate the strength of concrete from a determining part of the work, at a certain age, or after curing under conditions similar to those in the work.

Similarly, the Project Manager shall decide to use them in any of the following circumstances:

- when a breach has arisen upon application of acceptance criteria in the case of statistical concrete controls, or
- upon the request of any of the parties, when justifiable doubts exist on the representativeness of results obtained during experimental controls on fresh concrete specimens.

The concrete informative tests may consist of:

- a) elaboration and breakage of specimens, in a manner similar to that described for control tests, but keeping the specimens under non-standard conditions, that are as close as possible to the conditions under which the concrete whose strength is to be estimated are kept.
- b) The breakage of standard specimens obtained from the concrete in accordance with UNE-EN 12390-3. This test shall not be carried out when the extraction may significantly affect the strength capacity of the element under examination, to the point of constituting an unacceptable risk. In such cases, the possibility of surveying the element prior to extraction.
- c) Use of reliable non destructive methods as a complement to the methods described above and duly related with those methods.

The Project Manager shall judge the results in each case, taking into account that, in order to obtain reliable results these always delicate tests must be carried out by specialised staff.

86.9 Control of the concrete for the production of precast elements

In the case of precast elements with EC marking, the concrete control shall be carried out in accordance with the corresponding criteria laid down in the corresponding harmonised European standard.

In the case of products for which EC marking is not in force or for products where the precast producer requires a weighting factor of 1.50 for the concrete in accordance with 9.1.1, the instructions given in this section shall be followed.

This control procedure is generally applied to self-consumed concrete manufactured in fixed plants located in installations designed for the industrial manufacture of structured precast elements.

The specific criteria established for materials in Article 85 and the tests indicated in section 86.3 are applicable.

The control described in the following section shall be carried out by the component manufacturer in its own plant. The Project Manager may order checking of compliance of this control in accordance with the provisions in Article 91.

86.9.1 Control of conformity in the workability of the concrete

86.9.1.1 Testing

The fresh concrete consistency tests shall be carried out in accordance with the provisions in section 86.3.1 when specimens are manufactured for checking strength.

In the case of self-compacting concrete, the concrete compliance with regards to workability shall be determined in accordance with the provisions in Annex 17.

86.9.1.2 Acceptance criteria

When the value obtained is within the tolerances set out in 31.5, it shall be accepted. Deviation from these criteria shall require evaluation and justification.

86.9.2 Statistical control of strength

For the strength control in accordance with Article 91.5.2, a batch shall be considered a set of the same type of concrete used to manufacture all precast elements of the same type provided these have not been manufactured over a time period greater than one month.

All the mixtures in the same batch shall be produced using the same component materials and their dosage shall be the same. It is not permitted to mix elements from different columns of Table 86.9.2 in the same batch.

This statistical control of strength shall be carried out using the results of cumulative test on the same type of concrete on the same floor over one month, irrespective of whether the elements precast using mixtures from this batch belong to more than one work.

Table 86.9.2
Maximum limits of strength control batches for concretes used in the
manufacture of precast elements

Maximum limits	Prestressed	Reinforced
Period of manufacture	Monthly	Monthly
Test frequency (up to 300m ³ per type)*	Daily	Daily
Minimum number of tests	16	16

* With productions greater than 300 m³ by type and day, it should be increased by one daily sampling.

86.9.2.1 Testing

The design or, if applicable, the precast producer shall identify the characteristic strength to be complied with by each type of concrete used to produce the manufactured structured precast elements.

Compliance of the strength of the concrete in each batch shall be tested by measuring strength in all mixtures subject to control on the basis of their results, by applying the compliance criteria laid down in 86.9.2.

Sampling shall be carried out on a random basis among mixtures of the same type of concrete within the period considered.

An external comparative control shall be carried out on the strength of concrete with frequency never less than 2 measurements per month on total output, to achieve fair sampling of concretes.

86.9.2.2 Acceptance or rejection criteria for the strength of the concrete

The acceptance criterion for the strength of concrete manufactured in the plant and destined for structural precast elements shall be defined using the following equation:

$$f(\bar{x}) = \bar{x} - 1,645\sigma \geq f_{tk}$$

- \bar{x} Average value of the results obtained in the N mixtures tested,
- σ Value of typical deviation corresponding to production of the types of concretes supplied in N/mm², obtained from the last 35 results.
- f_{ck} Value of characteristic strength specified by the manufacturer for the type of concrete used.

In exceptional cases, when continuous production of a type of concrete is not carried out, meanings that monthly sampling is less than the 16 specified for the batch in table 86.9.2, batches shall be estimated on a weekly basis using the following equation:

$$f(\bar{x}) = \bar{x} - K_2 r_n \geq f_{ck}$$

where:

- \bar{x} Average value of the results obtained in the N mixtures tested,
- K_2 Value of the coefficient shown in Table 89.9.2.3 according to the number of mixtures N
- r_n Value of sample run defined as

$$r_n = x_N - x_1$$

f_{tk} Value of characteristic strength specified by the manufacturer for the type of concrete used.

Table 89.9.2.3

Coefficient	Number of mixtures tested				
	2	3	4	5	6
K_2	1,66	1,02	0,82	0,73	0,66

86.9.2.3 Decisions arising from the control of strength of concrete

If the concrete is found to be non-compliant, the Prefabricator shall notify the corresponding Project Manager, which will assess the need to apply the criteria established for concrete manufactured in the plant, in accordance with 86.7.3.

Article 87. Control of steel

When steel is equipped with EC marking, its compliance shall be checked by means of documentary verification that the values stated in the document accompanying the EC marking allow compliance with the specifications laid down in the design and in Article 32 of this Code.

