



Ministry of Public Works
Secretaría General Técnica
Standing Committee of Cement

Cement Reception Instruction (RC-16)

CEMENT RECEPTION INSTRUCTION (RC-16)

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CHAPTER I

AIM, SCOPE OF APPLICATION, DEFINITIONS AND ADMINISTRATIVE REQUIREMENTS

Article 1 Aim and scope of application

The aim of this Instruction is to establish general technical specifications to be met by cements, as well as to regulate their reception to ensure that construction products containing cement allow the constructions in which they are used to meet the essential requirements laid down.

The scope of application covers the reception of cement in construction works, in concrete manufacturing plants and in any other installations like in those where construction products are manufactured, whose composition includes cement.

Article 2 Terms

For the purpose of this Instruction, the following definitions are applied:

Distribution depot: installation that markets cement packaged in a factory, delivery point or dispatching centre, only carrying out storage and transport operations, for which it is fully liable.

Storer: natural person or legal entity that purchases packaged cement from the manufacturer or intermediary, which takes full liability for the maintenance of the cement quality, in all its aspects, in the distribution depot and which supplies the cement to a client.

Dispatching centre: installation (not situated in the factory) for the transfer and dispatch of cement (received as bulk or in any other system), in which the activities carried out should not alter the characteristics or integrity of the product received from the manufacturer and where an intermediary is fully liable for all aspects of the cement quality.

Client: Natural person or legal entity that acquires a consignment of cement.

Delivery: time when ownership of the consignment and responsibility for cement quality (including its packaging) is transferred from the supplier to the client.

- If the transport is contracted by the client, delivery is made to the supplier's installations once loading is complete.
- If the transport is contracted by the supplier, delivery is made to the client's installations once unloading is complete.

Factory: installation used by a manufacturer complete with installations suitable for the continuous production of large quantities of cement, which has the necessary silos capacity for the storage and dispatch of each cement produced. This installation, together with installed production control, enables production to be controlled with sufficient precision to guarantee that the requirements are met of the specifications standard applicable to the product.

Manufacturer: natural person or legal entity that operates a factory or depot.

Intermediary: natural person or legal entity that purchases in compliance with this Instruction, from the manufacturer or importer, which takes full liability for the maintenance of the quality, in all its aspects, in the cement handling centre, and which supplies it to another natural person or legal entity.

Batch: quantity of cement of the same designation and origin as is submitted for reception.

Sample: the quantity of cement extracted, if applicable, from a batch for control purposes.

Transport operator: natural person or legal entity contracted, either by the supplier or recipient, to make the transport of a consignment of cement from the supply centres to the recipient installations. In order to make the transport, the operators may use their own vehicles or stipulate agreements with a carrier.

Depot: installation for the transfer of bulk cement (not situated in the factory), used to dispatch cement (bulk or bagged) after transport or storage, where the manufacturer is fully liable for all aspects relating to the cement quality.

Consignment: quantity of cement, of the same name and origin, received in the place of supply in a single transport unit (lorry, container, ship, etc.).

Cement Reception Manager: person responsible for verifying the conformity of the cement received. This is the Optional Management (in construction works, this equates to the Execution Director) or the person assigned this task in the installations in which cement is used under the scope of this Instruction or the representative delegated to carry out this task. The Reception Manager may, in the exercise of his powers, arrange at any time for additional tests or inspections to be carried out on the consignments received.

Supplier: authorised cement consignment shipper.

Carrier: person responsible for the vehicle transporting the cement.

Article 3 Administrative requirements

3.1. General requirements

Under the scope of application of this Instruction, the only cements that can be used are those that are legally marketed in Spain, in any of the other European Union Member States or which are part of the Agreement on the European Economic Area and in States with a customs association agreement with the European Union.

Consequently, cements must be subject to the provision of Regulation (EU) No 305/2011 of 9 March, and, if applicable, with the provisions of Royal Decree 1313/1988 of 28 October, whereby the approval of cements intended for the manufacture of concretes and mortar was declared compulsory for all types of prefabricated products and works, and implementing provisions.

Regulation EU No 305/2011 of 9 March also requires compliance with the provisions of Royal Decree No 255, of 28 February 2003, wherein the Regulation for classification, packing and labelling of dangerous preparations is approved, with special attention given to the provisions of Article 9 (product labelling) and of Article 13 (safety data sheet), and in the Order of the Ministry of the Presidency PRE/1954/2004 of 22 June 2004, referring to soluble (VI) chromium limits in cement.

In application of said provisions:

a) Cements relating to Annex I of this Instruction must bear the CE marking and must be accompanied by the required information; they must also have a declaration of performance prepared by the manufacturer.

b) If the cements listed in Annex II of this Instruction are not equipped with the corresponding harmonised standard, they shall comply with the provisions of Royal Decree No 1313, of 28 October 1988 and the provisions laid down therein and, consequently, they shall be equipped with a certificate of conformity with regulatory requirements.

To the extent to which these cements are included in harmonised standards, during the period of coexistence of applicable harmonised standards and national standards may comply with the provisions of Section a) or the provisions of Section b). Once this period of coexistence is over, they must comply with the provisions of Section a).

Said transitional period of coexistence is as specified in the corresponding Communication of the European Commission and subsequent Resolution of the Directorate-General of Industry of Small and Medium Enterprises of the Ministry of Industry, Energy and Tourism. During this time, the cements concerned can be marked in compliance with the provisions of Sections a) or b); once this period is over, the CE marking is compulsory and will be the only possibility for marketing.

c) Cements that are not covered by any of the above sections, which are legally marketed in any Member States of the Agreement on the European Economic Area and in countries with which a customs association agreement has been stipulated with the European Union, can be marketed, as long as they offer an equivalent safety level, to be recognised by the competent body of the Administration.

The standards specified in this Instruction may be replaced by others used by any other EU Member State or signatory of the Agreement on the European Economic Area or any country party to an association agreement regarding customs with the European Union, as long as they can show that they have identical technical specifications.

For the purpose of this Instruction, it must be understood that the Standards UNE, UNE-EN or UNE-EN ISO specified in the articles always refer to the versions specified therein, except where UNE-EN standards transpose EN standards whose reference has been published in the Official

Journal of the European Union, under the scope of application of Regulation (EU) No 305/2011 of 9 March, establishing harmonised conditions for the marketing of construction products, in which case the mention must relate to the latest European Commission Communication including said reference.

3.2. Requirements relating to voluntary marks of quality

This Instruction envisages the existence on the market of voluntary quality marks that, as an essential condition, must provide added value for the general requirements that can be demanded of cements.

The quality markings granted by a certification entity may have official recognition by any competent authority. The term “competent authority” is used to refer to any management centre belonging to the Public Administration of any Member State of the European Economic Area or any of the States that have signed the Agreement on the European Economic Area or countries with which the European Union has stipulated a customs association agreement, with competence under the scope of the legislation governing constructions or public works. In order to access official recognition as bringing this added value, the voluntary quality marks referring to the cements concerned by this Instruction must satisfy the needs established in this Instruction and the conditions that the competent authority considers necessary to guarantee the added value brought by the quality marking.

In any case, the document or certificate that includes the recognition of the quality marking by the competent authority providing it will include a specific declaration of compliance with the contents of this Instruction.

For greater dissemination in accessing information by users, any competent authority of those considered in the above paragraphs may request publication of the quality markings they recognise on the web page of the Standing Committee of Cement.

CHAPTER II

TYPES OF CEMENTS AND SPECIFICATIONS

Article 4 Cement types

The types of cements included in this Instruction, and their corresponding composition, are as described in Annex I, for cements subject to EC marking and in Annex II for cements subject to Royal Decree 1313/1988.

Article 5 Specifications

5.1. Specifications of cements subject to CE marking

Cements subject to CE marking included in Annex I of this Instruction shall comply with the specifications established therein.

5.2. Specifications of cements subject to Royal Decree 1313/1988

Cements subject to Royal Decree 1313/1988 of 28 October included in Annex II of this Instruction shall comply with the specifications established therein.

When a harmonised standard includes any of the cements contemplated in Annex II and therefore shall have CE marking, it will comply with the specifications that in said standard are prescribed starting from the end of the period of coexistence.

Article 6 Designation of cements

6.1. Designation of cements subject to CE marking

Cements subject to CE marking included in Annex I of this Instruction shall be designated according to the criteria established therein.

6.2. Designation of cements subject to Royal Decree 1313/1988

Cements subject to Royal Decree 1313/1988 of 28 October included in Annex II of this Instruction shall be designated according to the criteria established therein.

CHAPTER III

RECEPTION

Article 7 General considerations and organisation of reception

For the purpose of this Instruction, during the reception of cements, it must be checked that they fit, at the time of delivery, with that specified in the project or, if applicable, in the request and that they meet the requirements and other conditions demanded in this Instruction.

7.1. General considerations

If reception is carried out on site, the control plan prepared by the project author, in accordance with this Instruction, must establish guidelines and criteria for execution when the control programme approved by the Optional Management (in construction works, this equates to the Execution Director), for the development of said plan, must be able to fulfil it and adjust to the work circumstances. In a similar fashion, in other cases, reception will take place in accordance with the specific control programme prepared, in accordance with this Instruction, to that end.

The Reception Manager must monitor to ensure that once accepted, cements are stored and treated in such a way as to guarantee maintenance of performance until use.

Reception will include:

- a) Control of documentation, including quality marks, if applicable and of labelling, according to 8.1;
- b) control of supply by means of visual inspection, according to 8.2; and
- c) if applicable, control by means of tests, in accordance with paragraph 8.3.

7.2. Organisation of reception

The cement will be received by the Reception Manager at the place of supplier, with the term used to mean any of the places included under the scope of application established in Article 1.

If the cement should be collected by the recipient at its factory or the installation of the supplier, the reception shall take place in said place and at said time, in which case, all suitable means must be assured to ensure that once received, the cement is transported in a way that can guarantee maintenance of its performance until it reaches the relevant work, plant or installation.

The supplier and the Reception Manager or their respective representatives shall be present at the time of reception. The Reception Manager shall ensure that this is performed in accordance with the provisions of the corresponding control programme, which may establish distribution of the cement consignment subject to control in order to form batches from which the samples required to permit experimental verification of conformity criteria will be extracted.

Batches will be established in compliance with the following criteria:

1.- In the event of continuous supply:

- a) In the event of supplies of cement with different designation or origin, they shall constitute independent batches for each type of cement and origin.
- b) In general, and without prejudice to the provisions of the control plan, the batch will be made up of the set of consignments or the quantity of cement of the same designation and origin received in a month, unless the monthly quantity exceeds 200 tonnes in weight. In this case, the consignments received shall be divided to form batches for each 200 tonnes or fraction, so that at least two batches shall be made up each month.

2.- If the cement supply is discontinuous or irregular:

- a) In general, the batch establishment criteria described above shall be maintained so that at least one batch shall be made up per month, during the supply period.
- b) The Reception Manager or authorised person may fix a smaller size for forming batches if he believes it to be appropriate.

Section AV.3 of this Instruction lays down criteria for sampling.

Article 8 Control stages in cement reception

In accordance with the provisions of paragraph 7.1, reception of cement shall include at least the following:

- a first stage of checking documentation, including quality marks, if applicable and of labelling of packaged cement; and
- a second stage, consisting of a visual inspection of the material supplied.

Both stages are compulsory, however the control is organised.

Considering that the Reception Manager may consider it necessary to run tests, an optional third stage will be included, of type and class testing of the cement, as well as its chemical, physical and mechanical characteristics, by carrying out identification tests and, if applicable, complementary tests.

Annex V of this Instruction lays down criteria for the scheduling, preparation and development of this third stage.

8.1. First stage: Checking the cement labelling and documents

At the start of the supply, the Reception Manager or the appointed person, shall check that the documentation – to be provided by the supplier – is as laid down in a), b), c), d) and e) of this paragraph and that both this and the regulatory labelling comply with the provisions of this Instruction.

These documents shall include at least the following:

- a) the supply sheet or delivery note, with the information contained in Section AIV.2.1;
- b) the label, or set of information that must be printed on the container or, if applicable, on the documents accompanying the cement, in accordance with the relevant standard, as given in Section AIV.2.5;
- c) the declaration of performance corresponding to the CE marking, according to Section AIV.2.2 or, if applicable, the certificate of conformity with Royal Decree 1313/1988, in accordance with Section AIV.2.4;
- d) in the case of cements not subject to CE marking, the certificate of the manufacturer's warranty, signed by a natural person; and
- e) for cements which show quality marks, accurate documentation on such marks, in accordance with paragraph AIV.3, and, if applicable, documentation referring to recognition of the mark as set out in paragraph 3.2, including reference to the document in which official recognition by the competent authority is recorded. In particular, a certificate proving that the declared and, if applicable, officially recognised, mark is valid.

The Reception Manager, or appointed person, must check that the designation given in the delivery note or documents or, as applicable, on the containers, corresponds to the type and strength class of cement specified in the project or on the order. This is of particular importance in cases of use for which limits have been established, or even complete bans.

8.1.1 Conformity criteria

For the purpose of this stage, the supply is compliant when the labels and documents that should accompany the consignment:

- coincide with those of the cement requested;
- are complete; and
- meet all the established requirements.

The relevant information is provided in Annex IV.

8.1.2 Action in the event of non-conformity

If the documents or label are defective, giving rise to doubt as to the authenticity, the Reception Manager will demand that such defects be remedied. If not remedied, the consignment can be rejected and the Reception Manager may prepare a report explaining why the consignment was rejected.

In the case of rejection, the Reception Manager will report these circumstances to the competent industrial product control (market surveillance) authorities (Article 14 of Industry Law 21/1992). Additionally, if the cement of the consignment has an officially recognised marking

and has defects in its identification or in the documents and labels required, the relevant certifying body and competent authority will be notified, which granted the recognition.

The Reception Manager shall register, archive and keep a copy of this deed, together with the documents specified previously.

8.2. Second stage: Control by means of visual inspection

Once the document control stage has been completed, the Reception Manager shall, in order to accept the consignment, submit the cement supplied to visual inspection when, according to the method of transport or condition of containers at the time of delivery, he believes it necessary to check that the cement has not been altered or mixed in an undesirable manner.

Despite the difficulty in assessing the state of cement through visual inspection, this inspection includes this type of examination in order to check for certain symptoms, such as weathering or the presence of foreign bodies, which may be a clear indicator or evidence of the alteration of the performance of the cement supplied, or a lack of homogeneity seen in the appearance and colour of the cement that can, in some cases, reflect a possible contamination with other cements or that the container has included cements of different origin. Said symptoms are due, in most cases, to deficiencies in storage, loading or transport of the cement, which took place during the period running between when it was manufactured and when it reached its destination.

8.2.1 Conformity criteria

For the purpose of this stage, the supply is compliant when the cement:

- does not show any significant symptoms of weathering with respect to the volume supplied;
- does not contain foreign bodies; and
- does not clearly show samples of heterogeneity in its appearance or colour.

For contained cements, it will be checked that the containers do not show any signs of having undergone inadequate transport or storage that may have affected the cement in this way. The supply is compliant when the sack of contained cement:

- is not damp;
- the date on which the sack was filled in the factory is printed on it. If it has been bagged at a depot, two dates should appear: that of manufacture or dispatch from the factory and that on which it was filled at the depot;
- the container dating procedure must at least include information on the week and year number;
- contains reference to compliance with the regulatory limit of water-soluble (VI) chrome in accordance with the provisions of Ministerial Order PRE/1954/2004 that transposes Directive 2003/53/EC;

- at least one of the sides must include the label corresponding to the CE marking and Royal Decree 1313/1988, where applicable and that corresponding to cements with an officially recognised quality marking, if applicable;
- contains the name or logo of the cement manufacturer and the factory (or that of the container installation, when not pertaining to the factory).

8.2.2 Action in the event of non-conformity

If the cement shows any of the defects cited in the above section, which shed doubt on its suitability for the specific intended use, the Reception Manager will consider, in accordance with the provisions of Section 8.3 of this Article and before accepting the supply, whether or not it would be best to run tests according to the specifications of Annex V of this Instruction, for which it will take samples as appropriate and in accordance with Section AV.3.