While EC marking is not enforced for indented steel designed for the processing of reinforcement for reinforced concrete, it shall be compliant with this Code and also with EC 10.080. The demonstration of the this compliance in accordance with the provisions of 88.5.2 may be carried out by means of:

- a) Having an officially recognized quality mark, in accordance with the provisions in 19 of Annex of this Code,
- b) Carrying out check tests during reception. In this case, depending on the quantity of steel supplied, a distinction shall be drawn between:
 - supplies less than 300 t:
The supplies shall be divided into batches, each corresponding to the same supplier, manufacturer, designation and series, the maximum quantity being 40 tons. Specimens shall be taken for each batch on which the following tests shall be carried out:

- Check that the equivalence section complies with the specifications in 32.1
- Check that the geometrical characteristics are within the permissible limits laid down in the specific adherence certificate in accordance with 32.2 or alternatively they comply with the corresponding corrugation index.
- Conduct a fold-unfold test or alternatively a simple fold test as described in 32.2, checking the absence of cracking after the test.

At least one specimen of each diameter, type of steel used and manufactured shall also be checked to ensure that the elastic limit, the break load, the relationship between both, enlargement of the break and enlargement under maximum load complies with the specifications in Article 32 of this Code.

- supplies greater or equal to 300 t:

In this case, the general provisions given for smaller supplies shall be applied but the check on mechanical properties referred to in the last paragraph shall be extended to four specimens.

Alternatively, the Supplier may opt for the provision of a certificate of traceability, signed by a natural person that declares the manufacturers and pourings corresponding to each part of the supply.

The Supplier shall also provide a copy of the manufacturer's control certificate that includes the results of mechanical and chemical tests obtained for each pouring. In this case, verification or contrast tests shall be carried out on the traceability of the pouring by determining chemical properties on one out of every four batches, with a minimum of five tests that shall be understood to be acceptable when their chemical composition displays variations around the production control certificate values compliant with the following criteria:

%C test	=	% C certificate	± 0.03
%C _{eq} test	=	% C _{eq} certificate	± 0.03
%P test	=	% P certificate	± 0.008
%S test	=	% S certificate	± 0.008
%N test	=	% N certificate	± 0.002

Once the traceability of the pourings and their compliance with the chemical properties have been checked, they shall be divided into batches, corresponding to each pouring, series and manufacturer. The minimum number may not be lower than 15 in any case. Two specimens shall be taken for each batch on the following tests are carried out:

- Check that the equivalence section complies with the specifications in 32.1
- Check that the geometrical characteristics of ridges are within the permissible limits laid down in the specific adherence certificate in accordance with 32.2 or alternatively they comply with the corresponding corrugation index.
- Conduct a fold-unfold test or alternatively a simple fold test as described in 32.2, checking the absence of cracking after the test.
- Check that the elastic limit, the break load, the relationship between both and the enlargement during breakage comply with the specifications in this Code.

The batch shall be accepted if no non-compliance with the specifications indicated in Article 32 or detected in said tests or checks under this point. Otherwise, if non-compliance is detected only on a single sample, an additional series of five specimens corresponding to the same batch and used to carry out a new set of tests or checks on the properties for which the non-compliance is detected. If a new case of non-compliance appears, the batch shall be rejected.

- c) in the case of structures subject to fatigue, the behaviour of steel products for steel concrete with regard to fatigue may be demonstrated by submitting a test report that guarantees the requirements in section 38.10 that is no more than one year old and conducted by one of the laboratory described in section 78.2.2.1 of this Code.
- d) in the case of structures located in a seismic area, the behaviour with regard to cyclic loads with alternative strain may be demonstrated by submitting a test report that guarantees the requirements laid down in Article 32 that is no more than one year old and carried out by one of the laboratories set out in section 78.2.2.1 of this Code unless otherwise indicated by the Project Manager.

Article 88. Control of passive reinforcements

The aim of this Article is to define procedures for checking compliance before installation in the work of electrically welded mesh, basic reinforcements electrically welded into a lattice work, processed reinforcements or, if appropriate, reinforced steelwork.

The notes in this Article are applicable if the product is being supplied for the industrial plant outside the work, and also if it has been prepared in the work's own plant.

88.1 General criteria for the control of passive reinforcements

Conformity of a reinforcements with provisions laid down in the design shall be checked during reception at the work and include their behaviour with regard to mechanical properties, adherence, geometry and any other characteristic laid down in the Specific Project Technical Specifications or decided by the Project Manager.

In accordance with the provisions in 79.3, in the case of standard reinforcement, welded mesh and basic reinforcement welded into a lattice in possession of EC marking as laid down in directive 89/106/ECC, their compliance may be sufficiently checked by ensuring that the categories or values stated in the documents accompanying the referred EC marking allow compliance with design specifications or otherwise with this Code to be established.

If standard reinforcements are not equipped with EC marking, their compliance shall be checked by applying the same criteria as laid down for steel in Article 87. Two tests shall also be carried out per batch to check compliance with regards to unfolding load referred to in sections 33.1.1 and 33.1.2, as well as checking the geometry in four elements per batch as defined in Article 87, using the criteria in 7.3.5 in UNE-EN 10080. When the standard reinforcements have a quality mark as 81.1, the Project Manager could exempt these experimental checks. The documentation will be checked accordingly to 88.4.1, 88.5.2 and 88.6. Moreover, the Project Manager shall reject the use of standard reinforcement with a level of oxidation that could affect bonding conditions. In these cases it will be considered an excessive level of oxidation when, after brushing with wire brush, the weight lost of the sample bar is higher to 1%. Likewise, once eliminated the oxide, shall be checked that the height of rib satisfies the established limits for bonding in Article 32 of this Code.

In the case of reinforced steelworks, in accordance with section 33.2, the Project Manager or, if applicable, the Constructor, shall notify the Supplier in writing of the work programme, noting orders and limit dates for reception at the work after which the reinforcement manufacturer shall notify the Project Manager in writing of its manufacturing programme with the aim of making it

possible to carry out sampling and check activities that should preferably be carried out in its own installation

The reception control shall also be applied to processed reinforcements and also, if applicable, to reinforce steelworks received at the work from an industrial installation outside the work and also to any reinforcement prepared directly by the Constructor within its own work.