If postponing acceptance of the supply and deciding to run tests, the Reception Manager may note this circumstance, explaining the reasons behind the decision.

The Reception Manager shall register, archive and keep a copy of this deed, together with the documents specified under Section 8.1.

8.3. Third stage: Control by means of tests

This third stage of reception is optional and applies when appropriate to the project, by virtue of the special characteristics of the work or the possible presence at reception of the defects specified, so requires. As ultimate guarantor of the conformity of the cement received, the Reception Manager shall decide to apply this stage when appropriate.

If tests are to be carried out, these shall be performed in accordance with Annexes V and VI of this Instruction.

The identification and complementary tests of this stage are as described in Sections AVI.1 and AVI.2, respectively.

In any case, the cement supplier, having been duly informed by the Reception Manager, may, where considered appropriate and in situations where it is considered necessary, request that counter-samples be taken.

8.3.1 Conformity criteria

For the purpose of this stage, the consignment is compliant when the cement satisfies the criteria laid down by Section AV.5 or by the specific applicable legislation.

It must be shown that the risk level for the user is no greater than that obtained in application of the criteria of said section.

8.3.2 Action in the event of non-conformity

In the event of non-conformity, the Reception Manager will record the situation in a report describing his decision to either conditionally reject the batch, if asked by the supplier to take counter-samples, or to reject it definitively.

In the case of conditional rejection, and insofar as no reliable results are available that can guarantee compliance with the conformity criteria, the conditions must be stored in suitable conditions, in accordance with the provisions of Article 10, so as to prevent any contamination or deterioration.

For the conformity of cements subjected to counter-sampling, the criteria to be applied shall be that established by Section 8.3.1.

Once he has the results of the counter-samples, the Reception Manager will note the final decision, explaining his reasons. He may decide that it is best to take a new batch of samples, if the supplier should so request, if contradictory results have been obtained and if the lack of consequences in the delay of reception allows.

In the event of definitive rejection, the Reception Manager will apply the communication procedure established below:

- in the case of rejection, the Reception Manager will report these circumstances to the competent industrial product control (market monitoring) authorities (Article 14 of Industry Law 21/1992);
- additionally, if the cement of the consignment should be marked by an officially recognised voluntary quality marking, this circumstance will be reported to the relevant certifying body and to the authority that granted the recognition;
- The Reception Manager shall register, archive and keep a copy of this deed, together with the remainder of the documents specified previously.

CHAPTER IV

TRANSPORT, STORAGE, HANDLING AND USE OF CEMENTS

Article 9 Transport of the cement

This Article lays down the conditions to be met when transporting the cement, in order to guarantee the conservation of its performance. the requirements of the documents accompanying a supply of cement and its labelling are given in Annex IV to this Instruction.

9.1. Forms and conditions for the transport of cement

9.1.1 Forms for the transport of cement

The cement can be transported as bulk or in containers.

9.1.2 Conditions for the transport of bulk cement

Bulk cement can only be transported using vehicles equipped with suitable containers (cubes or cisterns) that are sealed, secure and confined as necessary to guarantee the perfect conservation and that do not harm the environment.

The party contracting the bulk cement transport (supplier or recipient) must define the transport conditions, including the requirement that it be made in previously calibrated, clean, sealed containers, so as to maintain the characteristics of the cement until unloading.

The transport operator must send the carrier the conditions required by the party contracting the transport and must ensure that they are respected.

The carrier is responsible for the cleanliness, seal and emptying of the containers, as well as for ensuring respect of compatibilities and incompatibilities are indicated by the party contracting the transport with respect to products transported previously.

When the cement supplier is the party contracting the bulk transport, it must:

- 1) Establish a system that includes at least a control of the calibration of lorries to verify that they are empty. There must be no more than 4 % difference in relation to the calibration registered for the vehicle.
- 2) Define a relationship of compatibilities or incompatibilities with respect to products carried previously by the carrier. If the product is incompatible, the certificate of cube cleaning. The following aspects must at least be considered in this relationship:
 - a) In the case of grey cement:

If the product transported previously was cement or any product that is part of the main constituents of the common cements indicated in AI.1, the carrier will only be required to empty the cube, given that this product is considered compatible.
 - b) In the case of white cement:

If the product transported previously was white cement, the carrier will only be asked to empty the cube, as the product is considered compatible.

c) In the case of calcium aluminate cement:

If the product transported previously was calcium aluminate cement, the carrier will only be asked to empty the cube, as the product is considered compatible.

Bulk cement will be supplied weighed using instruments that comply with the specifications of class III, in compliance with Standard UNE-EN 45501. The maximum permissible error in relation to the net weight of the bulk cement supplied is fixed as 1 %.

9.1.3 Conditions for the transport of contained cement

When cement is supplied in containers, suitable containers must be used that can guarantee the retention of the cement and allow for its characteristics to be maintained until the time it is used. These containers must have the strength and resistance that suffices to ensure that no damages are suffered during handling that may result in the alteration of the cement they contain.

Article 10 Storage

For the purpose of this Instruction, in order to avoid any difficulties in the reception process and considering that the cement may mix, weather, become contaminated, etc. it is required that storage take place in suitable means that are in good conditions in terms of seal and cleanliness, and the latter in particular when changing type or class of cement to be transported, with the aim of avoiding any possible alteration to performance and ensuring good condition at the time of reception.

These same precautions must be considered if it should be necessary to transfer the cement internally, within the installations of the recipient, once the supply has been accepted.

The storage of bulk cements, once the consignment has been accepted, will take place in sealed silos and, in particular, all contamination with any other different type and/or strength class cements, must be avoided. Therefore, mixing different varieties of cements in terms of type, strength class and other characteristics, if applicable, is specifically prohibited. The silos must be protected from damp and have an opening mechanism or system for loading in suitable conditions from the transport vehicles, with no risk of altering the cement.

Storage of contained cements, once the consignment has been accepted, must take place on pallets or similar platforms, in covered premises that are ventilated and protected from rain and direct exposure to the sun. Locations where the containers may be exposed to damp will be avoided in particular, along with any exposure to potential handling during storage, which may damage them or the quality of the cement.

Cement storage, loading and unloading installations must have suitable devices by which to minimise the release of powder into the atmosphere.

Article 11 Precautions when handling cements

As regards worker health and safety, the safety requirements and applicable regulations shall be those given in employment legislation on the prevention of risks at work.

Additionally, as concerns precautions to be taken for handling cements, it shall be necessary to bear in mind the provisions of Royal Decree No 255, of 28 February 2003, wherein the Regulation for classification, packing and labelling of dangerous preparations is approved, with special attention given to the provisions of Article 9 (product labelling) and of Article 13 (safety data sheet), and in the Order of the Ministry of the Presidency PRE/1954/2004 of 22 June 2004, referring to water-soluble chromium (VI) limits in cement.

Given that the final application of the cement is not known from the outset and that the use of controlled, closed, fully automated processes during which the cement products are only handled by machines, with no possible skin contact, cannot be guaranteed in all cases, the exemption envisaged in the aforementioned Order of the Ministry of the Presidency must be sufficiently justified and must have been requested by the recipient from the cement supplier, in writing.

Article 12 Basis for the use of cements

The choice of the different types of cements included in this Instruction, will be made according to the application or specific intended use, the conditions for installation and the exposure class to which the concrete or mortar manufactured using them, will be subjected.

The applications considered in this Instruction, for the cements it covers, are the manufacture of concretes and mortars for masonry, excluding special mortars and mortars for rendering and plastering.

For masonry mortars, for preference masonry cements will be used, although common cements can also be used with an appropriate additive content, choosing the most suitable according to mechanical characteristics, whiteness, if applicable, air-entrainment additive content, in the case of masonry cements.

Masonry cements must not be used to manufacture concretes, as its use is limited to masonry mortars (for factories making bricks, flooring, rendering, etc.).

The behaviour of cements may be affected by the installation conditions of the products containing them, including climate factors (temperature, relative humidity of the air and wind speed), procedures for executing the cement or mortar (casting on site, prefabricated, projected, etc.) and the environmental exposure classes. These conditions and procedures on the one hand have a major influence on the maturation process and may affect the subsequent hardening of the concrete or mortar and, on the other, can affect the durability of the concrete or mortar.

Article 13 Use of cements

For the application of this Article, due consideration must always be taken of the instructions established in the current Structural Concrete Code.

When cements are to be used in the presence of sulfates, they must have the additional characteristic of resistance to sulfates, as specified in Section All.2.1, as long as the sulfate content, expressed as SO_4 , is greater than or equal to 600 mg/l in the case of water, or 3 000 mg/kg in the case of soils.

If a structural element of unreinforced, reinforced or pre-stressed concrete should be subjected to attack by sea water, the cement to be used must have the sea water resisting additional characteristic, or, for lack thereof, the sulfates resisting additional characteristic.

In cases where aggregates need to be used that may produce alkali-aggregate reactions and the environment is damp, according to the current Structural Concrete Code, cements will be used with an alkaline content, expressed as sodium oxide equivalent ($\text{Na}_2\text{O} + 0.658 \text{ K}_2\text{O}$) of less than 0.60 % in the cement mixture. If this is not possible, an experimental study must be conducted on the possibility of using cements with additions, save for limestone filler.

When the need for whiteness dictates, white cements will be used that are compliant with the provisions of Section All.4.

In order to manufacture a concrete, we recommend using the cement of the lowest strength class possible that is compatible with the mechanical strength of the concrete specified so as to ensure the minimum cement content, which, for reasons of durability, is established by the current Structural Concrete Code for each exposure class according to the concrete type.

Annex VIII contains recommendations for use of cements for different types of applications, specific circumstances for concrete use and different grades of exposure.

Mixes of different type or origin cements cannot be used under any circumstances, as this would automatically result in the loss of traceability of the material and, with it, the manufacturer's guarantees. The Reception Manager shall watch to ensure that this does not happen.

13.1. Cement for structural concrete and adhesive injection products

When using cements in the manufacture of concrete and adhesive injection products coming under the scope of the current Structural Concrete Code, compliance is essential with said Instruction and, if applicable, with other specific applicable regulations.

ANNEXES

ANNEX I

CEMENTS SUBJECT TO CE MARKING. COMPOSITION, DESIGNATION, SPECIFICATIONS AND STANDARDS OF REFERENCE

AI.1.Composition, designation, specifications and durability of common cements.

Cements defined in Standard UNE-EN 197-1 are deemed to be common cement. This includes 27 common cements, 7 sulfate resisting common cements and 3 low early strength blastfurnace cements, of which two are resistant to sulfates.

AI.1.1. Composition

The proportions in volume of the constituents of common cements are specified in Tables AI.1.1a and AI.1.1b, according to the classification by type, name and designation.

The composition requirements refer to the sum of all main and minor additional constituents. It is understood that the end cement is the sum of the main and minor additional constituents plus the calcium sulfate necessary and any additives.

AI.1.2. Designation

Portland cement shall be designated by the code CEM I, followed by the strength class (32.5 – 42.5 – 52.5), a blank space followed by the letter (R) if characterised by high early strength or (N) if the early strength is normal (see example 1). For these cements, the designation will begin by referring to Standard EN 197-1, followed by a dash.

Portland cements with additives shall be designated by the code CEM II followed by a forward slash (/) and a letter indicating the sub-type (A or B) separated by a dash (-) and a letter designating the main component used as cement additive, i.e.:

S: granulated blastfurnace slag;

D: silica fume;

P: natural pozzolana;

Q: natural calcined pozzolana;

V: siliceous fly ash;

W: calcareous fly ash;

T: burnt shale;

L: limestone with a total organic carbon content of less than or equal to 0.5 % in volume;

LL: lime with a total organic carbon content of less than or equal to 0.2 % in volume;

(See example 2).

If using a combination of the foregoing constituents, the letter M will be used, with the addition of letters identifying the main constituents used as additives in brackets thereafter. Thereafter, the strength class will be indicated (32.5 – 42.5 – 52.5), a blank space followed by the letter R if characterised by high early strength or N if the early strength is normal. For these cements, the designation will begin by referring to Standard EN 197-1, followed by a dash (see example 3).

Blastfurnace cements, pozzolana cements and composite cements will be classified with the codes CEM III, CEM IV and CEM V, respectively, followed by a slash (/) and a letter indicating the sub-type (A, B or C), as applicable. When dealing with type IV pozzolana cements or type V composite cements, in brackets, letters will also be given identifying the main constituents used as additives. The strength class (32.5 – 42.5 – 52.5) is given thereafter, followed by a blank space and the letter R followed by the letter R if it is high early strength and the letter N if it is of normal early strength, and the letter L if it is low early strength (see examples 4 and 5). This latter case only applies to blastfurnace cements. For these cements, the designation will begin by referring to Standard EN 197-1, followed by a dash.

For low heat common cements, the letters LH must be added, preceded by a dash at the end of the corresponding designation (see example 5).

For sulfate resisting common cements, the letters SR must be added, preceded by a dash at the end of the corresponding designation (see examples 6, 7 and 8). In the case of CEM I, a blank space is added to the letters SR, and the number 0, 3 or 5, depending on whether its C₃A content in the clinker is 0 %, ≤3 % or ≤5 %, respectively (see example 6).

For low heat common, sulfate resisting cements, the letters LH/SR must be added, preceded by a dash at the end of the corresponding designation (see examples 4 and 5).

TABLE AI.1.1a. Common cements

Main Types	Name	Designation	Composition (proportion by mass ^{1) 5)}											
			Main constituents										Minor additional constituents	
			Clinker K	Blastfurnace slag S	Silica fume D ²⁾	Pozzolana		Fly ash		Burnt shale T	Limestone ⁴⁾			
						Natural P	Natural calcined Q	Siliceous V	Calcareous W		L	LL		
CEM I	Portland cement	CEM I	95-100	–	–	–	–	–	–	–	–	–	0-5	
CEM II	Portland-slag cement	CEM II/A-S	80-94	6-20	–	–	–	–	–	–	–	–	0-5	
		CEM II/B-S	65-79	21-35	–	–	–	–	–	–	–	–	0-5	
	Portland-silica fume cement	CEM II/A-D	90-94	–	6-10	–	–	–	–	–	–	–	0-5	
	Portland-pozzolana cement	CEM II/A-P	80-94	–	–	6-20	–	–	–	–	–	–	0-5	
		CEM II/B-P	65-79	–	–	21-35	–	–	–	–	–	–	0-5	
		CEM II/A-Q	80-94	–	–	–	6-20	–	–	–	–	–	0-5	
		CEM II/B-Q	65-79	–	–	–	21-35	–	–	–	–	–	0-5	
	Portland-fly ash cement	CEM II/A-V	80-94	–	–	–	–	6-20	–	–	–	–	0-5	
		CEM II/B-V	65-79	–	–	–	–	21-35	–	–	–	–	0-5	
		CEM II/A-W	80-94	–	–	–	–	–	6-20	–	–	–	0-5	
		CEM II/B-W	65-79	–	–	–	–	–	21-35	–	–	–	0-5	
	Portlandburnt shale cement	CEM II/A-T	80-94	–	–	–	–	–	–	–	6-20	–	0-5	
		CEM II/B-T	65-79	–	–	–	–	–	–	–	21-35	–	0-5	
	Portland- limestone cement	CEM II/A-L	80-94	–	–	–	–	–	–	–	–	6-20	0-5	
		CEM II/B-L	65-79	–	–	–	–	–	–	–	–	21-35	0-5	
		CEM II/A-LL	80-94	–	–	–	–	–	–	–	–	6-20	0-5	
		CEM II/B-LL	65-79	–	–	–	–	–	–	–	–	21-35	0-5	
	Portlandcomposite cement ³⁾	CEM II/A-M	80-88	12-20										0-5
		CEM II/B-M	65-79	<----- 21-35 ----->										0-5
CEM III	Blastfurnace cement	CEM III/A	35-64	36-65	–	–	–	–	–	–	–	–	0-5	
		CEM III/B	20-34	66-80	–	–	–	–	–	–	–	–	0-5	
		CEM III/C	5-19	81-95	–	–	–	–	–	–	–	–	0-5	
CEM IV	Pozzolanic cement ³⁾	CEM IV/A	65-89	–	<----- 11-35 ----->					–	–	0-5		
		CEM IV/B	45-64	–	<----- 36-55 ----->					–	–	0-5		
CEM V	Composite cement ³⁾	CEM V/A	40-64	18-30	–	<----- 18-30 ----->			–	–	–	0-5		
		CEM V/B	20-38	31-49	–	<----- 31-49 ----->			–	–	–	0-5		

¹⁾ The values in the table refer to the sum of main and minor additional constituents.