88.2 Sampling of reinforcement

The Project Manager, acting on its own behalf or through a quality control body, shall take the samples in its own installation where the reinforcement is being produced on batches destined for the work. The sampling may be attended by representatives of the Constructor and the reinforcement manufacturer. Except in exceptional cases, the Project Manager shall take the samples at its own work.

The quality control body shall supervise the representativeness of the sample and not excepting any cases samples should be taken from reinforcements that cutting of the design or from reinforcements specifically destined for the conduct of tests unless they are manufactured in its presence or under its direct control. Once the samples have been removed, the reinforcements altered during the sampling shall be replaced, if applicable.

The quality control body shall issue one certificate for each sample that shall be signed by all parties present, a copy of the certificate being given to each. The certificate shall be drawn up in accordance with a model approved by the Project Manager at the beginning of the work, whose minimum contents are set out in Annex 21.

Control, preventive and countersamples (verification samples) shall be taken. The countersamples shall be taken in cases where the representative of the reinforcement Supplier or the Constructor, if applicable, requires it.

The sample size shall be sufficient to carry out all the checks and tests covered by this Code. All samples shall be sent for testing at the control laboratory after being correctly taken and identified.

88.3 Testing

Any tests on the reinforcements other than those specified in this section shall be carried out in accordance with provisions laid down for this purpose in the technical specifications or in accordance with instructions of the Project Manager.

88.3.1 Tests for checking the conformity of the mechanical characteristics of the reinforcements

In general, the mechanical characteristics of the reinforced shall be determined in accordance with the provisions of UNE EN ISO 15630-1. If it is necessary to determine the mechanical characteristics on standard reinforcements, this should be carried out in accordance with UNE EN ISO 15630-30 and UNE EN ISO 15630-3 for welded mesh or basic reinforcement welded in a lattice, respectively.

Fold-unfold and simple fold test should be carried out in accordance with the corresponding UNE-EN ISO 15630 on mandrels indicated in UNE EN 10080.

88.3.2 Tests for checking the conformity of the bonding characteristics of the reinforcements

The reinforcement geometry characteristics shall be tested by applying the methods given for this purpose in UNE EN ISO 15630-1.

88.3.3 Tests for checking the conformity of the geometry of the reinforcements

The conformity of the geometric characteristics of the reinforcements shall be checked by:

- determining longitudinal dimensions with a measurement resolution of at least 1.0 mm.
- determination of the true fold diameters by applying the corresponding fold plans.
- determination of geometrical alignments, with a resolution of at least 1°

88.4 Control prior to supply

Checks prior to supply of processed reinforcements or, if applicable, of the reinforced steelwork, are carried out with the aim of checking conformity of processes and the installations it is aimed to use.

88.4.1 Checking of documents prior to supply

In case of finished or assembled reinforcements, in addition to the general documents referred to in section 79.3.1, that are applicable to reinforcements it is aimed to supply to the work, the Supplier or, if applicable, the Constructor shall submit a copy certified by a natural person to the Project Manager the following documentation:

- a) if applicable, a copy certified of a document showing that the reinforcement holds an officially recognized quality mark,
- b) if the product is steelwork reinforced by means of non-resistant welding, qualification certificates of the personnel carrying out the weld, specifying their special training for this procedure.
- c) if it is planned to carry out resistance welding processes, type approval certificates for the welds, in accordance with UNE-EN 287-1 and the welding process in accordance with UNE-EN ISO 15614-1.
- d) if the design requires anchorage and lap lengths that, under the terms of 69.5, demand the use of steel with an adherence certificate, these shall be incorporated in the corresponding documentation before supply. If EC marking for ribbed steel is not in force, this certificate shall be no older than 36 months from the steel manufacture date.

In case of standard reinforcement, the Supplier or, if applicable, the Constructor, Constructor shall submit to the Project Manager a copy certified by a natural person of documents a) and d).

If the reinforcement or steelwork processing procedure is covered by an officially recognised quality mark, the Project Manager may be exempt from the documents referred to in parts b, c and d.

Before starting to supply the reinforcements in accordance with the design, the Project Manager may review the cutting plans prepared specifically for the work. This review is obligatory in the cases indicated in 69.3.1.

When the reinforcement supply is changed, it will be necessary to re-submit the corresponding documents.

88.4.2 Checking of steelwork installations

The Project Manager shall assess the advisability of carrying out a control visit to the steelwork installation where the reinforcements are processed, directly or through a quality control body, with the aim of checking its eligibility for manufacturing the reinforcements required in the work. In particular, compliance with the requirements laid down in section 69.2 will be observed.

These controls shall be necessary in the case of installations belonging to the work site, when a check will be carried out to ensure that a minimum space has been set aside for the steelwork process with a pre-established space for storing raw materials, a fixed space for machinery and

processing and installation processes and also special enclosures for storing finished reinforcements and, if appropriate, assembled reinforcements.

The Project Manager may demand from the standard reinforcements Supplier, if applicable, the steelwork Processor or the Constructor, information demonstrating the presence of a production control in accordance with the requirements of 69.2.4 and correctly documented by the recording of checks and test results in corresponding self-control documents that include at least the characteristics specified in this Code.

88.5 Control during supply

88.5.1 Checking the supply of steel for passive reinforcement

In the case of reinforcements processed in the own work site, the Project Manager shall check the compliance of the steel products used in accordance with the provisions of Article 87.

88.5.2 Control of documents of reinforcement during supply or fabrication on site:

The Project Manager shall check that each consignment of reinforcements supplied to the work is accompanied by the corresponding supply sheet, in accordance with the provisions set out in 79.3.1.

It shall also check that the supply of reinforcements corresponds with the steel identification declared by the Manufacturer and supplied by the reinforcement Supplier in accordance with the provision in 69.1.1. If some traceability problem is detected, the reinforcements affected by the problem shall be rejected.

For reinforcements processed in the work installations, a check should be carried out that the Constructor maintains a manufacturing log showing the same information as in the supply sheets to which this section refers for each batch of elements manufactured.

The Project Manager shall accept the reinforcement consignment documentation after checking that it conforms to specifications in the design.