²⁾ The proportion of silica fume is limited to 10 %.

³⁾ In Portland-composite cements CEM II/A-M and CEM II/B-M, in pozzolan cements CEM IV/A and CEM IV/B and in composite cements CEM V/A and CEM V/B the main constituents other than clinker shall be declared by designation of the cement (see Section AI.1.2).

⁴⁾ Total organic carbon (TOC) content determined in accordance with Standard UNE EN 13639, shall be less than 0.20 % by mass LL, or less than 0.50 % by mass for lime L.

⁵⁾ The composition requirements refer to the sum of all main and minor additional constituents. It is understood that the end cement is the sum of the main and minor additional constituents plus the calcium sulfate necessary and any additives.

TABLE AI.1.1b. Common sulfate resisting cements of Standard UNE-EN 197-1

Main types	Name	Designation	C ₃ A content (%) ⁴⁾	Composition (proportion by mass ¹⁾)				
				Main constituents				Minor additional constituents
				Clinker K	Blastfurnace slag S	Pozzolana natural P	Siliceous fly ash V	
CEM I	Sulfate resisting Portland cement	CEM I-SR 0	= 0	95-100	-	-	-	0-5
		CEM I-SR 3	≤ 3					
		CEM I-SR 5	≤ 5					
CEM III ³⁾	Sulfate resisting blastfurnace cement	CEM III/B-SR	-	20-34	66-80	-	-	0-5
		CEM III/C-SR	-	5-19	81-95	-	-	0-5
CEM IV	Sulfate resisting pozzolana cement ²⁾		≤ 9	65-79	-	21-35		0-5
		CEM IV/B-SR	≤ 9	45-64	-	36-55		0-5
¹⁾ The values in the table refer to the sum of main and minor additional constituents.								
²⁾ In sulfate resisting pozzolana cements, types CEM V/A-SR and CEM V/B-SR, the main constituents in addition to the clinker shall be declared by designation of the cement (see Section AI.1.2).								
³⁾ For sulfate resisting blastfurnace cements, CEM III/B-SR and CEM III/C-SR, there is no requirement in respect of the C ₃ A content of the clinker.								
⁴⁾ Analysed in the clinker.								

Below is a series of examples of names of common cements.

Example 1: EN 197-1- CEM I 42.5 R

corresponding to a Portland cement, strength class 42.5 and high initial strength.

Example 2: EN 197-1- CEM II/A-L 32.5 N

corresponds to a Portland cement with a content of between 6 % and 20 % by mass of limestone, with strength class 32.5 and normal early strength.

Example 3: EN 197-1- CEM II/A-M (S-V-L) 32.5 R

corresponds to a composite Portland cement with between 6 % and 20 % by mass of granulated blastfurnace slag (S), siliceous fly ash (V) and limestone (L) of strength class 32.5 and high early strength.

Example 4: EN 197-1- CEM III/B 32.5 L

corresponds to a blastfurnace cement with a content of 66 % to 80 % by mass of granulated blastfurnace slag (S) with strength class 32.5 and low early strength.

Example 5: EN 197-1- CEM IV/A (V-S) 32.5 N-LH

corresponds to a pozzolana cement with a content of 11 % to 35 % by mass of siliceous fly ash (V) and granulated blastfurnace slag (S) with strength class 32.5 and normal early strength and low heat.

Example 6: EN 197-1- CEM I 42.5 R-SR 3

corresponds to a Portland cement of strength class 42.5, high early strength and sulfate resisting with a C₃A content in the clinker less than or equal to 3 %.

Example 7: EN 197-1- CEM III/B 32.5 N-LH/SR

corresponds to a blastfurnace cement with a content of 66 % to 80 % by mass of granulated blastfurnace slag (S) with strength class 32.5, normal early strength, low heat and sulfate resisting.

Example 8: EN 197-1- CEM IV/A (P-V) 32.5 N-SR

corresponds to a sulfate resisting pozzolana cement with a content of between 21 % and 35 % in mass of natural pozzolana (P) and siliceous fly ash (V), with strength class 32.5, normal early strength and C₃A content in clinker equal to or less than 9 % by mass.

AI.1.3. Mechanical and physical specifications

The specifications relating to the mechanical and physical characteristics that must be met by common cements according to the strength class are given in Table AI.1.3.

Table AI.1.3. Mechanical and physical specifications of common cements

Strength class	Compressive strength ²⁾ UNE-EN 196-1 (N/mm ²)				Initial setting time UNE-EN 196-3 (min)	Soundness UNE-EN 196-3 (Expansion, mm)	Heat of hydration ³⁾ (J/g)	
	Early strength		Standard strength				UNE-EN 196-9	UNE-EN 196-8
	2 days	7 days	28 days				41 hours	7 days
32.5 L ¹⁾	-	≥12.0	≥32.5	≤52.5	≥75	≤10	≤270	
32.5 N	-	≥16.0						
32.5 R	≥10.0	-						
42.5 L ¹⁾	-	≥16.0	≥42.5	≤62.5	≥60			
42.5 N	≥10.0	-						
42.5 R	≥20.0	-						
52.5 L ¹⁾	≥10.0	-	≥52.5	-	≥45			
52.5 N	≥20.0	-						
52.5 R	≥30.0	-						
<div><div>¹⁾ Strength class only defined for CEM III.</div><div>²⁾ 1 N/mm² = 1 MPa.</div><div>³⁾ Only for low heat (LH) cements.</div></div>								

AI.1.4. Chemical specifications

The specifications relating to the chemical characteristics to be met by common cements are given in Tables AI.1.4a and AI.1.4b.

Table Al.1.4a. Chemical specifications of common cements

Characteristic	Test reference	Cement type	Strength class	Specification ¹⁾
Loss on ignition	UNE-EN 196-2	CEM I CEM III	All	≤ 5.0 %
Insoluble residue	UNE-EN 196-2 ²⁾	CEM I CEM III	All	≤ 5.0 %
Sulfate content (as SO ₃)	UNE-EN 196-2	CEM I CEM II ³⁾ CEM IV CEM V	32.5 N 32.5 R 42.5 N	≤ 3.5 %
			42.5 R 52.5 N 52.5 R	≤ 4.0 %
			CEM III ⁴⁾	
			All	
Chloride content (Cl ⁻)	UNE-EN 196-2	All ⁵⁾	All	≤ 0.10 % ⁶⁾
Pozzolanicity	UNE-EN 196-5	CEM IV	All	Satisfies the test
¹⁾ If specifications are given as percentages, they refer to the mass of the final cement. ²⁾ The insoluble residue is determined by means of a method based on dissolving the sample in hydrochloric acid and then attacking with a sodium carbonate solution ³⁾ CEM II/B-T and CEM II/B-M cement with a T content in excess of 20 % may contain up to 4.5 % sulfate for all strength classes. ⁴⁾ CEM III/C may contain up to 4.5 % sulfate. ⁵⁾ CEM III cement may contain more than 0.10 % chlorine but in this case, the maximum content shall be delivered in the packs and delivery notes. ⁶⁾ For pre-stressing applications, the cement may have been specifically manufactured with chloride values that are below the admissible maximum. In this case, the value must be expressed in the containers and delivery notes.				

Table Al.1.4b. Chemical specifications of common sulfate resisting cements

Characteristic	Test reference	Cement type	Strength class	Specification ¹⁾
Sulfate content (as SO ₃)	UNE-EN 196-2	CEM I-SR 0 CEM I-SR 3 CEM I-SR 5 ²⁾ CEM IV/B-SR	32.5 N 32.5 R 42.5 N	≤ 3.0 %
			42.5 R 52.5 N 52.5 R	≤ 3.5 %
C ₃ A in the clinker ³⁾	UNE-EN 196-2 ⁴⁾	CEM I-SR 0	All	0 %
		CEM I-SR 3		≤ 3 %
		CEM I-SR 5		≤ 5 %
	- ⁵⁾	CEM IV/A-SR CEM IV/B-SR		≤ 9 %
Pozzolanicity properties	UNE-EN 196-5	CEM IV/A-SR CEM IV/B-SR	All	Satisfies the test at 8 days
¹⁾ Requirements are given as percentage by mass of the final cement or clinker, as defined in the table. ²⁾ For some specific applications, cements CEM I-SR 5 may be produced with a higher sulfate content. In this case, the greater sulfate content numerical value shall be declared in the delivery note. ³⁾ The test method used for the determination of the C ₃ A of clinker from an analysis of a final cement is being studied. ⁴⁾ In the specific case of CEM I, the C ₃ A content of the clinker may be calculated through a chemical analysis of the cement. The C ₃ A content shall be calculated using the formula: C ₃ A = 2.65 A - 1.69 F, where A and F are the percentages by mass of aluminium oxide (Al ₂ O ₃) and iron oxide (III) (Fe ₂ O ₃) of the clinker, respectively, determined in accordance with Standard UNE-EN 196-2. ⁵⁾ Until completion of the test method, the C ₃ A content must be determined according to the clinker analysis as part of the manufacturer's factory production control.				

AI.1.5. Durability

In many applications, particularly in severe environmental conditions, the type, sub-type and strength class of the cement can affect the durability of concrete, mortar and grout, like, for example, in resistance to chemical attack, resistance to freezing-thawing and, if applicable, the protection of reinforcements.

Low early strength blastfurnace cements may require additional precautions, such as extension of the time for removal from the mould and special care with adverse weather conditions, all due to its slow development of strength.

AI.2.Composition, designation, specifications and durability of very low heat special cements

Cements defined in UNE-EN 14216 are deemed low heat cements.

AI.2.1. Composition

The proportions in volume of the constituents of very low heat special cements are specified in Table AI.2.1, according to the classification by type, name and designation.

TABLE AI.2.1. Very low heat special cements

Main types	Name	Designation	Composition (proportion by mass) ¹⁾							Minor additional constituents
			Main constituents							
			Clinker K	Blastfurnace slag S	Silica fume D ²⁾	Pozzolana		Fly ash		
						Natural P	Natural calcined Q	Siliceous V	Calcareous W	
VLH III	Blastfurnace cement	VLH III/B	20-34	66-80	-	-	-	-	-	0-5
		VLH III/C	5-19	81-95	-	-	-	-	-	0-5
VLH IV	Pozzolanic cement ³⁾	VLH IV/A	65-89	-	<-----11-35----->					0-5
		VLH IV/B	45-64	-	<-----36-55----->					0-5
VLH V	Composite cement ³⁾	VLH V/A	40-64	18-30	-	<-----18-30----->			-	0-5
		VLH V/B	20-38	31-50	-	<-----31-50----->			-	0-5

¹⁾ The values of the table refer to the sum of the main and minor additional constituents. The composition requirements refer to the sum of all main and minor additional constituents. The end cement is the sum of the main and minor additional constituents plus the calcium sulfate and any additives.

²⁾ The proportion of silica fume is limited to 10 %.

³⁾ In pozzolanic cements VLH IV/A and VLH IV/B and in composite cements VLH V/A and VLH V/B the main constituents other than clinker shall be declared by designation of the cement.



AI.2.2. Designation

Very low heat special cements are designated using the codes VLH followed by the cement type, in accordance with Section AI.2.1. When dealing with type IV pozzolana cements or type V composite cements, in brackets, letters will also be given identifying the main constituents used as additives. This is followed by the standard strength class 22.5. For these cements, the designation will begin by referring to standard UNE-EN 14216, followed by a dash.

Example 9: EN 14216- VLH IV/B (P) 22.5,

corresponds to a very low heat special pozzolana cement with a content between 36 % and 55 % by mass of natural pozzolana (P) and strength class 22.5.

AI.2.3. Mechanical and physical specifications

The specifications relating to the mechanical and physical characteristics that must be met by very low heat special cements according to the strength class are given in Table AI.2.3.

Table AI.2.3. Mechanical and physical specifications and durability of very low heat special cements

Strength class	Compressive strength UNE-EN 196-1 (N/mm ²)		Initial setting time UNE-EN 196-3 (min)	Soundness UNE-EN 196-3 Expansion (mm)	Heat of hydration (J/g)	
	Standard strength 28 days				UNE-EN 196-9 at 41 hours	UNE-EN 196-8 at 7 days
22.5	≥22.5	≤42.5	≥75	≤10	≤220	

AI.2.4. Chemical specifications

The specifications relating to the chemical characteristics that must be met by very low heat special very low heat special cements are given in Table AI.2.4.

Table AI.2.4. Chemical specifications and durability of very low heat special cements

Property	Test reference	Designation	Specification ¹⁾
Loss on ignition	UNE-EN 196-2	VLH III	≤5.0 %
Insoluble residue	UNE-EN 196-2 ²⁾	VLH III	≤5.0 %
Sulfate content (as SO ₃)	UNE-EN 196-2	VLH III/B	≤4.0 %
		VLH III/C	≤4.5 %
		VLH IV	≤3.5 %
		VLH V	≤3.5 %
Chloride ion content		All ³⁾	≤0.10 %
Pozzolanicity	UNE-EN 196-5	VLH IV	Satisfies the test at 8 days

¹⁾ Requirements given as percentages by mass of the final cement.

²⁾ Determination of residue insoluble in hydrochloric acid and sodium carbonate.

³⁾ Cement type VLH III may contain more than 0.10 % chloride, but in this case, the maximum chloride content shall be stated on the container and/or the delivery note.

AI.2.5. Durability

In many applications, particularly in severe environmental conditions, the type, sub-type and strength class of the cement can affect the durability of concrete, mortar and grout, like, for example, in resistance to chemical attack, resistance to freezing-thawing, in chemical resistance and in the protection of reinforcements.

Concrete or mortar manufactured using very low heat special require additional protection against drying out and from carbonation during curing. The resistance to ice of very low heat special cements must be suited to the environmental conditions of the place in which it is to be used.

AI.3.Composition, designation, specifications and durability of calcium aluminate cement

The cement defined in standard UNE-EN 14647 is deemed to be calcium aluminate cement.

AI.3.1. Composition

Calcium aluminate cement consists purely of calcium aluminate cement clinker obtained from a defined mixture of aluminium and calcareous materials that undergo a suitable thermal treatment.

AI.3.2. Designation

Calcium aluminate cement is identified by the letters CAC, with no reference made to strength class. For these cements, the designation will begin by referring to standard UNE-EN 14647, followed by a dash.

Example 10: UNE-EN 14647- CAC

corresponds to calcium aluminate cement.

AI.3.3. Mechanical and physical specifications

The specifications relating to the mechanical and physical characteristics that must be met by calcium aluminate cement are given in Table AI.3.3.

Table AI.3.3. Mechanical and physical specifications of calcium aluminate cement

Compressive strength UNE-EN 196-1 and UNE-EN 14647 (Section 7.1) (N/mm ²)		Initial setting time UNE-EN 196-3 and UNE-EN 14647 (Section 7.2) (min)
At 6 hours	At 24 hours	
≥ 18.0	≥40.0	≥90

AI.3.4. Chemical specifications

The specifications relating to the chemical characteristics that must be met by calcium aluminate cement are given in Table AI.3.4.

Table AI.3.4. Chemical specifications of calcium aluminate cement

Property	Test reference	Requirement ¹⁾
Aluminium content (as Al ₂ O ₃)	UNE-EN 196-2	35 % ≤ Al ₂ O ₃ ≤ 58%
Sulfur content (as S ²⁻)		≤ 0.10 %
Chloride ion content		≤ 0.10 %
Alkali content ²⁾		≤ 0.4 %
Sulfate content (as SO ₃)		≤ 0.5 %
¹⁾ Requirements given as percentages by mass of the final cement.		
²⁾ Expressed as Na ₂ O equivalent (Na ₂ O + 0.658 K ₂ O).		

AI.3.5. Durability

Calcium aluminate cement develops strength far more quickly than Portland cement, in just a few hours reaching values similar to ones it achieves in 28 days. Over time, strength tends to decline as the conversion process takes place of hydrated calcium aluminates, from its hexagonal structure to the first stages of a thermodynamically stable cubic structure. This process is highly dependent on the water/cement ratio and the temperature during the first 24 hours after installation.

Calcium aluminate cement has good sulfate resistance and strongly resists some aggressive media as long as they are not alkaline. In order to ensure the durability of works built using it, the instructions given in the current Structural Concrete Code and the indications in the Standard UNE-EN 14647, must be applied. With suitable aggregates, refractory mortar and concrete can be manufactured.

AI.4.Composition, designation, specifications and durability of masonry cements

Cements defined in Standard UNE-EN 413-1 are deemed to be masonry cement.

AI.4.1. Composition

Masonry cements consist of Portland cement clinker, inorganic constituents and, where appropriate, additives as shown in Table AI.4.1. Small quantities of calcium sulfate are added to the other constituents of masonry cements during their manufacture in order to control setting.

The inorganic constituents of masonry cements must be materials chosen from:

- natural mineral materials;
- mineral materials used in the clinker manufacturing process or products resulting from this process;
- hydrated or hydraulic lime for construction in accordance with Standard UNE-EN 459-1;
- constituents specified in Standard UNE-EN 197-1;
- inorganic pigments (except those containing carbon black) conforming to Standard UNE-EN 12878.

Table Al.4.1. Composition of masonry cements

Type and strength class	Content (% by mass)	
	Portland cement clinker	Additives ^{1) and 2)}
MC 5	≥ 25	≤ 1
MC 12.5 MC 12.5 X ³⁾ MC 22.5 MC 22.5 X ³⁾	≥ 40	≤ 1
¹⁾ Excluding pigments. ²⁾ The quantity of organic additives on a dry base shall not exceed 0.5 % by mass of the masonry cement. ³⁾ The term X designates a masonry cement that does not contain an air entraining agent.		

Al.4.2. Designation

Masonry cements are identified by the letters MC, followed by the strength class (5, 12.5 and 22.5) and, where applicable, the letter X to indicate that no air entraining agent has been added. For these cements, the designation will begin by referring to Standard EN 413-1, followed by a dash (see example 11).

Example 11: EN 413-1- MC 12.5 X

corresponds to a masonry cement with strength class 12.5 and without an air entraining agent

Al.4.3. Mechanical and physical specifications

The specifications relating to the mechanical and physical characteristics that must be met by masonry cements according to the type and strength class are given in Table Al.4.3a.

Table Al.4.3a. Mechanical and physical specifications of masonry cements

Type and strength class	Compressive strength (N/mm ²) UNE-EN 196-1 ¹⁾			Setting time UNE-EN 413-2		Fineness on a 90 µm sieve UNE 80122	Soundness UNE-EN 196-3
	7 days	28 days		principle (min)	Final ²⁾ (hours)	Residue (%)	Expansion (mm)
MC 5	-	≥5.0	≤15	≥60	≤15	≤15	≤10
MC 12.5	≥7	≥12.5	≤32.5				
MC 12.5 X	≥7	≥12.5	≤32.5				
MC 22.5	≥10	≥22.5	≤42.5				
MC 22.5 X	≥10	≥22.5	≤42.5				
¹⁾ The test must be carried out in accordance with Standard UNE-EN 196-1. If at the age of 24 hours, the test prisms do not show sufficient strength, they can be demoulded after 48 hours. Loading speed for test prisms breakage of cements with strength class 5 will be 400 ± 40 N/s. That of Standard UNE-EN 459-2 can be used as an alternative compacting device.							
²⁾ If the masonry cement initial setting time is less than 6 hours, no requirement shall be specified for the final setting time.							

Masonry cements are also subject to the specifications established in Table Al.4.3b on fresh mortar. The properties of fresh mortar shall be determined on a mortar of standard consistency obtained for a penetration value of 35 ± 3 mm, determined by applying the reference method defined in Standard UNE EN 413-2. The flow table test is the alternative method.

Table Al.4.3b. Specifications for fresh mortar of masonry cements

Type and strength class	Air content UNE-EN 413-2 (% by volume)	Water retention UNE-EN 413-2 (% by mass)
MC 5 MC 12.5 MC 22.5	$8 \leq \text{air content} \leq 22$	≥ 80
MC 12.5 X MC 22.5 X	$\leq 6^{1)}$	≥ 75
¹⁾ The control of the masonry cement manufacturing process ensures that this upper limit is not exceeded.		

Al.4.4. Chemical specifications

The specifications relating to the chemical characteristics that must be met by masonry cements are given in Table Al.4.4.

Table Al.4.4. Chemical specifications of masonry cements

Property	Test reference	Type and class of cement	Value (% by mass)
Sulfate content (expressed as SO ₃)	UNE-EN 196-2	MC 5	≤ 2.5
		MC 12.5 MC 12.5 X MC 22.5 MC 22.5 X	≤ 3.5
		MC 5	No requirement
Chloride content (expressed as Cl ⁻)		MC 12.5 MC 12.5 X MC 22.5 MC 22.5 X	≤ 0.10

Al.4.5. Durability

In many applications, particularly in severe environmental conditions, the type and strength class of masonry cement can affect the durability of mortar. The choice of the type of cement for different uses and types of exposure must be in accordance with appropriate standards and/or regulations valid in the place of use of the mortar.

Al.5.Reference standards for cements subject to CE marking**Al.5.1. Product standards**

UNE-EN 197-1:2011	Cement. Part 1: Composition, specifications and conformity criteria for common cements.
UNE-EN 14216:2005	Cement. Composition, specifications and conformity criteria of very low heat special cements.
UNE-EN 413-1:2011	Masonry cements. Part 1: Composition, specifications and conformity criteria.
UNE-EN 14647:2006	Calcium aluminate cement. Composition, specifications and conformity criteria.

AI.5.2. Conformity evaluation standards

UNE-EN 197-2:2014 Cement. Part 2: Conformity evaluation.

AI.5.3. Standards on sampling and test methods

UNE 80117:2012 Methods of testing cement. Physical tests. Colour determination in clinkers and white cements.

UNE 80216:2010 Methods of testing cement. Quantitative determination of constituents.

UNE 80220:2012 Methods of testing cement. Chemical analysis. Determining humidity.

UNE 80304:2006 Cements. Calculations of potential composition of Portland clinker.

UNE 80402:2008 Cements. Supply conditions.

UNE 80402:2008/M1:2011 Cements. Supply conditions.

UNE-EN 196-1:2005 Methods of testing cement. Part 1: Determination of mechanical strength.

UNE-EN 196-2:2014 Methods of testing cement. Part 2: Chemical analysis of cements.

UNE-EN 196-3:2005+A1:2009 Methods of testing cement. Part 3: Determination of setting time and soundness.

UNE-EN 196-5:2011 Methods of testing cement. Part 5: Pozzolanicity test for pozzolanic cement.

UNE-EN 196-6:2010 Methods of testing cement. Part 6: Determination of fineness.

UNE-EN 196-7:2008 Methods of testing cement. Part 7: Methods of taking and preparing samples of cement.

UNE-EN 196-8:2010 Methods of testing cement. Part 8: Heat of hydration. Solution method.

UNE-EN 196-9:2011 Methods of testing cement. Part 9: Heat of hydration. Semi-adiabatic method.

UNE-EN 196-10:2008 Methods of testing cement. Part 10: Determination the water-soluble chromium (VI) content of cement.

UNE-EN 413-2:2006 Masonry cements. Part 2 Test methods

AI.5.4. Other standards

UNE-EN 450-1:2013	Fly ash for concrete. Part 1: Definitions, specifications and conformity criteria.
UNE-EN 451-1:2006	Method of testing fly ash. Part 1: Determination of free calcium oxide content.
UNE-EN 459-1: 2011	Building lime. Part 1: Definitions, specifications and conformity criteria.
UNE-EN 459-2: 2011	Building lime. Part 2: Test methods.
UNE-EN 933-9: 2010+A1:2013	Tests for geometrical properties of aggregates. Part 9: Assessment of fines. Methylene blue test.
UNE-EN 934-2: 2010+A1:2012	Admixtures for concrete, mortar and grout. Part 2: Concrete admixtures. Definitions and requirements, conformity, marking and labelling.
UNE-EN 12878:2007	Pigments for the colouring of building materials based on cement and/or lime. Specifications and methods of test.
UNE-EN 12878:2007 ERRATUM:2008	Pigments for the colouring of building materials based on cement and/or lime. Specifications and methods of test.
UNE EN 13639:2002	Determination of total organic carbon in limestone.
UNE-EN 13639:2002/AC: 2005	Determination of total organic carbon in limestone.
UNE-EN ISO/IEC 17065:2012	Conformity assessment. Requirements for bodies certifying products, processes and services. (ISO/IEC 17065:2012).
UNE-EN ISO/IEC 17021: 2011	Conformity assessment. Requirements for bodies providing audits and certification of management system. (ISO/IEC 17021: 2011).
UNE-EN ISO 9001:2008	Quality management systems. Requirements. (ISO 9001:2008).
UNE-EN ISO 9001:2008/AC:2009	Quality management systems. Requirements. (ISO 9001:2008/Cor 1:2009).
UNE-EN ISO/IEC 17025:2005	General requirements for the competence of testing and calibration laboratories.
UNE-EN ISO/IEC 17025:2005	General requirements for the competence of testing

ERRATUM: 2006

and calibration laboratories.
(ISO/IEC 17025:2005/Cor 1:2006).

UNE-ISO 9277: 2009

Determination of the specific surface area of solids by
gas adsorption. BET method.

ANNEX II

CEMENTS SUBJECT TO ROYAL DECREE 1313/1988

COMPOSITION, DESIGNATION, SPECIFICATIONS AND STANDARDS OF REFERENCE

All.1. Composition, designation and specifications of cements subject to Royal Decree 1313/1988

The cements subject to Royal Decree 1313/1988 are all those with additional characteristics, such as resisting sulfates, sea water or blanching and those with special characteristics, whose characteristics are not defined by any harmonised European standard.

All cements subject to Royal Decree 1313/1988, in turn, have CE markings, except for special purpose cements. Therefore, they must have a designation that is compliant with Royal Decree 1313/1988 and another that is compliant with the CE marking defined in Annex I. For simplification, in certain situations and where there is a lack of space, only the designation compliant with the corresponding UNE Standard may appear. Nonetheless, the box of the CE marking will not be omitted, when applicable.

The composition requirements refer to the sum of all main and minor additional constituents. It is understood that the end cement is the sum of the main and minor additional constituents plus the calcium sulfate necessary and any additives.

All.2. Sulfate resisting cements

Sulfate resisting cements are those defined in Annex I in relation to Standard UNE-EN 197-1 (SR) as well as those with the sulfate resisting additional characteristic defined in Standard UNE-EN 80303-1 (SRC).

All.2.1. Composition and specifications

Sulfate resisting cements are those prepared using a clinker that complies with the conditions described in Table All.2.1. These cements must also comply with the provisions relative to the type and class as given in Section AI.1.

Table AII.2.1. Additional specifications of sulfate resisting cements (SRC)

Main types	Name		Designation	Specifications of sulfate resisting cement clinker (SRC)	
				C ₃ A %	C ₃ A % + C ₄ AF %
II	Portland cements with additives, sulfate resisting	With blastfurnace slag (S)	II/A-S	≤ 6.0	≤ 22.0
II			II/B-S		
II		With silica fume (D)	II/A-D		
II		With natural pozzolana (P)	II/A-P		
II			II/B-P		
II		With fly ash (V)	II/A-V		
II			II/B-V		
III	Cements with additives, sulfate resisting	With blastfurnace slag (S)	III/A	≤ 8.0	≤ 25.0
V		Composite cements (S+P+V)	V/A	≤ 8.0	≤ 25.0

The specifications on C₃A and (C₃A + C₄AF) refer to percentages in mass of clinker. The C₃A and C₄AF content shall be determined by calculation in accordance with Standard UNE 80304, from tests on clinker in accordance with UNE-EN 196-2.

The pozzolanic materials that are part of these cements (siliceous fly ash, natural pozzolana and silica fume, as applicable) comply with the following provisions:

- the ratio between SiO₂/(CaO+MgO), as percentage by mass, shall be greater than 3.5, where CaO is the reactive calcium oxide defined in Standard UNE-EN 197-1.
- siliceous fly ash or Blaine fine-milled natural pozzolana equivalent to that of the reference cement with a tolerance of $\pm 200 \text{ cm}^2/\text{g}$, and mixed in a cement/pozzolanic material proportion of 75/25 by mass shall comply with the Pozzolanicity test after ageing for 7 days, in accordance with Standard UNE-EN 196-5;
- the same mixture of 75/25 by mass shall display a compressive strength after ageing for 28 days greater than or equal to 75 per cent of the reference cement strength at the same age (resistant activity index, RAI), in accordance with test method of Standard UNE-EN 196-1.

The reference cement, both for the pozzolanicity test and strength test, will be any of the sulfate resisting Portland cements indicated below and defined in Standard UNE-EN 197-1: CEM I 42.5 R-SR 0, CEM I 42.5 R-SR 3 and CEM I 42.5 R-SR 5.

AII.2.2. Designation

The designation of sulfate resisting cements is similar to that corresponding to the type of homologous cement of those defined in Annex I, omitting the prefix CEM, followed by strength class, the expression “/SRC” and the reference to Standard UNE 80303-1.

Example 1: II/A-V 42.5 R/SRC - UNE 80303-1

EN 197-1 - CEM II/A-V 42.5 R

corresponds to a Portland cement with fly ash, strength class 42.5, high early strength and sulfate resisting in accordance with Standard UNE 80303-1 (SRC).

Example 2: III/A 32.5 L-LH/SRC - UNE 80303-1

EN 197-1 - CEM III/A 32.5 L-LH

corresponds to a cement with granulated blastfurnace slag, with a content of 36 % to 65 % by mass of granulated blastfurnace slag (S) with strength class 32.5, low early strength, low heat and sulfate resisting, in accordance with Standard UNE 80303-1 (SRC).

All.3. Sea-water resisting cements

Sea-water resisting cements are those with the additional characteristic of resisting sea water, as defined in Standard UNE 80303-2.

All.3.1. Composition and specifications

Sea-water resisting cements are those whose composition uses a clinker that complies with the conditions described in Table All.3.1. These cements must also comply with the provisions relative to the type and class as given in Section AI.1.

The pozzolanic constituents that are part of these cements (siliceous fly ash, natural pozzolana and silica fume, as applicable) comply with the provisions indicated under Section All.2.1.

Table All.3.1. Additional specifications of sea-water resisting cements

Types	Names		Designations	Specifications of sea-water resisting cements (MR)	
				C ₃ A %	C ₃ A % + C ₄ AF %
I	Sea-water resisting Portland cements		I	≤ 5.0	≤ 22.0
II	Portland cements with additives, sea-water resisting	With blastfurnace slag (S)	II/A-S	≤ 8.0	≤ 25.0
II			II/B-S		
II		With silica fume (D)	II/A-D		
II		With natural pozzolana (P)	II/A-P		
II			II/B-P		
II		With fly ash (V)	II/A-V		
II			II/B-V		
III	Cements with additives, sea-water resisting	With blastfurnace slag (S)	III/A	≤10.0	≤ 25.0
III			III/B	None	
III			III/C	None	
IV		Pozzolan cements (D+P+V)	IV/A	≤8.0	≤ 25.0
IV			IV/B	≤ 10.0	≤ 25.0
V		Composite cements (S+P+V)	V/A		
The specifications on C ₃ A and (C ₃ A + C ₄ AF) refer to percentages in mass of clinker. The C ₃ A and C ₄ AF content shall be determined by calculation in accordance with Standard UNE 80304, from tests on clinker in accordance with UNE-EN 196-2					

All.3.2. Designation

Sea-water resisting cements shall be designated in a same way as described in Annex I for the corresponding common cements, omitting the prefix CEM followed by a forward slash (/) and codes (MR) used to identify this additional characteristic and reference to the corresponding UNE Standard.