88.5.3 Experimental checks of the processed reinforcement or the steelwork reinforcement during the supply or fabrication in the construction site

Experimental checks on reinforcement processed shall include the checking of mechanical properties, adherence properties and geometrical dimensions, as well as other additional properties when process of resistant welding is used.

If the reinforcement processed or the reinforced steelwork is covered by an officially recognised quality mark with a level of guarantee in accordance with Annex 19, the Project Manager may exempt the products from all the experimental checks referred to in this section.

For the purposes of experimental control of reinforcements, the set of reinforcements complying with the following conditions is defined as a batch:

- the batch size shall not exceed 30 tons.
- in the case of reinforcements processed in a fixed industrial installation outside the work, they shall be supplied in consecutive consignments from the steelwork installation,
- in the case of reinforcements processed in work installations, they shall not be processed for a period longer than one month,
- all the steel used to process reinforcements is of the same type and the same supplied shape (straight bar or roll).

In general, as provided in article 78.2.2, the tests shall be done in control laboratories satisfying the prescriptions in the articles. Nevertheless, in case of processed reinforcement or

steelwork reinforcement produced in accordance with a officially recognized quality distinctive, it is allowed that the rib geometry checking could be done directly by the quality control entity, in order to accelerate the period for the supply and installation of elements whose production control is supervised by the certification entity and officially recognized by the Administration.

88.5.3.1 Checking the conformity of the mechanical characteristics of processed and steelwork reinforcements

The mechanical characteristics of processed reinforcements shall be checked for compliance by the Project Manager.

In the case of reinforcements manufactured without welding processes, mechanical characterisation shall be carried out by tensile tests on two samples corresponding to one diameter from each series (fine, medium and large) of those defined in UNE EN 10080. If the ribbed steel used to process the reinforcements is covered by an officially recognised quality mark in accordance with the provisions in Annex 19, the Project Manager may carry out the test on a single sample of every sample. If straightening processes have not been used, the products may be exempt from carrying out these tests.

In the case of reinforcements manufactured using resistant or non-resistant welding processes, at least four samples shall be taken per batch, corresponding to the most representatives diameter combinations of the weld process in the opinion of the Project Management or, if appropriate, the control body, by carrying out the following checks:

- a) tensile test on two specimens corresponding to the lowest diameter in each sample, and
- b) simple folding tests or, if appropriate, fold-unfold tests on specimens corresponding to the highest diameter steels in each sample.

If the ribbed steel used to process the reinforcement is covered by an officially recognised quality mark, the Project Manager may carry out the above tests on a unique sample per batch

The batch shall be accepted provided that: the following is complied with:

- c) in the case of straightening, the final mechanical properties of the steel should provide results consistent with the margins defined for each process in this Code and applied to the specification corresponding to steel in section 32.2.
- d) in the case of other processes, the mechanical characteristics after the tensile and fold tests described in this section continue to comply with the specifications laid down for steel in Article 32

Otherwise, a new set of samples will be taken from the same batch. If any specification is not complied with again, the batch shall be rejected.

88.5.3.2 Checking the conformity of the bonding characteristics of the processed reinforcements and the steelwork reinforcement

Checking the conformity of reinforcement bonding characteristics is required whenever the processing includes any straightening process.

To characterise the adherence, two samples are taken corresponding to each one of the diameters forming part of the batch that have undergone straightening. Their geometrical characteristics shall be determined. If the steel is covered by an adherence characteristic certificate in accordance with Annex C in UNE EN 10080, it will be sufficient to determine its corrugation height.

The batch shall be accepted if it meets the specifications laid down in Article 32 in the case of steel supplied in a bar. Otherwise, a new set of samples will be taken from the same batch. If any specification is not complied with, the batch shall be rejected.

Project Manager shall also reject the use of reinforcements with a level of oxidation that may affect their adherence condition. The level of oxidation shall be understood to be excessive when it is found that the weight lost from a specimen of bar, welded mesh or basic reinforcement welded into a lattice exceeds 1% when brushed with a wire brush.

A check shall also be carried out to ensure that once the rust has been eliminated, the rib height complies with the limit laid down for adherence to the concrete in accordance with Article 32 of this Code.

88.5.3.3 Checking the conformity of the geometric characteristics of the processed reinforcements and the steelwork reinforcement

The geometrical characteristics of the reinforcements in a batch constituted by consecutive consignments up to 30 tons, will be done on a sample made up of a minimum of fifteen reinforcement elements, preferably of different shapes and types, as per criteria of the Project Manager.

Checks to be carried out on each element shall be at least the following:

- a) Correspondence of reinforcement diameters and steel types with that laid down in the design, and
- b) alignment of straight elements, geometrical sizes and fold diameters, checking for deviations observable to the naked eye in straight sections and that the fold diameters and geometric deviations with regard to the design cut shapes comply with the tolerances laid down in the relevant design or, if applicable, in Annex 11 of this Code.

In the case of reinforced steelworks, the following checks shall also be carried out::

- a) correspondence of the number of reinforced elements (bars, bases, etc.) indicated in the design, and
- b) compliance of distances between bars

If conditions are not complied with, the reinforcement responsible for the non-compliance shall be discarded and a checking of the complete consignment will be carried out.. If the tests are positive, the consignment shall be accepted after replacement of the defective reinforcement. Otherwise the complete consignment will be rejected.

88.5.3.4 Additional checks in the case of manufacturing processes using resistant welding

If resistant welding is used to process a reinforcement in an industrial installation outside the work, the Project Manager shall provide documentary evidence that the processes are covered by an officially recognised mark. In the case of reinforcements processed directly in the work, the Project Manager shall allow the production of a resistant weld only in the case of intensive control.

The Project Manager shall also order the conduct of a set of experimental checks on process compliance depending on the type of welding, in accordance with the provisions in section 7.2 of UNE 36832.

88.6 Supply certificate

The Constructor shall file a certificate signed by a natural person and prepared by the passive reinforcement Supplier, that it shall forward to the Project Manager by the end of the work, this shall express compliance of all actually supplied passive reinforcements with this Code, and state the true quantities of each type and also their traceability to the manufacturers in accordance with information available in the documentation laid down by UNE EN 10080.

If the same supplier carries out several consignments over several months, monthly certificates shall be submitted during the same month. A single certificate may be accepted including all the batches supplied during the reference month.

When the EC marking for the steel products comes into force, the reinforcements Supplier shall provide the Constructor with a copy of the compliance certificate included in the documentation accompanying the said EC marking.

In the case of installations in the works, the Constructor shall process and deliver to the Project Manager a certificate equivalent to that indicated for the installations outside the works.

Article 89. Control of steel for active reinforcements

When steel for active reinforcement is equipped with EC marking, its compliance shall be checked by means of documentary verification that the values stated in the document accompanying the EC marking allow compliance with the specifications laid down in the design and in Article 34 of this Code to be deduced.

If the steel for active reinforcements is not equipped with EC marking, its compliance shall be checked following the next criteria:

- a) if the steel is covered by an officially recognized quality mark, it shall be sufficient to check that the official mark recognition remains in force,
- b) In other cases, depending on the quantity of steel supplied, a distinction shall be drawn between:

- supplies less than 100 t:

The supplies shall be divided into batches, each corresponding to the same supplier, designation and series, the maximum quantity being 40 tons. Two specimens shall be taken for each batch that shall be used to check that the equivalent cross section complies with the specifications in Article 34.

The elastic limit, break load and extension under maximum load shall also be measured on at least two occasions during performance of the work.

- supplies greater than 100 t:

The Supplier shall supply a certificate of traceability, signed by a natural person that declares the manufacturers and pourings corresponding to each part of the supply. The supply shall be divided into batches corresponding to each pouring and manufacturer. Two specimens shall be taken for each batch that shall be used to check that the equivalent cross section complies with the specifications in Article 34:

The elastic limit, break load and extension under maximum load shall also be measured on at least two occasions during performance of the work.

The Supplier shall provide a copy of the manufacturer's production control certificate that includes the results of mechanical and chemical tests obtained for

each pouring. Counterchecks shall be carried out on traceability of the pouring by determining chemical characteristics on one of every four batches, with a minimum of five tests. The Supplier shall also submit a certificate under results of tests carried out by an official laboratory or in accordance with section 78.2.2 that makes it possible to check the steel's compliance with corrosion and stress in accordance with the provisions of Article 34 of this Code.

If the steel for active reinforcement is covered by an officially recognised quality mark, a check shall be carried out to ensure:

- a) the quality mark on the product issued by the certifying body remains in force, and
- b) the official mark recognition remains in force.

Article 90. Control of prestressing systems and elements

90.1 General criteria for the control

Compliance of prestressed elements with provisions laid down in the design shall be checked during reception at the work and include all components required to apply the prestressing force to the structure. The prestressing components reception control shall include, where applicable:

- the prestressing steel,
- the prestressing units of whatever type (wires, cables, bars, etc.)
- anchorage devices, where applicable
- connection devices, where applicable
- sheaths, where appropriate
- grouting materials, where appropriate, and
- systems for applying prestressing force.

In accordance with the provisions in 79.3, in the case of prestressing components or systems covered by EC marking as laid down in Directive 89/106/EEC, compliance may be sufficiently proven by checking that the categories or values declared in the documentation accompanying the EC marking allows compliance of design specifications to be deduced.

90.2 Sampling

Where applicable, the prestressing steel samples shall be taken in the own work site in accordance with UNE EN ISO 377. Representatives of the Project Manager, the Constructor, the prestressing Applicator and the prestressing steel Manufacturer may be present.

The Project Manager shall supervise the representativeness of the sample and shall not accept sampling from elements that have been supplied specifically for the conduct of tests under any circumstances.

The control laboratory representative or, if applicable, the quality control body representative shall issue one certificate for each sample, that shall be signed by all parties present, a copy of the certificate being given to each. The certificate shall be drawn up in accordance with a model approved by the Project Manager at the beginning of the work, whose minimum contents are set out in Annex 21.

The sample size shall be sufficient to carry out all the checks and tests covered by this Code. All samples shall be sent for testing at the control laboratory after being correctly taken and identified.

90.3 Testing

If the Project Manager decides to carry out tests for mechanical characterisation of any prestressing unit, wire, bar or cable, it should be carried out in accordance with the provisions in UNE EN ISO 15630-3.

90.4 Control prior to the application of the prestressing

The aim of checks prior to the application of the prestressing is to check the documentary compliance of materials, systems and processes used for the application of prestressing force.

90.4.1 Control of documents

In addition to the general documents referred to in section 79.3.1, that are applicable to materials or systems for the application of the prestressing it is aimed to supply to the works, a copy certified by a natural person of the following documentation shall be submitted to the Project Manager:

- a) a certificate attesting that the prestressing components to be supplied are legally marketed or, if appropriate, the EC marking compliance certificate,
- b) if applicable, a certificate proving that the prestressing application system is covered by an officially recognised quality mark,

When a change in supplier occurs during the work, it will be necessary to re-submit the corresponding documents.

90.4.2 Checking of the prestressing systems

The Project Manager shall assess the advisability of carrying out an control of the prestressing application system either directly or through a quality control body before the start of a supply with the aim of checking that the conditions of eligibility for application in the works are maintained. In particular, compliance with the requirements laid down in Article 70 will be observed.

90.5 Control during the application of the prestressing

90.5.1 Control of documents during supply:

Each batch of prestressing unit (wires, bars or cables), anchorage or connection devices, sheaths, grouting materials or other prestressing accessory shall be accompanied by a supply sheet whose contents comply with Annex 21 of this Code.

If the prestressing application system is covered by EC marking, the application procedure provided by the marking shall be supplied to the Project Manager.

90.5.2 Experimental control

90.5.2.1 Possible exemptions from the experimental control

The Project Manager may exempt the product from the carrying out of checks required by this Code for reception of various prestressing components when the product application system is covered by an officially recognised quality mark.