Example 3: III/B 32.5 R/MR - UNE 80303-2

EN 197-1- CEM III/B 32.5 R

corresponds to a cement with granulated blastfurnace slag, with a content of 66 % to 80 % by mass of granulated blastfurnace slag with strength class 32.5, high early strength and sea-water resisting, in accordance with Standard UNE 80303-2 (MR).

Example 4: IV/B (P, V) 32.5 N-LH/MR - UNE 80303-2

EN 197-1 - CEM IV/B (P, V) 32.5 N-LH

corresponds to a pozzolanic cement with natural pozzolana (P) and siliceous fly ash (V), with strength class 32.5, normal early strength, low heat and sea-water resisting, in accordance with Standard UNE 80303-2 (MR).

All.4. White cements

White cements are those with a whiteness - with reference to the CIELAB coordinates determined using the test method of Standard UNE 80117— L^* of no less than 87, which are defined in Standard UNE 80305 and which comply with Standard UNE-EN 197-1 (see Section AI.1), UNE-EN 14216 (see Section AI.2) or Standard UNE-EN 413-1 (see Section AI.4).

White Portland cement clinker is the essential constituent present in all white cements and is defined in Annex III of this Instruction.

All.4.1. Classification, composition, designation and specifications of white common cements

All.4.1.1. Classification and composition

The types, sub-types, denominations and composition correspond to those reported for common cements in Section AI.1.1 of this Instruction.

All.4.1.2. Designation

White common cements are designated in a similar fashion to that specific in Section AI.1 for the corresponding common cements, replacing the prefix CEM with the prefix BL. If the cement has an additional characteristic (sulfate resisting or sea-water resisting), this will indicated as specified in Sections All.2.2 and All.3.2, as applicable.

Lastly, reference will be made to Standard UNE 80305 and the standard corresponding to the additional characteristic, as appropriate.

Example 5: BL I 42.5 R UNE 80305

EN 197-1- CEM I 42.5 R

corresponding to a Portland cement (type I), white, strength class 42.5 and high initial strength.

Example 6: BL II/A-L 32.5 N-LH/MR UNE 80305 UNE 80303-2

EN 197-1 - CEM II/A-L 32.5 N-LH

corresponds to a white cement with the addition of between 6 and 21 % lime with a TOC of less than 0.5 % (L), with strength class 32.5, ordinary early strength, low heat and sea-water resisting.

All.4.1.3. Mechanical, physical, chemical and durability specifications

The mechanical, physical, chemical and durability specifications of white common cements are those indicated in Sections AI.1.3, AI.1.4 and AI.1.5 of this Instruction.

They must also comply with the whiteness requirement specified in Section All.4.

All.4.2. Classification, composition, designation and specifications of white masonry cements

All.4.2.1. Classification and composition

White masonry cement will have strength class 22.5 X and its constituents will comply with that indicated in Section AI.4.1 of this Instruction.

The proportions by mass of the constituents of white masonry cements are as stated in Table All.4.2.1.

Table All.4.2.1. Composition of white masonry cement

Type and strength class	Content (% by mass)	
	White Portland clinker	Additives ¹⁾
BL 22.5 X	≥ 40	≤ 1 ^{1) 2)}
¹⁾ Excluding pigments.		
²⁾ The organic content shall not exceed 0.5 % expressed as dry product mass.		

All.4.2.2. Designation

White masonry cements shall be designated in a similar fashion to that indicated under Section AI.4, replacing the prefix MC with the prefix BL and adding the reference to Standard UNE 80305 at the end.

Example 7: BL 22.5 X UNE 80305

EN 413-1- MC 22.5 X

All.4.2.3. Mechanical, physical, chemical and durability specifications

The mechanical, physical, chemical and durability specifications of white masonry cement shall be those specified for it in Sections AI.4.3, AI.4.4 and AI.4.5 of this Instruction; it must also comply with the whiteness requirement specified in Section AI.4.

The requirement established in Table AI.4.2.3 in relation to fresh mortar, will also apply. The properties of fresh mortar shall be determined on a paste with normal consistency obtained for a penetration value of 35 ± 3 mm, determined by applying the reference method defined in Standard UNE EN 413-2.

Table AI.4.2.3. Requirements for fresh mortar

Type and strength class	Water retention (UNE-EN 413-2) (%, by mass)
BL 22.5 X	≥ 75

AI.5. Special purpose cement

Special purpose cement is as defined in Standard UNE 80307.

AI.5.1. Classification and composition

The proportions by mass of the constituents of white special purpose cement are as specified in Table AI.5.1. The constituents of this cement must comply with the requirements for it as established in Annex III.

Table AI.5.1. Special purpose cement: composition and proportion by mass^{1) 4)}

Type	Name	Designation	Clinker (K)	Blastfurnac e slag (S)	Natural pozzolana ²⁾ (P)	Siliceous fly ash (V)	Minor additional constituents ³⁾
ESP-VI	Special purpose cement	ESP VI-1	25-55	45-75			0-5
<div><div>1)</div><div>The table values refer to % by mass with respect to the cement core, thereby meaning the clinker and additions, with the exclusion of calcium sulfate (setting regulator) and additives.</div></div> <div><div>2)</div><div>The natural pozzolana content shall not exceed 40 %.</div></div> <div><div>3)</div><div>Minor additional constituents may be lime or one or more of the main constituents, unless they are included as such in the cement.</div></div> <div><div>4)</div><div>The composition requirements refer to the sum of all main and minor additional constituents. It is understood that the final cement is the sum of the main and minor additional constituents plus the calcium sulfate necessary and any additives.</div></div>							

AI.5.2. Designation

In the case of special purpose cement, the designation corresponding to the type shall be indicated (ESP VI-1), followed by that relating to the strength class (22.5N – 32.5N – 42.5N) and the reference to Standard UNE 80307.

Example 8: ESP VI-1 32.5 N - UNE 80307

corresponds to a special purpose cement, with strength class 32.5 and normal initial strength.

All.5.3. Mechanical and physical specifications

The specifications relating to the mechanical and physical characteristics that must be met by special purpose cements are given in Table All.5.3.

Table All.5.3. Mechanical and physical specifications of special purpose cements

Strength class	Compressive strength UNE-EN 196-1 (N/mm ²)		Initial setting time UNE-EN 196-3 (min)	Soundness UNE-EN 196-3 (expansion) (mm)
	28 days	90 days		
22.5 N	≥ 12.5	≤ 32.5	≥ 60	≤ 10
32.5 N	≥ 22.5	≤ 42.5		
42.5 N	≥ 32.5	≤ 52.5		

All.5.4. Chemical specifications

The specifications relating to the chemical characteristics that must be met by special purpose cements are given in Table All.5.4.

Table All.5.4. Chemical specifications of special purpose cements

Type and designation	Specifications	
	Sulfate content (as SO ₃) UNE-EN 196-2	Chloride ion content UNE-EN 196-2
ESP VI-1	≤3.5 %	≤0.10 %

All.6. Reference standards for cements subject to Royal Decree 1313/1988

All.6.1. Product standards

UNE 80303-1:2013	Cements with additional characteristics. Part 1: Sulfate resisting cements.
UNE 80303-2:2011	Cements with additional characteristics. Part 2: Sea-water resisting cements.
UNE 80305:2012	White cements.
UNE 80307:2001	Special purpose cements.

All.6.2. Conformity evaluation standards

UNE-EN 197-2:2014	Cement. Part 2: Conformity evaluation
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All.6.3. Standards on sampling and test methods

UNE 80117:2012	Methods of testing cement. Physical tests. Colour determination in clinkers and white cements.
UNE 80216:2010	Methods of testing cement. Quantitative determination of constituents.

UNE 80220:2012	Methods of testing cement. Chemical analysis. Determining humidity.
UNE 80304:2006	Cements. Calculations of potential composition of Portland clinker.
UNE 80402:2008	Cements. Supply conditions.
UNE 80402:2008/M1:2011	Cements. Supply conditions.
UNE-EN 196-1:2005	Methods of testing cement. Part 1: Determination of mechanical strength.
UNE-EN 196-2:2014	Methods of testing cement. Part 2: Chemical analysis of cements.
UNE-EN 196-3:2005+A1:2009	Methods of testing cement. Part 3: Determination of setting time and soundness.
UNE-EN 196-5:2011	Methods of testing cement. Part 5: Pozzolanicity test for pozzolanic cement.
UNE-EN 196-6:2010	Methods of testing cement. Part 6: Determination of fineness.
UNE-EN 196-7:2008	Methods of testing cement. Part 7: Methods of taking and preparing samples of cement.
UNE-EN 196-8:2010	Methods of testing cement. Part 8: Heat of hydration. Solution method.
UNE-EN 196-9:2011	Methods of testing cement. Part 9: Heat of hydration. Semi-adiabatic method.
UNE-EN 196-10:2008	Methods of testing cement. Part 10: Determination of the water-soluble chromium (VI) content of cements.
UNE-EN 413-2:2006	Masonry cements. Part 2 Test methods

All.6.4. Other standards

UNE-EN 450-1:2013	Fly ash for concrete. Part 1: Definitions, specifications and conformity criteria.
UNE-EN 451-1:2006	Method of testing fly ash. Part 1: Determination of free calcium oxide content.
UNE-EN 459-1: 2011	Building lime. Part 1: Definitions, specifications and conformity criteria.

UNE-EN 459-2: 2011	Building lime. Part 2: Test methods.
UNE-EN 933-9: 2010+A1:2013	Tests for geometrical properties of aggregates. Part 9: Assessment of fines. Methylene blue test.
UNE-EN 934-2: 2010+A1:2012	Admixtures for concrete, mortar and grout. Part 2: Concrete admixtures. Definitions and requirements, conformity, marking and labelling.
UNE-EN 12878:2007	Pigments for the colouring of building materials based on cement and/or lime. Specifications and methods of test.
UNE-EN 12878:2007 ERRATUM:2008	Pigments for the colouring of building materials based on cement and/or lime. Specifications and methods of test.
UNE EN 13639:2002	Determination of total organic carbon in limestone.
UNE-EN 13639:2002/AC: 2005	Determination of total organic carbon in limestone.
UNE-EN ISO/IEC 17065:2012	Conformity assessment. Requirements for bodies certifying products, processes and services. (ISO/IEC 17065:2012).
UNE-EN ISO/IEC 17021: 2011	Conformity assessment. Requirements for bodies providing audits and certification of management system. (ISO/IEC 17021: 2011).
UNE-EN ISO 9001:2008	Quality management systems. Requirements. (ISO 9001:2008).
UNE-EN ISO 9001:2008/AC:2009	Quality management systems. Requirements. (ISO 9001:2008/Cor 1:2009).
UNE-EN ISO/IEC 17025:2005	General requirements for the competence of testing and calibration laboratories.
UNE-EN ISO/IEC 17025:2005	ERRATUM: 2006 General requirements for the competence of testing and calibration laboratories. (ISO/IEC 17025:2005/Cor 1:2006).
UNE-ISO 9277: 2009	Determination of the specific surface area of solids by gas adsorption. BET method.

ANNEX III

CEMENT CONSTITUENTS

AIII.1. General

The specified component requirements shall be determined in accordance with the test methods described in UNE EN 196 series standards.

AIII.2. Main constituents

AIII.2.1. Cement clinker

AIII.2.1.1. Portland cement clinker (K)

Portland cement clinker is obtained by sintering a homogeneous mixture of raw materials (raw, meal, paste or slurry), CaO, SiO₂, Al₂O₃, Fe₂O₃ and small quantities of other materials.

Portland cement clinker is a hydraulic material that must consist of at least two-thirds by mass of calcium silicates [3CaO.SiO₂] and [2CaO.SiO₂], with the remainder made up of clinker containing aluminium, iron and other compounds. The ratio by mass (CaO)/(SiO₂) shall be no less than 2.0 and the magnesium oxide content (MgO) shall not exceed 5.0 % by mass.

The tricalcium aluminate content (C₃A) of the Portland cement clinker used in sulfate resisting common cements types CEM I and CEM IV of Standard UNE-EN 197-1, and types CEM II, CEM III/A and CEM V/A of Standard UNE 80303-1, as well as sea-water resisting cements of Standard UNE 80303-2, must comply with the limits indicated in Tables AI.1.1b., AII.1.1 and AII.3.1, respectively.

It shall be calculated as follows:

$$\text{If } A/F > 0.64 \quad C_3A = 2.65 A - 1.69 F$$

$$\text{If } A/F < 0.64 \quad C_3A = 0$$

where A and F are percentages by mass of Al₂O₃ and Fe₂O₃, respectively of the clinker, determined in accordance with Standard EN 196-2.

Additionally, the tricalcium aluminate and tetracalcium ferritoaluminate content (C₃A + C₄AF) of the Portland cement clinker used in sulfate resisting cements and sea-water resisting cements of Standards UNE 80303-1 and UNE 80303-2, respectively, shall comply with the limits specified for each in the Tables AII.1.1 and AII.3.1.

Tetracalcium ferritoaluminate is calculated as follows:

$$\text{If } A/F > 0.64 \quad C_4AF = 3.04 F$$

$$\text{If } A/F < 0.64 \quad C_4AF = 4.77 A$$

All.2.1.2. Portland cement clinker (K) used in sulfate resisting cements and in sea-water resisting cements

The additional specifications for sulfate resisting and sea-water resisting common cements, insofar as the clinker, limits to tricalcium aluminate content and the sum of its tricalcium aluminate and tetracalcium ferritoaluminate contents, are given in Tables All.1.1 and All.2.1 of this Instruction.

All.2.1.3. White Portland cement clinker (K)

White Portland cement clinker is the essential component present in all white cements. Its requirements are defined in Standard UNE-EN 197-1 and, moreover, must have a whiteness of $L^* \geq 87$, measured in accordance with Standard UNE 80117.

All.2.1.4 Calcium aluminate cement (K) clinker

Calcium aluminate clinker is a hydraulic material that is obtained by the melting or sintering of a homogeneous mixture of aluminous and calcareous materials containing elements normally expressed in the form of oxides. The main elements are oxides of aluminium, calcium and iron (Al_2O_3 , CaO , Fe_2O_3), and small quantities of oxides of other elements (SiO_2 , TiO_2 , S^{2-} , SO_3 , Cl^- , Na_2O , K_2O , etc.). The main mineral component is monovalent calcium aluminate ($\text{CaO} \cdot \text{Al}_2\text{O}_3$).

All.2.2. Granulated blastfurnace slag (S)

Granulated Blastfurnace slag is obtained by rapid cooling of a slag that is smelted and of suitable composition, obtained by smelting iron ore in a blastfurnace. It is normally referred to as granulated slag, to distinguish it from other forms obtained using other cooling systems. At least two thirds of its mass consists of glass slag and it has hydraulic properties when suitably activated.

In granulated blastfurnace slag, the mass ratio $(\text{CaO} + \text{MgO})/(\text{SiO}_2)$ shall exceed 1.0 and the sum of calcium, magnesium and siliceous oxides ($\text{CaO} + \text{MgO} + \text{SiO}_2$) can be no less than two thirds of its mass. The remainder contains aluminium oxide (Al_2O_3) together with small quantities of other compounds.

All.2.3. Pozzolan materials (P, Q)

All.2.3.1. General

Pozzolan materials are natural substances siliceous or silico-aluminous composition or a combination thereof.

Pozzolan materials do not harden in themselves when mixed with water, but when finely ground, in the presence of water they react, at normal ambient temperature, with dissolved calcium hydroxide $[\text{Ca}(\text{OH})_2]$ to form calcium silicate and calcium aluminate compounds able to develop strength. These compounds are similar to those that form when hydraulic materials harden.