90.5.2.2 Experimental conformity control of prestressing units

If applicable, the Project Manager shall check compliance of prestressing units supplied to the work in accordance with the provisions of the design special technical specifications.

90.5.2.3 Experimental the conformity control of the anchorage and connection devices

Experimental control during supply shall be limited to checking apparent characteristics such as size and interchangeability of parts, absence of cracks or burrs that indicate defects in the manufacturing processes, etc. In particular, the state of surfaces that perform the function of retaining tendons (teeth, screws, etc.) shall be observed and also surfaces that must slide over each other during the wedge penetration process. The number of components subject to checking shall be, as minimum:

- a) six for each batch received at the works.
- b) 5% of those that must perform a similar function in the prestressing of each piece of part of the works.

When circumstances suggest that storage durational conditions may have affected the status of the services indicated above, the state before use shall be checked again.

90.5.2.4 Control of sheaths and prestressing accessories

In the case of sheaths, the experimental control shall be limited to checking apparent characteristics such as size, rigidity of sheath on crushing, absence of dents, absence of cracks or perforations that may affect watertightness, etc.

In particular, a check should be carried out to ensure that the sheath curvature, in accordance with the radiuses to be used in the works, do not give rise to appreciable local strains or breaks that may affect sheath watertightness.

A check shall also be carried out on the watertightness and resistance to crushing and impact of the joining part, control ports, connection fittings, etc., depending on the conditions to be used.

A check should also be carried out to ensure that the separator, if applicable, do not give rise to tapering of the reinforcement or major difficulty in injection.

When storage has been prolonged or conducted under poor conditions for any reason, a minute check shall be carried out to assess whether any rest on the metal components may be damaged to watertightness or for any other reason.

90.5.2.5 Control of filling materials

When the materials used to prepare the injection grout (cement, water and, if applicable, admixtures) are of a different type or category to those used in manufacturing the concrete in the works, the criteria laid down for this purpose in this Code shall be applied for reception.

The Project Manager may require that the production control results on admixtures used, if appropriate, to give rise to the effect of producing the characteristics of the grout or water by means of appropriate laboratory tests. Specific work temperature conditions shall also be considered, if applicable, to prevent the need for the admixture to display aerating properties, if necessary.

90.6 Supply certificate

When supply to the work of any of the prestressing elements is complete, the Constructor shall provide the Project Manager with a certificate, drawn up by the Supplier and signed by a natural person, whose content shall comply with the provisions of Annex 21 of this Code. In the

case of prestressing systems with EC marking, the certificate shall form part of the EC marking documentation for prestressing elements supplied to the work.

Article 91. Control of precast elements

91.1 General criteria for the conformity control of precast elements

Compliance of precast elements with the provisions of the design shall be checked during reception at the work and include a check on compliance of behaviour and also with regard to the concrete and reinforcement and also the behaviour of the precast elements.

In accordance with the provisions in 79.3, in the case of precast elements or systems covered by EC marking as laid down in Directive 89/106/EEC, compliance may be sufficiently proven by checking that the categories or values declared in the documentation accompanying the said EC marking allow compliance of design specifications to be deduced, not being necessary the provision in the Royal Decree 1630/1980, on July 18th.

In case of floor slabs systems including precast concrete elements not needing EC marking, will be applicable the provision in the Royal Decree 1630/1980, of July 18th, on the production and use of resistant elements for floors and covers.

The Project Manager shall monitor the situation in particular to ensure sufficient criteria are maintained to guarantee traceability between components positioned permanently in the work and the materials and products used.

For the purposes of the control, the precasting of structural concrete elements shall include at least the following processes:

- processing of reinforcement,
- steelwork reinforcement,
- installation of passive reinforcement,
- prestressing operations, if applicable,
- manufacture of concrete, and
- pouring, compacting and curing of concrete.

The reception control for precast elements may include checks on the precasting processes and also the on the products used (concrete, reinforcement processed and prestressing steel) and also the final geometry of the components.

Reception control shall be carried out both on components precast in an industrial installation outside the work and also on those precast directly by the Constructor in his own work. The criteria of this Code shall also be applied to standardised components and components precast as standard, and also those precast specifically for a work, in accordance with a specific design.

The Supplier or, if applicable, the Constructor shall include in its production control system a system for following up each of the processes applied during its activity and shall define check criteria that allow the Project Manager to ensure that the referred processes have been carried out as laid down in this Code.

For this reason, the corresponding self-control registers shall show the results of all checks carried out for each of the activities applicable from among those laid down in this Code.

The Project Manager may require the Supplier or, if applicable, the Constructor to provide documentary evidence on any of the processes relating to precasting laid down in this Code and, in particular, information demonstrating the existence of a production control that includes all the characteristics specified by this Code and whose results shall be recorded in self-control documents. It may also carry out, where necessary, appropriate controls in its own precasting installations and, if applicable, sampling for subsequent testing.

Precast elements processed using concrete compliant with EN 206-1:2000, the weighting coefficient of 1.70 for concrete and 1.15 for steel shall be applied to the prefabricate component design in a permanent or temporary situation. These coefficients may be used to 1.35 and 1.10 respectively in the event that the precast component is covered by a quality mark with a level of guarantee compliant with section 5.3 of Annex 19 f this Code. When presenting voluntarily a production control certificate drawn up by a control body or a certification entity accredited in all cases under the provisions of Royal Decree 2200/1995 of 28 December demonstrating that the concrete is manufactured in criteria laid down in this Code may be voluntarily submitted, a weighting coefficient of 1.50 may be applied for the concrete.

91.2 Sampling

If decided by the Project Manager, a quality control body shall carry out in its own installation, where the elements are precast, the sampling on consignments destined for the work. In the case of standardized precast components produced in serie, the sampling will be carried out on materials, products and components and also batches supplied to the work. Except in exceptional cases, the Project Manager shall take the samples at its own work.

The sampling may be attended by representatives of the Project Manager, the Constructor and the Supplier of precast elements.

The control organisation shall supervise the representativeness of the sample and shall not accept sampling from materials and reinforcements that do not correspond to those indicated in the design under any circumstances. Once the samples have been removed, the procedures laid down for this purpose in Articles 86 and 88 for the concrete and reinforcements respectively shall be carried out.

A quality control organisation shall draw up a certificate for each sampling operation to be signed by all parties present, who shall be given a copy. The certificate shall be drawn up in accordance with a model approved by the Project Manager at the beginning of the work, whose minimum contents are set out in Annex 21.

The sample size shall be sufficient to carry out all the checks and tests to be conducted. All samples shall be sent for testing to the control laboratory after being correctly taken and identified.

91.3 Testing

Any tests on precast elements or their components other than those set out in this section shall be carried as established for this purpose in the corresponding technical specifications or in accordance with the instructions of the Project Manager.

91.3.1 Checking the conformity of the precasting processes

Checking of the conformity of precasting processes by the Project Manager shall include at least processing of a passive reinforcement, its installation in the moulds, manufacture of the concrete and also pouring, compacting and curing of the concrete and, if applicable, prestressing application operations.

The compliance for each process shall be checked by applying the same procedures laid down in the Articles of this Code applying to the general case of construction of the structure in the site.

91.3.2 Tests for checking the conformity of products used in the precasting of structural elements

Tests to check required characteristics in accordance with this Code, for concrete, process reinforcements and prestressing components used in the precasting of structural elements shall be as generally defined in Articles 86, 88 and 90 of this Code.

91.3.3 Tests for checking the conformity of the geometry of the precast elements

The precast elements geometry shall be checked by measuring dimensional characteristics using a meter rule with divisions of at least 1.0 mm.

91.3.4 Checking the conformity of the cover of the reinforcement

Compliance of covers with requirements set out in the design shall be checked at the installation, reviewing the appropriate arrangements of spacers.

91.3.5 Other tests

Any tests or checks other than those laid down in this Code shall be carried as established for this purpose in the technical specifications or in accordance with the guidelines by the Project Manager.

91.4 Control prior to supply

The aim of control prior to supply is to check compliance of administrative conditions and also precasting installations by means of the corresponding documentary controls and checks.

91.4.1 Checking of documents

In addition to the general documents referred to in section 79.3.1, that are applicable to precast elements, the Supplier of the precast elements or the Constructor shall submit a copy certified by a natural person following documentation to the Project Manager:

- a) where applicable, a copy certified by a physical person of the certificate guarantee that the precast elements that form the supply to the work hold an officially recognised quality mark,
- b) where appropriate, certificates showing the qualifications of the staff carrying out non-resistant welding of passive reinforcement, guaranteeing their specific training for this procedure,
- c) where applicable, weld type approval certificate in accordance with UNE-EN 287-1 and the welding process certificate in accordance with UNE-EN ISO 15614-1 in the event of passive reinforcement resistance welding,.
- d) where applicable, a certificate that the steel for passive reinforcement, the steel for active reinforcements or the reinforced steelwork is covered by an officially recognised quality mark.

In the case of precast elements in accordance with the design that require a change to the original quartering cut shown in the design, the Supplier or, if applicable, the Constructor shall send the new cut for acceptance in writing to the Project Manager. In any case, before beginning the supply of precast elements in accordance with the design, the Project Manager may review the cut plans prepared specifically for the work components directly or through a quality control organisation.

When a change in Supplier occurs during the work, it will be necessary to re-submit the corresponding documents.

91.4.2 Checking of installations

The Project Manager shall assess the advisability of carrying out a control visit to the installation where the precast elements are processed directly or through a quality control body with the aim of checking:

- that the installations comply with all the requirements laid down in this Code and in particular those established in Article 76 of this Code,
- that the precasting processes are correctly carried out, and

- that a material stock management system is in place allowing the necessary traceability to be achieved.

These controls are required in the case of precasting installations belonging to the work.

The Prefabricator shall be able to demonstrate that its stock management and process controls guarantee traceability up to the delivery to the work including transport where applicable.

The Prefabricator or, where appropriate, the Constructor shall demonstrate that its concrete plant and its installations and equipment for its processing of the reinforcement and application of prestressing complies with the technical requirements laid down for the product in general in this Code.

91.4.3 Possible exemption from prior checks

If the precast elements are covered by an officially recognised quality mark, the Project Manager may exempt them from the document checks referred to in points b) and c) of section 91.4.1.

91.5 Control during supply

91.5.1 Control of documents during supply:

The Project Manager shall check that each consignment of precast elements supplied to the work is accompanied by the corresponding supply sheet, in accordance with the provisions set out in 79.3.1.

The Project Manager shall check that the documents supplied by the precast elements Supplier or, if applicable, by the Constructor, its compliance with material safety coefficients adopted in the design.

The Project Manager shall accept the precast component batch documents after checking that they are compliant with this Code and also with the specifications laid down in the design.

91.5.2 Tests for checking the conformity of the materials used

The Project Manager shall check that the Prefabricator or, if applicable, the Constructor has checked the compliance of products used directly for the precasting of the structural components and, in particular, that of concrete, that of processed reinforcements and that of prestressing components.

The concrete shall be inspected applying the criteria of Article 86 of this Code, and considering as a batch the set of the same type of concrete used to manufacture all components of the same type provided these have not been manufactured over a time period greater than three months.

Processed reinforcement shall be inspected by applying the criteria in Article 88 of this Code.

The Project Manager may use any of the following procedures to carry out the said checks:

- review of document registers where the responsible person in the precasting installation shall show controls carried out for reception and also the results,
- checking of reception procedures by means of control in the industrial installation,
- in the case of precast elements not covered by an officially recognised mark, by means of checks on samples taken in the precasting installations,

all this without prejudice to tests ordered by the Project Manager.

91.5.3 Experimental checks during supply:

The experimental checking of precast elements shall include a check on the compliance of products used, a check on precasting processes and a check on geometrical sizes.