Pozzolana consists essentially of reactive silicon dioxide (SiO_2) and aluminium oxide (Al_2O_3). The remainder contains iron oxide (Fe_2O_3) and other oxides. The proportion of reactive calcium oxide is not particularly important to hardening. Reactive silicon dioxide content (SiO_2) shall be no less than 25 % by mass.

Pozzolanic materials shall be correctly prepared, i.e. selected, homogenised, dried or heat treated and comminuted, depending on their state of production or supply.

AIII.2.3.2. Natural pozzolana (P)

Natural pozzolana is usually a material of volcanic origin or from sedimentary rocks with suitable chemical and mineralogical composition.

In order to be able to use it in sulfate resisting cements (SRC) and sea-water resisting cements (MR) - in compliance respectively with Standards UNE 80303-1 and UNE 80303-2 - natural pozzolana must comply with the specifications laid down in sea-water resisting AII.2.1 on its composition, pozzolanicity and index of activity resistant.

AIII.2.3.3. Natural calcined pozzolana (Q)

Natural calcined pozzolana is a material of volcanic origin, from clay, shale or sedimentary rocks, activated by thermal treatment.

AIII.2.4. Fly ash (V, W)

AIII.2.4.1. General

Fly ash is obtained by electrostatic or mechanical precipitation of dust-like particles from the gases from furnaces fired with pulverised coal. The ash obtained by other methods shall not be used in cements. Fly ash may be of a siliceous or calcareous nature. The first have pozzolanicity; the second may also have hydraulic properties. The loss on ignition of fly ash determined as compliant with Standard UNE-EN 196-2, but using a calcination time of one hour, shall be within one of the following limits:

- a) 0 to 5 per cent by mass.
- b) 2 to 7 per cent by mass.
- c) 4 to 9 per cent by mass.

The upper limit of loss on ignition of the fly ash used as main constituent of cement, shall be stated on its container and/or delivery note.

AIII.2.4.2. Siliceous fly ash (V)

Siliceous fly ash is a fine powder of mostly spherical particles with pozzolanicity. It mainly consists of reactive silicon dioxide (SiO_2) and aluminium oxide (Al_2O_3). The remainder contains iron oxide (Fe_2O_3) and other compounds.

Reactive silicon dioxide content (SiO_2) shall be no less than 25 % by mass. The proportion of reactive calcium oxide (CaO) shall be less than 10.0 % by mass and the free calcium oxide (CaO) content, determined using the method described in Standard UNE-EN 451-1, shall not exceed 1.0 % by mass.

Fly ash with a free calcium oxide (CaO) content of less than 2.5 % by mass is also acceptable, as long as the expansion requirement (soundness) does not exceed 10 mm when tested in accordance with Standard UNE-EN 196-3, using a mixture of 30 % by mass of siliceous fly ash and 70 % by mass of a cement type CEM I.

In order to be able to use it in sulfate resisting cements (SRC) and sea-water resisting cements (MR) - in compliance respectively with Standards UNE 80303-1 and UNE 80303-2 - siliceous fly ash must comply with the specifications laid down in sea-water resisting AII.2.1 on its composition, pozzolanicity and index of activity resistant.

AIII.2.4.3. Calcareous fly ash (W)

Calcareous fly ash is a fine powder with hydraulic or pozzolanicity properties. It mainly consists of reactive calcium oxide (CaO), reactive silicon dioxide (SiO_2) and aluminium oxide (Al_2O_3). The remainder contains iron oxide (Fe_2O_3) and other compounds.

The proportion of reactive calcium oxide (CaO) shall be greater than 10 % by mass. If this proportion does not exceed 15 % by mass, it will also be required that the content of reactive silicon dioxide (SiO_2) by mass exceeds 25 %. If not, its compressive strength, determined in compliance with Standard UNE-EN 196-1, shall be at least 10 N/mm² at 28 days.

In order to carry out the compressive strength test, the calcareous fly ash will first be milled to a fineness that, when wet sieved, the proportion withheld by the 40 μm mesh sieve shall be between 10 % and 30 % by mass. The mortar will only be prepared with ground calcareous fly ash. The mortar specimens will be demoulded 48 hours after preparation and then cured in a moist atmosphere of relative humidity of at least 90 %.

The expansion (soundness) of calcareous fly ash shall not exceed 10 mm when tested in compliance with Standard UNE-EN 196-3, using a mixture of 30 % by mass of calcareous fly ash ground as described above and 70 % by mass of CEM I type cement.

Given that sulfate content (SO_3) of this ash may be considerable, care must be taken in ensuring that the proportions used do not exceed the upper limit permitted in cement, if necessary making precise adjustments to constituents containing calcium sulfate (CaSO_4).

AIII.2.5. Burnt shale (T)

Burnt shale, specifically burnt oil shale, is produced in a special kiln at temperatures of approximately 800°C. Owing to the composition of the natural material and the production process, burnt shale contains clinker phases, mainly dicalcium silicate (2CaO SiO_2) and monocalcium aluminate ($\text{CaO Al}_2\text{O}_3$). It also contains larger proportions of pozzolanically reacting

oxides, especially silicon dioxide (SiO_2), as well as small amounts of free calcium oxide (CaO) and calcium sulfate (CaSO_4). Consequently, in a finely ground state, burnt shale has hydraulic properties, like Portland cement and in addition pozzolanic properties.

Burnt shale must have a compressive strength of at least 25 N/mm^2 at 28 days, when tested in compliance with Standard UNE-EN 196-1. The mortar used for compressive strength testing shall be prepared only with finely ground burnt shale. The mortar specimens must be demoulded 48 hours after preparation and cured in a moist atmosphere of relative humidity of at least 90 % until tested.

The expansion (soundness) of burnt shale shall not exceed 10 mm when tested in accordance with UNE EN 196-3, using a mixture of 30 % by mass of ground burnt shale and 70 % by mass of a CEM I cement.

If the sulfate content (SO_3) of the burnt shale exceeds the permissible upper limit for the sulfate content of the cement, it must be considered by the cement manufacturer, who shall accordingly reduce the constituents containing calcium sulfate (CaSO_4).

AIII.2.6. Limestone (L, LL)

Limestone complies with the following requirements:

a) The content of calcium carbonate (CaCO_3), calculated from the calcium oxide (CaO) content shall be at least 75 % by mass.

b) The clay content, determined using the methylene blue test in accordance with Standard UNE-EN 933-9, shall be greater than 1.20 g/100 g. For this test, the limestone shall be ground to a fineness of approximately $5\,000 \text{ cm}^2/\text{g}$, determined as specific surface in accordance with UNE-EN 196-6.

c) The total organic carbon content (TOC), determined in accordance with the Standard UNE-EN 13639, shall comply with one of the following criteria:

For sub-types LL: it shall not exceed 0.20 % by mass.

For sub-types L: it shall not exceed 0.50 % by mass.

AIII.2.7. Silica fume (D)

Silica fume originates from the reduction of high purity quartz with coal in electric arc furnaces, to produce silicon and ferrosilicon alloys; it consists of very fine spherical particles containing at least 85 % by mass of amorphous silicon dioxide (SiO_2).

The silica fume will comply with the following requirements:

a) The loss on ignition determined as compliant with Standard UNE-EN 196-2, but using a calcination time of one hour, shall not exceed 4 % by mass;

b) The specific surface (BET) of the untreated silica fume, determined in compliance with Standard ISO 9277, shall be at least 15 m²/g.

In order to be able to use it in sulfate resisting cements (SRC) and sea-water resisting cements (MR) - in compliance respectively with Standards UNE 80303-1 and UNE 80303-2 - silica fume must comply with the specifications laid down in sea-water resisting All.2.1 on its composition, pozzolanicity and index of activity resistant.

AIII.3. Minor additional constituents

Minor additional constituents are natural mineral materials or derived from the clinker production process. Minor additional constituents may also be those specified in Section AIII.2, unless they are included as main constituents in the cement. They will be correctly selected, homogenised, dried and comminuted, depending on their state of production or supply.

Minor additional constituents will not significantly increase the cement's demand for water, will not reduce the strength of the cement or mortar under any circumstances, nor reduce the protection of strengthening against corrosion. These constituents tend to improve the physical properties of cement (such as docility or water retention).

The manufacturer will provide information on the minor additional constituents of the cement when the user so requests.

AIII.4. Calcium sulfate

Calcium sulfate (CaSO₄) is added when manufacturing cement to control setting.

Calcium sulfate may be gypsum (calcium sulfate dehydrate CaSO₄.2H₂O), hemihydrate (CaSO₄.½H₂O), or anhydrite (anhydrous calcium sulfate CaSO₄), or any mixture of them. Gypsum and anhydrite are found in naturally. Calcium sulfate is also available as a by-product of certain industrial processes.

AIII.5. Additives

Additives are constituents not covered in the above sections, which are added to improve the manufacture or the properties of the cement.

The total quantity of inorganic admixtures must not exceed 1 % by mass of the cement (except for pigments); whilst the quantity of organic additives must not exceed 0.2 % by mass of the cement, measured on a dry basis.

AIII.5.1. Additives in UNE-EN 197-1 standard cements

When additives for common concrete, mortar or grout complying with EN 934 series standards are used in cement to Standard UNE-EN 197-1, this circumstance must be disclosed by declaring the standard additive designation on bags and/or delivery notes.

All.5.2. Additives in UNE-EN 413-1 standard masonry cements

In masonry cements, inorganic pigments can be incorporated, compliant with Standard UNE-EN 12878, with the exception of carbon black, with the use of organic pigments strictly forbidden.

In the same way, air entraining agents can be used to improve docility and durability, respecting the limits indicated in Section AI.4.3, with the aim of ensuring good adherence.

ANNEX IV.

SUPPLY CONDITIONS RELATING TO RECEPTION

AIV.1. General

The aim of this Annex is to provide the Reception Managers with information in order to allow them to complete the tasks established in Section 8.1 of Article 8 of this Instruction with reference to the checking of the documents accompanying the supply of cement and the labelling, when supplied in containers.

AIV.2. Supply documents and labelling of cements

Supplies, both as bulk and in containers, must have the regulatory documents. The cement supplier must be willing to provide these documents, consisting essentially of the supply delivery note, the label, the declaration of performance or the certificate of manufacturer's warranty, as appropriate.

Documents and labelling may differ depending on whether the cement is subject to CE marking or Royal Decree 1313/1988. Sections AIV.2.1 to AIV.2.3 of this Annex provide information on the contents of the documents and label.

The Reception Manager must record, archive and keep a copy of all these documents.

AIV.2.1. Delivery note

For each consignment dispatched, both of bulk and contained cement, the supplier must issue a supply delivery note for the recipient before it leaves its installations; this must accompany the consignment during transport.

The supply delivery note will include information on the cement identification in terms of quantity and quality, as well as the reference data of the supplier, recipient and transport agents.

The delivery note for transport by road (or in documents attached to it) must at least include the following information:

On the suppliers, recipients and transport agents:

1. Name or business name and address of the supplier.
2. Place of origin and type of installation: (factory, dispatching centre, depot, store).
3. Name and address of the purchaser and cement destination.
4. Where applicable, name and business name and address of the transport operator.
5. Name or business name and address of the transporter.

Identification of the vehicle transporting it. In the case of articulated vehicles, both the registration number of the motor vehicle driving it and those of the semi-trailers or trailers coupled and pulled by it, must be indicated.

On the cement supplied:

6. Order reference number, where applicable.
7. Quantity supplied (in kg).
8. Date of supply.
9. Full normalised name of the cement (including reference standard), as indicated in Annexes 1 and 2.
10. Information on CE marking (where applicable).
 - 10.1. Number of cement performance declaration (see AIV.2.2).
11. Information on the certificate of conformity with regulatory requirements (where applicable):
 - 11.1. DCE certification mark (see AIV.2.4).
12. Information of the officially recognised marking (where applicable):
 - 12.1. Number of the officially recognised marking.
 - 12.2. Certificate number.
13. Recommendations for storage, conservation, use and restrictions to use, if applicable.
14. Reference to compliance with the maximum limit of soluble (VI) chrome in accordance with the provisions of Ministerial Order PRE/1954/2004 of 24 June that transposes Directive 2003/53/EC. Where applicable, reference will be included to the period for which the reducing agent is effective.
15. Health and safety warnings for handling the cement:
 - 15.1. Identification of dangers in accordance with Regulation (EC) No 1272/2008 (CLP).
 - 15.2. Relevant safety instructions.
 - 15.3. Safety advice.

Reference to the safety date provided to the customer will be considered valid for compliance in the delivery note or annexed document.
16. Responsibilities on correct environmental management of the container, according to the law on containers.

If cement is contained, the information of points 11, 12, 13 14 and 16 above may not always be included in the delivery note if it is given on the container.

For each delivery note, copies will be issued at least for the supplier, recipient and carrier.

AIV.2.2. Performance declaration

For cements subject to CE marking

Document to be prepared and issued by the cement manufacturer whereby it takes liability for the conformity of the cement with the declared performance under the scope of Regulation (EU) No 305/2011 and the Delegated Regulation 574/2014.

This performance declaration may be sent to the cement recipient by electronic means, providing it through the manufacturer's website, or as a hard copy, if so required.

The performance declaration must be prepared in Spanish.

The declaration must include the following data:

1. The performance declaration number (manufacturer coding).
2. Name and/or unique identification code of the cement type.
3. Intended use or uses of the cement.
4. Name or registered trademark and full address of the manufacturer.
5. System of assessment and verification of constancy of performance (1+).
6. Name and number of the notified body issuing the certificate of constancy of cement performance:
 - number of the certificate of performance constancy issued by the notified body and date of certificate issue.
7. Overview of performance declared according to the following format:

Essential characteristics*	Compliance of performance*	Harmonised technical specification*

(*) All rows necessary will be included.

- the text: "The performance of the afore-specified cement is compliant with all the declared performance.

This performance declaration is issued in compliance with Regulation (EU) No 305/2011, under the responsibility of the manufacturer specified above."

- signature by and on behalf of the manufacturer (name and office);
- place and date of issue.

AIV.2.3. CE marking

Upon issuing the performance declaration, the manufacturer is required to affix the CE marking of the cement.

Upon affixing the CE marking, the manufacturer is indicating that it takes responsibility for the conformity of the cement, and for compliance with all applicable requirements as established in Regulation (EU) No 305/2011.

The CE marking must be affixed before the cement is placed on the market, in a visible, legible, indelible manner, on the container or on a label attached to it, or on the documents accompanying it (such as a delivery note), in Spanish.

The CE marking will contain the following data:

- the CE logotype;
- the last two digits of the year in which CE marking is affixed;
- name and registered address of the manufacturer;
- name and unique identification code of the cement type;
- reference number for the cement performance declaration;
- reference to the number of the applicable harmonised standard;
- intended use of the cement;
- identification number of the notified body;
- list of essential characteristics and level or class of performance of each;
- if applicable, the manufacturer's web page, where the performance declaration can be consulted;
- if applicable, a pictogram or any other marking will be included to indicate in particular a risk or specific use.

Section AIV.3 gives an example of the CE marking.

AIV.2.4. Certificate of conformity with regulatory requirements

For cements subject to Royal Decree 1313/1988

The certificate of conformity with the regulatory requirements or, if applicable, the certificate of conformity of production (the latter is obtained a year after possession of the first certificate), issued by the Ministry of Industry, Energy and Tourism, by the authorities of Industry of the Autonomous Community in which the cement factory is located or by the accredited certifying bodies for this field, must contain the following data:

- name and address of the manufacturer or its legal representative;
- identification of the cement (normalised designation and applicable standard);
- cement factory of origin;
- date of certification (initial);
- certification marking (consisting of the code "DCE" and 4 figures, separated by a dash "-");
- dates of issue and expiry of the certificate; and

- signature and stamp of the authority granting it.

AIV.2.5. Labelling of cement containers

The labelling system (printing, type, size, position, colours, etc.) may be any of those officially authorised in a European Union Member State or State party to the Agreement on the European Economic Area, with the only specification that the CE marking logotype must be black.

Contained cements must show the following information on the container:

- name or identification mark and full address of the manufacturer and the cement factory and installation in which it was packaged, where different from the factory;
- normalised designation of the cement supplied in compliance with this Instruction and applicable UNE standard;
- the containers must have the weight of the cement content stated in kilograms;
- counter-signature of the certificate of conformity with the regulatory requirements, where applicable;
- date of manufacture and date of packaging, specifying at least the number of the week and year. If the containers are sent out directly from the factory, the date may refer only to the packaging date. The container dating procedure must at least include information on the week and year number;
- specific conditions applicable to the handling and use of the product, and restrictions to use if applicable;
- at least one of its sides must have, in separate boxes, the labelling corresponding to the CE marking as indicated in AIV.2.3 or Royal Decree 1313/1988, as indicated in AIV.2.4, and, if applicable, that corresponding to cements with an officially recognised quality marking;
- in a boxed area, health and safety warnings will be given for handling the cement;
- reference to compliance with the regulatory limit of water-soluble (VI) chrome in accordance with the provisions of Ministerial Order PRE/1954/2004 that transposes Directive 2003/53/EC.

Additionally, containers of masonry cements (UNE-EN 413-1) will also bear the following phrase: "These cements can be used for masonry works."

AIV.3. Supplementary documentation for and labelling of cements with a voluntary quality mark

Voluntary quality markings, including those recognised in accordance with Section 3.2, which may appear in the documents and labels considered under this Section AIV.2, must comply with the following conditions:

- the additional information supplied must be clearly separated from that relating to the CE marking or certificate of conformity with the regulatory requirements;
- the logotype identifying the marking shall not create any confusion with the CE marking and shall not reduce the legibility or visibility of this.

ANNEX V

RECEPTION BY MEANS OF TESTING

AV.1. Organisation of reception by means of testing

The aim of this Annex is to develop Section 8.3 of this Instruction, bringing criteria to the cement Reception Managers, to determine the relevant conformity by means of tests, when the reception organisation so requires.

When the Reception Manager believes it necessary to carry out tests, they will be carried out keeping perfectly to that established in this Instruction.

In cases where the Reception Manager believes it necessary, in addition to the preceptive phases of checking the documents, labels and performing a visual inspection, this Annex lays down criteria by which to carry out a third, optional phase consisting of type testing, sub-type testing (in cements CEM II, CEM IV and CEM V, reference to the main constituents) and testing the cement strength class and complementary tests for the other chemical and physical characteristics.

In any case, the supplier may demand, if considered appropriate, that counter-tests be carried out.

AV.2. Control by means of tests

AV.2.1. General

In general, verifying conformity of the specifications by performing tests may be carried out according to the provisions in the following paragraphs:

- a) in two stages, so as to ensure that the complementary tests are only carried out when satisfactory results of the identification tests make it appropriate; or
- b) in one single stage, performing the identification and supplementary tests at the same time.

AV.2.1.1. Identification tests

Identification tests are those that enable the verification of the type, sub-type and strength class of the cement being received and other additives recognised in Section AVI.1.

The test methods shall be established in the corresponding standards cited in the tables in Annexes 1 and 2.

AV.2.1.2. Complementary tests

Complementary tests are those that enable the determination of the other characteristics of the cement being received and other additives recognised in Section AVI.2.

Characteristics shall be determined in accordance with the corresponding standards cited for each property and type of cement in the tables in Annexes 1 and 2.

AV.2.2. Conformity criteria

The conformity criteria demanded in order to accept the batch will be as specified in Section AV.5.

If identification tests have been performed and, if applicable, complementary tests and they do not show compliance with these criteria, the batch will be considered as non-compliant, without prejudice to the provisions of the project and action must be taken in accordance with that established in the reception organisation, including possible definitive rejection.

AV.2.3. Action in the event of non-conformity

If deciding to definitively reject, the provisions given under Section 8.3.2, shall apply.

AV.3. Sampling

AV.3.1. General

Where necessary, samples can be taken for preference in the same place and at the same time as reception, under the instructions of the Reception Manager or of persons who have been formally delegated in writing to this end and in their presence and the presence of the supplier's representative. If any of these should be absent, the fact will be noted in the relevant deed.

Sampling will be taken from each batch prepared, in accordance with the criteria laid down in Section 7.2, with the Reception Manager preparing a deed, to be signed by the parties' representatives present and which must at least contain the following information:

- a) sampling deed reference number;
- b) sample identification code and number (which enables its traceability with respect to batch and consignment);
- c) identification of the place (work, plant or factory) where reception takes place;
- d) indication of the type of sample and reason for sampling (control tests, counter-tests, etc.);
- e) full designation of the cement, in compliance with that indicated in Annexes 1, 2 and the commercial make;
- f) observations regarding:
 - the absence of any of the parties at sampling;
 - other aspects considered to be of interest (e.g. conditions in which samples are taken, defects noted in the visual inspection, number of identical samples making up the material taken for each batch place of cement destination, etc.).
- g) name and representation of the party requesting the sampling;
- h) name and representation of the parties present at sampling;
- i) name and representation of the party responsible for sampling;

j) place, date and time of sampling; and

k) signatures of the party responsible for sampling and the representatives of the parties present.

Samples will be stored in sealed containers to be identified both inside and out with a label that must specify: the sampling deed reference number, the sample identification code, the place identification (work, plant and factory) where reception takes place and the type of sampling.

When being sent to the laboratory, the sample must be accompanied by a copy of this deed.

The batch of cement subject to conditional acceptance must be stored at the work, plant or factory in the way specified in Article 10, it being assured that it can be perfectly identifiable from the other cements stored there and with clear indication that it cannot be used.

AV.3.2. Sample types and number

Three different types of identical samples for a single batch are distinguished: control, preventive and contrast.

Control samples, taken at the request of the Reception Manager, are those taken for sending to a test laboratory he has chosen to ensure that all the necessary tests are run.

Preventive samples, also taken at the request of the Reception Manager, are those intended to stay in the work, plant or factory of prefabricated items with the aim of covering possible incidents as may occur with the control sample or where the need should arise to run tests as a consequence of anomalies detected in the behaviour of the concrete or prefabricated item, once installed in situ.

Contrast samples, taken at the request of the supplier, are those intended to be delivered to it for its storage and, if applicable, for sending to a laboratory, chosen by it, for the carrying out of counter-tests.

As regards the type and number of samples of a single batch, the control plan or, for lack thereof, the Reception Manager, shall establish the criteria to be observed. If no indication is given, we recommend considering the following minimum criteria:

- a) to store in the work, plant or factory: one preventive sample of each of the batches;
- b) for the composition control tests: at least one control sample from each of the batches which are going to be tested;
- c) for the physical, mechanical and chemical tests: at least one control sample from each of the batches which are going to be tested.

The supplier may ask for contrast samples to be taken with the same criteria as that specified in the paragraph above.

AV.3.3. Operations

Where applicable, samples will be taken in accordance with that established below.

For packaged cements, each batch will be divided into three equal parts. From each of these parts, a random container will be taken. From each of the container, using a suitable, clean medium, appropriate quantities will be taken to form a total of a minimum of 32 kg or 40 kg if the supplier requests a contrast sample.

In the case of bulk-supplied cements, 32 kg shall be taken from each batch (or 40 kg if the manufacturer requests a sample) from three samples taken during unloading. These samples shall be taken during unloading, at appreciably equal intervals, once the permanent regime for this has been established.

In all cases (contained or bulk cement), the material of the three samples together will be homogenised in accordance with Standard UNE-EN 196-7. The material will be divided after quartering the quantity to be distributed, by using a sample divider or, for lack thereof, by taking extractions of approximately 0.5 kg of each of the quarters, which are subsequently then put into the containers prepared to hold the samples. This must continue until the desired weight is obtained for each container (no less than 5 kg and no more than 8 kg).

AV.3.4. Sample packaging

Each of the individual samples will be put into a container manufactured with inert material with respect to the cement, and which is not subject to corrosion. It shall have a double lid, one that is a pressure fit and the other that screws in. These containers must be airtight and damp-proof.

The containers will be sealed once closed to guarantee that samples remain intact. This seal will bear the seals or identifications of the parties.

In any case, both inside and outside of all containers, a label will be positioned containing the information declared under Section AV.3.1. The container will also include a copy of the sampling deed, for preference in the space between the pressure-fit lid and the screw-fit top.

AV.3.5. Sample storage

The control sample must be sent to the laboratory as quickly as possible once all packaging-related operations are complete.

The preventive samples and, if applicable, contrast samples, will be kept on site, in the plant or factory, as applicable, for at least one hundred days, with it being specified that they cannot be used before this date for testing. The Reception Manager will ensure that the samples stay in a

closed place where they are protected from damp and excess temperatures (preferably no higher than 30 °C).

The container must not be able to be damaged and the seal shall not be broken during handling. If this anomaly should occur, the sample will lose its representational role and must be eliminated.

AV.4. Testing

The project author or Reception Manager shall decide which tests are to be carried out.

AV.4.1. Testing laboratories

The laboratory chosen for testing must be accredited for cement tests in compliance with the criteria of Royal Decree 2200/1995 of 28 December.

AV.4.2. Sample preparation in the laboratory

Once the sample has been received in the laboratory, it will be checked that the seals are unaltered and that it has been stored in the conditions defined in AV.3.5 in the same container into which they were taken, from when they were prepared for testing.

When the time comes to perform tests, the seals shall be broken and the containers opened in a suitably equipped place, according to the provisions in Standard UNE EN 196-1.

A portion of the sample will be taken for testing and the remainder conserved in the same closed container, which will be re-sealed. This container will keep all the original identification labels in addition to other new ones, if they have deteriorated. They will be kept in these conditions for at least two months after the results have been reported.

AV.4.3. Laboratory results

The test results must be provided as requested by the Reception Manager and accompanied by the measurement uncertainty so as to determine the confidence level, along with the information on the dates both on which the sample entered the laboratory and when the tests were carried out.

AV.5. Conformity of the supply at reception

In order to accept a consignment or batch submitted for testing at reception, they must meet the conditions defined under AV.5.1.1 and A.5.5.1.2 for CE marked cements and AV.5.2.1 and AV.5.2.2 for other cements.

As a rule, the control is carried out by variables for strength and attributes for the remainder of the characteristics.

AV.5.1. Conformity criteria of cements subject to CE marking

In the case of cements which are subject to CE marking, controls shall be performed using at least one control sample for each set of tests, applying the criteria for conformity defined in paragraphs AV.5.1.3 for the single results, and in AV.5.1.1 and AV.5.2.2 for the cases of control by variables and control by attributes, respectively.

AV.5.1.1. Inspection by variables

For control by variables of a batch of a common cement subject to CE marking, conformity shall be verified when conditions (1) and (2) are met simultaneously:

$$x_1 - k_2 \cdot \sigma \geq L \quad (1)$$

$$x_n + k_2 \cdot \sigma \leq U \quad (2)$$

where:

x_n is the greatest value of the results obtained with a sample size of n ;

x_1 is the lowest value of the results obtained with a sample size of n ;

σ is 3.6, or, if the supplier made it available to the person responsible, the standard deviation value for the origin population (*);

k_2 a constant defined in Table AV.5.1.1;

L the specified lower limit to be equalled or exceeded by some cement characteristics;

U the specified upper limit that cannot be exceeded by any cement characteristics;

P_K the limit quality for each cement characteristic, expressed as the maximum percentage of defects admissible;

The values of k_2 are given in Table AV.5.1.1

Table AV.5.1.1

Number of control samples (n)	k_2	
	For $P_K = 5 \%$	For $P_K = 10 \%$
	Early and standard strength lower limit. Air content of masonry cements	Other properties
1	1.26	0.90
2	0.78	0.42
3	0.54	0.17
5	0.26	- 0.11
7	0.09	- 0.28

(*) Standard deviation can be supplied by the manufacturer as the result of production control tests, certified by a laboratory of those considered under AV.4.1, with reference to tests carried out at most three months previous.

AV.5.1.2. Inspection by attributes

For control by attributes, the number of non-conforming results from the sample (c_D) shall be compared with the number of acceptable results for the value of subnominals from the origin batch (c_2) established in Table AV.5.1.2.

Table AV.5.1.2

Number of control samples (n) $P_k = 10 \%$	c_2	Number of control samples (n) $P_k = 5 \%$
1	0	1
2	0	2
3	0	3
4	0	4
5	1	5
6	1	6
7	1	7

The batch is compliant when the following condition is met:

$$c_D \leq c_2$$

AV.5.1.3. Single result conformity criteria

In addition to the statistical conformity criteria, compliance of the results with the requirements of this Instruction demands that each test result be checked to ensure that it remains within the limit values specified in the tables of this section.

Table AV.5.1.3a. Common cements, including those of low heat (Section AI.1 of Annex I). Limit values for single results

Property		Limit values for single results									
		Strength class									
		32.5 L	32.5 N	32.5 R	42.5 L	42.5 N	42.5 R	52.5 L	52.5 N	52.5 R	
Early strength (Mpa), lower limit value	2 days	-	-	8.0	-	8.0	18.0	8.0	18.0	28.0	
	7 days	10.0	14.0	-	14.0	-	-	-	-	-	
Standard strength (Mpa), lower limit value	28 days	30.0			40.0			50.0			
Initial setting time (min), lower limit value		60			50			40			
Soundness (expansion) (mm), upper limit value		10									
Sulfate content (as % SO ₃), upper limit value	CEM I CEM II ^a CEM IV CEM V	-	4.0	-	4.0	4.5	-	4.5			
	CEM I-SR 0 CEM I-SR 3 CEM I-SR 5 ^b CEM IV/A-SR CEM IV/B-SR	-	3.5	-	3.5	4.0	-	4.0			
	CEM III/A CEM III/B	4.5									
	CEM III/C	5.0									
	C ₃ A (%), upper limit value	CEM I-SR 0	1								
		CEM I-SR 3	4								
CEM I-SR 5		6									
CEM IV/A-SR		10									
CEM IV/B-SR		10									
Chloride content (%) ^c , upper limit value		0.10 ^d									
Pozzolanicity		-	Positive after 15 days	-	Positive after 15 days	-	Positive after 15 days				
Heat of hydration (J/g), upper limit value	LH	300									

^a CEM II/B-T and CEM II/B-M cement types with a T content > 20%, may contain up to 5.0 % of sulfate (as SO3) for all strength classes.

^b The CEM I–SR 5 used in specific applications can be produced with a greater sulfate content (see Table 5). In this case, the upper limit value is 0.5 % above the declared value.

^c CEM III cement may contain more than 0.10 % chlorides, but in this case the maximum chloride content shall be declared.

^d For pre-stressed applications, cements can be manufactured in accordance with a lower requirement. If this is the case, the value of 0.10 % should be replaced by said lesser value, as should be indicated in the delivery note.

Table AV.5.1.3b. Very low heat special cements (Section AI.2 of Annex I). Limit values for single results

Property		Limit values for single results
Standard strength (Mpa) Lower limit value after 28 days		20.0
Initial setting time (min) Lower limit value		60
Soundness (expansion) (mm) Upper limit value		10
Sulfate content (as % SO ₃), upper limit value	VLH IV, VLH V	4.0
	VLH III/B	4.5
	VLH III/C	5.0
Chloride content (%) ^a		0.10
Heat of hydration (J/g), Upper limit value		250
Pozzolanicity		That the test complies after 15 days

^a VLH III cement may contain more than 0.10 % chlorides, but in this case, the maximum content shall be declared.

Table AV.5.1.3c. Calcium aluminate cements (Section AI.3 of Annex I). Limit values for single results

Property		Limit values applicable to single results
Strength (MPa)	6 hours	15.0
Lower limit value	24 hours	38.0
Initial setting time (min)	Lower limit value	75
Alumina content (%) ^a	Lower limit value	33
	Upper limit value	60
Sulfur content (%) ^a	Lower limit value	0.15
Chloride content (%) ^a	Upper limit value	0.10
Alkali content (%) ^{ab}	Upper limit value	0.5
Sulfate content (%) ^a	Upper limit value	0.6

^a Expressed in terms of final cement mass.