A check should also be carried out to ensure that the components bear an identification code or marking that, together with the supply documents, provides information on the manufacturer, the manufacturing batch and date so that the traceability of materials used for the fabrication of each element may be checked.

91.5.3.1 Possible exemption from experimental checks

In the case of standard components industrially produced covered by EC marking as laid down in Directive 89/106/CEE, the Project Manager may accept their compliance without carrying out additional experimental checks by ensuring that the documentation accompanying the EC marking shows the declared categories or values allow compliance with specifications laid down in this Code and also those that may have been defined specifically in the design. In this case, it will be particularly recommended that Project Manager should carry out a control of the precasting installations referred to in section 88.4.2 either directly or through a control organisation.

In the case of standard components industrially produced and destined to form part of a compound section, together with other parts carried out on site, compliance may be checked in accordance with the provisions of the above paragraph when method 1 of those defined in section 3.3 of Guide L for the application of Directive 89/106/EEC produced by the European Commission Services (document CONSTRUCT 03/629 Rev.1, dated 27 November 2003) has been used.

In accordance with the contents of section 3.2 of the Guide L for the application of Directive 89/106/EEC produced by the European Commission Services (document CONSTRUCT 03/629, Rev. 1, the compliance of the components referred to in the above paragraph may be accepted only when the documents accompanying the EC marking guarantee compliance with the parameters, classes and levels specifically defined by the Spanish Administration in the corresponding National Annexes for UNE-EN 1990 standard applicable to the corresponding precast component.

When method 3 of those defined in section 3.3 of Guide L described above have been used, compliance of precast elements may be checked in accordance with the provisions of paragraph 1 of this section by checking that the documents accompanying the said EC marking show the use of materials as indicated in the design and that this is compliant with the specifications in this Code.

In the case of precast elements not covered by EC marking that are covered by an officially recognised quality mark the Project Manager may exempt the products from any of the experimental checks laid down in section 91.5.3.3 and 91.5.3.4.

91.5.3.2 Batches for checking the conformity of precast elements

In the case of standard components precast as standard, a batch shall be defined as the quantity of components of the same type, forming part of the same consignment and obtained from the same manufacturer, provided that their date of manufacture do not differ by more than three months.

In the case of components precast specifically for the work in accordance with a specific design, all components in the same consignment from the same manufacturer are defined as a batch.

91.5.3.3 Experimental checking of precasting processes

This check will be carried out at least once during the work and shall include both a review of the Prefabricator production process and the conduct of specific checks on each process, carried out by a quality control organisation.

In the case of standard elements precast as standard, the Project Manager may limit this check to a review of the production control to be carried out on the self-control registers corresponding to the time period during which the components supplied to the works were manufactured.

Experimental checks on the process should be carried out in accordance with the following criteria:

- a) Passive reinforcement processes procedure:
Checks should be carried out on compliance of reinforcement with the design in accordance with the criteria in Article 88 of this Code.
- b) Passive reinforcement installation process:
Before placing in the mould, a check shall be carried out to ensure that the processed reinforcement, once ensemble, correspond with requirements laid down in the design with regard to geometrical size, steel cross sections and overlapping lengths.
Once placed on the mould, a check shall be carried out to ensure that spacers have been positioned in accordance with the requirements laid down in section 69.8.2 and that their sizes allow the corresponding minimum coverage laid down in section 37.2.4 to be ensured.
Checks should be carried out on a sample of at least five reinforcement sets and process compliance should be accepted when steel diameters shall be obtained from all samples that correspond to those laid down in the design and, also, the rest of the checks give deviations from nominal values less than the tolerances specified in Annex 11 for the class corresponding to safety coefficients used in the design.
- c) Prestressing application process:
The prestressing application process shall be checked at least once by applying the criteria laid down in Article 89 of this Code. The corresponding check shall be carried out before the corresponding tensioning checks, before the concrete pouring and, if applicable, before the injection.
Process compliance shall be accepted when no deviation from the criteria laid down in Article 90 is detected.
- d) Poured, compacted and cured concrete processes:
If the concrete is elaborated by the Prefabricator, the fabrication processes shall meet the same technical criteria than those laid down for the concrete plants in this Code apart from requirements relating to shipping. The pouring, compacting and curing shall also comply with the criteria laid down, in general, by this Code.
One control shall be carried out at least once during the work to check compliance with the requirements specified for these processes.

91.5.3.4 Experimental checking of the geometry of the precast elements

In the case of elements precast with EC marking in accordance with specific harmonised European standards, the geometry shall be checked by inspecting the EC marking documents because the tolerances shall comply with those referred in the corresponding standards.

In other cases not covered in the above paragraph, for each batch defined in 91.5.3.2, one sample shall be selected made up by a sufficiently representative number of components in accordance with Table 91.5.3.4, preferably belonging to different shapes and types. A check shall be carried out to ensure that the geometrical sizes of each component display size variations in relation to nominal design sizes in accordance with tolerances laid down in Annex 11 of this Code for the class corresponding to the safety coefficient used in the design.

Table 91.5.3.4

Type of component supplied	Minimum number of components checked in each batch
Components such as piles, girders, blocks	10
Elements such as slabs, pillars, girder beams, ...	3
Large components such as caissons, ...	1

If non-compliance arises, the non-compliant component shall be discarded and a new set of samples shall be taken. If positive, the batch shall be accepted. Otherwise the Project Manager shall require from the Supplier a technical justification that the part complies with the established requirements in accordance with this Code as described under point 4.h) of Annex 11 of this Code.

91.5.3.5 Supply certificate

Once the precast elements have been supplied, the Constructor shall provide the Project Manager with a product certificate drawn up by the Supplier of the precast elements and signed by a natural person, whose content shall comply with the provisions of Annex 21 of this Code. In the case of precast elements that are required to be covered by EC marking, this certificate shall be added to accompany the said EC marking.

If the same Supplier of precast elements carries out various supplies during the same month, a single certificate may be accepted including all the elements supplied during the reference month.