^b Expressed as equivalent Na₂O (Na₂O + 0.658 K₂O).

Table AV.5.1.3d. Masonry cements (Section AI.4 of Annex I). Limit values for single results

Property	Limit values for an single result			
	MC5	MC12.5	MC 12.5 X	MC 22.5 X
Strength (MPa)				
Lower limit value after 7 days	-	6	6	9
Lower limit value after 28 days	4	10.5	10.6	20.5
Strength (MPa)				
Upper limit value 28 days	17.5	37.5	37.5	47.5
Initial setting time (min)				
Lower limit value	45			
Final setting time (hrs)				
Upper limit value	17 ^a			
Soundness (expansion in mm)				
Upper limit value	10			
Sulfate content (as % SO ₃)				
Upper limit value	2.5	3.5 ^b	3.5 ^b	3.5 ^b
Chloride content (%)				
Upper limit value	-	0.10	0.10	0.10
Water retention (%)				
Lower limit value	75		70	
Air content (%)				
Lower limit value	6	6	-	-
Upper limit value	25	25	-	-

^a Where applicable (see Section 5.3.3)

^b 4.0% if it can be shown that the content in Portland cement clinker is no less than 50 %

AV.5.2. Conformity criteria for cements subject to Royal Decree 1313/1988

In the case of cements that are not subject to CE marking, reception inspections shall be performed on at least one control sample for each set of tests, applying the criteria for conformity defined in paragraphs AV.5.2.1 for single results and in AV.5.2.2 and AV.5.2.3 for control by variables and control by attributes, respectively.

AV.5.2.1. Inspection by variables

For inspection by variables on a batch of cement that is subject to Royal Decree 1313/1988, conformity shall be verified when conditions (1) and (2) are met simultaneously:

$$x_l - k_1 \cdot \sigma \geq L \quad (3)$$

$$x_n + k_1 \cdot \sigma \leq U \quad (4)$$

where:

x_n is the greatest value of the results obtained with a sample size of n ;

x_l is the lowest value of the results obtained with a sample size of n ;

σ is 3.6, or, if the supplier made it available to the person responsible, the standard deviation value for the origin population (*);

k_1 a constant defined in Table AV.5.2.1;

L the lower limit specified to be equalled or exceeded by some cement characteristics, defined in Annex III for each property and type of cement;

U the upper limit specified that cannot be exceeded by any cement characteristics, defined as applicable in Annex 3 for each property and type of cement;

P_K the limit quality for each cement characteristic, expressed as the maximum percentage of defects admissible.

The constant k_1 takes the following values:

Table AV.5.2.1

Number of samples (n)	k_1	
	For $P_K = 5 \%$	For $P_K = 10 \%$
	Lower limit of early and normal strength. Air content of white masonry cements	Other properties
3	2.11	1.75
5	1.63	1.27
7	1.35	0.99
10	1.09	0.73
20	0.64	0.27
35	0.32	-0.04

(*) Standard deviation can be supplied by the manufacturer as the result of production control tests, certified by a laboratory of those considered under AV.4.1, with reference to tests carried out at most three months previous.

AV.5.2.2. Inspection by attributes

For inspection by attributes, the number of non-conforming results from the sample (c_D) shall be compared with the number of acceptable results for the subnominal value from the original batch (c_1) established in Table AV.5.2.2.

Table AV.5.2.2

Number of samples (<i>n</i>) <i>P_k</i> = 10 %	<i>c</i> ₁	Number of samples (<i>n</i>) <i>P_k</i> = 5 %
≤ 28	0	≤ 58
45	1	93
60	2	123

The batch is compliant when the following condition is met:

$$C_D \leq C_1$$

AV.5.2.3. Single result conformity criteria

In addition to the statistical conformity criteria, compliance of the results with the requirements of this Instruction demands that each test result be checked to ensure that it remains within the limit values specified for the single results in Tables AV.5.1.3:

AV.5.3. Action in the event of non-conformity

If deciding to definitively reject, the provisions given under Section 8.3.2 of this Instruction shall apply.

AV.6. Carrying out of counter-tests

When counter-tests are carried out, the conformity criteria and action in the event of non-conformity shall be as indicated in Section 8.3.2 of this Instruction.

ANNEX VI

TESTS APPLICABLE UPON RECEPTION OF CEMENTS

AVI.1. Identification tests

AVI.1.1. Common cements

COMMON CEMENTS	TESTS
CEM I	<ul style="list-style-type: none"> • Mechanical strengths (at 7 and 28 days for strength classes 32.5 N and at 2 and 28 days for the remainder.) • Determination of loss on ignition • Determination of constituents
CEM II	<ul style="list-style-type: none"> • Mechanical strengths (at 7 and 28 days for strength classes 32.5 N and at 2 and 28 days for the remainder.) • Determination of constituents
CEM III	<ul style="list-style-type: none"> • Mechanical strengths (at 7 and 28 days for strength classes 32.5 N and at 2 and 28 days for the remainder.) • Determination of loss on ignition • Determination of constituents (*)
CEM IV	<ul style="list-style-type: none"> • Mechanical strengths (at 7 and 28 days for strength classes 32.5 N and at 2 and 28 days for the remainder.) • Pozzolanicity test at 8 and/or 15 days • Determination of constituents
CEM V	<ul style="list-style-type: none"> • Mechanical strengths (at 7 and 28 days for strength classes 32.5 N and at 2 and 28 days for the remainder.) • Determination of constituents (*)
LOW HEAT COMMON CEMENTS	TESTS
CEM I to V - LH	<ul style="list-style-type: none"> • Requirements for identification of cements (CEM) with the same designation (I to V) • Heat of hydration

(*) Determination of constituents in the case of CEM III and CEM V cements shall be exclusively qualitative, restricted to verifying that the cement type is not different from that requested.

AVI.1.2. Common cements with additional characteristics

SULFATE RESISTING CEMENTS	TESTS
CEM I to V /SR or /SRC	<ul style="list-style-type: none"> • Requirements for identification of common cements of homonymous type (I to V) • C₃A and C₃A + C₄AF clinker content (*)
SEA-WATER RESISTING CEMENTS	TESTS
I to V/MR	<ul style="list-style-type: none"> • Requirements for identification of common cements of homonymous type (I to V) • C₃A and C₃A + C₄AF clinker content (*)

(*) Documents must be demanded showing that the clinker used complies with the conditions laid down by Section AIII.2.1.2.

AVI.1.3. Other cements

LOW EARLY STRENGTH BLASTFURNACE SLAG CEMENTS	TESTS
CEM III	<ul style="list-style-type: none"> • Mechanical strengths (at 7 and 28 days for strength classes 32.5 and 42.5 and at 2 and 28 days for strength class 52.5) • Determination of loss on ignition • Heat of hydration (*)
VERY LOW HEAT SPECIAL CEMENTS	TESTS
VLH III, VLH IV, VLH V	<ul style="list-style-type: none"> • Mechanical strength at 28 days • Determination of loss on ignition (VLH III only) • Pozzolanicity test at 8 or 15 days (VLH IV only) • Heat of hydration

(*) Only applicable when there is also low or very low heat (LH, VLH)

AVI.1.3. Other cements (continued)

CALCIUM ALUMINATE CEMENTS	TESTS
CAC	<ul style="list-style-type: none"> • Mechanical strengths (at 6 hours and 24 hours) • Determination of alumina
MASONRY CEMENTS	TESTS
MC	<ul style="list-style-type: none"> • Mechanical strengths (at 7 and 28 days) (**)
SPECIAL PURPOSE CEMENTS	TESTS
ESP	<ul style="list-style-type: none"> • Mechanical strengths (at 28 and 90 days) • Determination of constituents
WHITE CEMENTS	TESTS
BL	<ul style="list-style-type: none"> • Requirements for identification of cements (CEM) with the same designation (I to V) • Whiteness

(**) With the exception of MC 5, which will only be tested at 28 days

AVI.2.Complementary tests

AVI.2.1. Common cements

COMMON CEMENTS	APPLICABLE TESTS
CEM I	<ul style="list-style-type: none">• Soundness• Setting times• Insoluble residue• Sulfate content• Chloride content
CEM II	<ul style="list-style-type: none">• Soundness• Setting times• Sulfate content• Chloride content

AVI.2.1. Common cements (continued)

CEM III	<ul style="list-style-type: none">• Soundness• Setting times• Insoluble residue• Sulfate content• Chloride content
CEM IV	<ul style="list-style-type: none">• Soundness• Setting times• Sulfate content• Chloride content
CEM V	<ul style="list-style-type: none">• Soundness• Setting times• Sulfate content• Chloride content
LOW HEAT COMMON CEMENTS	APPLICABLE TESTS
CEM I to V - LH	<ul style="list-style-type: none">• Soundness• Setting times• Insoluble residue (*)• Sulfate content• Chloride content

(*) Only for cement types I and III

AVI.2.2. Common cements with additional characteristics

SULFATE RESISTING CEMENTS	APPLICABLE TESTS
CEM I to V /SR or /SRC	<ul style="list-style-type: none"> • Soundness • Setting times • Insoluble residue (*) • Sulfate content • Chloride content

AVI.2.2. Common cements with additional characteristics (continued)

SEA-WATER RESISTING CEMENTS	APPLICABLE TESTS
I to V/MR	<ul style="list-style-type: none"> • Soundness • Setting times • Insoluble residue (*) • Sulfate content • Chloride content

(*) Only for cement types I and III

AVI.2.3. Other cements

LOW EARLY STRENGTH BLASTFURNACE SLAG CEMENTS	APPLICABLE TESTS
CEM III	<ul style="list-style-type: none"> • Soundness • Setting times • Insoluble residue • Sulfate content • Chloride content
VERY LOW HEAT SPECIAL CEMENTS	APPLICABLE TESTS
VLH III to V	<ul style="list-style-type: none"> • Soundness • Setting times • Sulfate content • Chloride content • Pozzolanicity (VLH IV)

AVI.2.3. Other cements (continued)

CALCIUM ALUMINATE CEMENTS	APPLICABLE TESTS
CAC	<ul style="list-style-type: none"> • Setting times • Determination of sulfates • Determination of chlorides • Determination of alkalis • Determination of aluminium oxide • Determination of sulphurs
MASONRY CEMENTS	APPLICABLE TESTS
MC	<ul style="list-style-type: none"> • There is no need for complementary tests
SPECIAL PURPOSE CEMENTS	APPLICABLE TESTS
ESP	<ul style="list-style-type: none"> • Soundness • Setting times • Determination of sulfates • Determination of chlorides
WHITE CEMENTS	APPLICABLE TESTS
BL	<ul style="list-style-type: none"> • Those tests required as complementary for common cements (CEM) with the same designation (I to V)

ANNEX VII

GUARANTEES ASSOCIATED WITH THE CE MARKING AND CERTIFICATION OF CONFORMITY WITH THE REGULATORY REQUIREMENTS

AVII.1.General

The harmonised standards establish the way by which the performance of construction products is to be expressed in relation to their essential characteristics; therefore, when a cement is under the scope of application of a harmonised standard, all types of information supplied on its performance must be as defined in said standard. In the case of cement, the manufacturer shall issue a performance declaration and affix the CE marking when the product is placed to the market.

That relating to compliance with the provisions of Royal Decree 255/2003 of 28 February and the Order of the Ministry of the Presidency PRE/1954/2004 of 22 June 2004 referring to the limits of water-soluble chrome (VI) in cement, is given in Standard UNE-EN 196-10. As considered in Regulation (EU) No 305/2011 of 9 March 2011 that establishes harmonised conditions for the marketing of construction products, the cement manufacturer will be liable for the product conformity with the declared performance. The manufacturer must be in a position to guarantee the suitability of the cements for their intended use (namely, as products used for hydraulic conglomerating products) and to make them available to those requesting them, with the aim that, in turn, this party can pass on these guarantees to the end-user of the work or product in which they are used, providing the documents that include the information of said guarantees. The Reception Manager will be responsible for verifying, in the way he believes to be most appropriate, that the product he is buying complies with the required specifications.

Regulation (EU) No 305/2011 of 9 March 2011 establishes the obligation for the manufacturer to issue a performance declaration including the performance of all essential characteristics that appear in Annexes ZA to the harmonised standards, once these specifications are available, with the reference having been published in the Official Journal of the European Union (OJEU) by means of the suitable European Commission Communication and a period of coexistence has been passed with current legislation, fixing its own Communication.

Most cements marketed today on the Spanish market have, in recent years, obtained conformity certification with the regulatory requirements of the CE marking (see Annex I).

The cement manufacturer wishing to affix the CE marking on its products will be responsible for compliance with Annex ZA of Standard UNE-EN for the corresponding product and in Standard UNE-EN 197-2 on conformity evaluation for cements, which is later quoted in this Annex.

Nevertheless, not all cements are obliged to have CE marking. As can be seen from this Instruction, apart from CE marked cements, there is also a whole series of cements that remain

subject exclusively to national non-harmonised standard and, therefore, cannot bear the CE marking. This is the case of special purpose cements compliant with UNE 80307 (see Annex II).

Cements to be marketed in Spain but which do not yet have the corresponding harmonised European standard continued to be obliged to comply with the technical specifications described in Annex I of Royal Decree 1313/1988, whereby the approval of cements for the manufacture of concrete and mortar for all types of works and prefabricated products is declared as subject to compulsory testing and controls as established by said technical specifications and the obtaining of a certificate of conformity with the regulatory requirements and, subsequently, the certificate of conformity of production.

Both in the case of CE marking and certification of conformity with regulatory requirements, the responsibility of the manufacturer as regards product conformity is limited to production, yet the cement may deteriorate from when it leaves the factory until it reaches the plant, factory or work. Amongst others, the risk of weathering continues, due to the action of damp and CO₂ in the environment, which can reduce its performance.

This is why it is important to take control measures that provide information on the condition of cement at the time of reception. It is essential to know and check the documents accompanying cement consignments, checking that they are correct, i.e. that they are what is required by the corresponding standard and complete, and therefore contain and provide all the required information. Chapter III of this Instruction establishes these means of control.

AVII.2.Conformity assessment procedures related to the CE marking and with certificate of conformity with the regulatory requirements

In order to be able to apply CE marking to cement and, if applicable, obtain the certificate of conformity with the regulatory requirements, the manufacturer must, through contracting the corresponding notified and/or authorised bodies, a conformity assessment of its product by means of a system of conformity certification that shows the validity of the values declared upon leaving the factory.

AVII.2.1a. CE marking conformity certification system

The cement conformity certification system with the needs of the harmonised standard and other current regulations is that decided by the European Commission and accepted by all Member States, and consists of:

- the carrying out, by a laboratory contracted by a notified certification body, of the initial tests that are carried out on all and each of the regulated properties at the start of production;
- the manufacturer's planning, execution and documentation of a production control plan in order to verify and show that the values obtained in those initial tests are maintained, including sampling and tests on the final product as part of this internal control;

- the carrying out, by the notified certification body, of an initial inspection of the factory and the factory production control plan prepared by the manufacturer;
- the continual surveillance, checking and approval by this same notified body, of said production control;
- the carrying out, by the laboratory to which the first point refers, of auditing or contrast tests on samples taken by the notified certification body.

All these activities are carried out under the responsibility of the notified certification body that is the one that will ultimately issue the CE certificate of constancy of performance of the cement in question, guaranteeing that they have all yielded compliant results in its assessment. Nonetheless, the assessment in compliance with these activities does not guarantee product quality or production quality, which remains the responsibility of the manufacturer.

The frequency and details of the procedure for evaluating conformity are those indicated in Standard UNE EN 197-2 and in the UNE Standard for the corresponding cement and which are summarised in Table AVII.2.1.

AVII.2.1b. System for conformity certification under Royal Decree 1313/1988

The process for evaluating cement conformity with the requirements of the product standard and other regulations in force, is the one established in Royal Decree 605/2006, approving procedures for application of Standard UNE EN 197-2 to cements which are not subject to the CE marking and to the dispatching centres for any type of cement, and consist of:

- the carrying out, by an accredited laboratory, of the initial tests of all and each of the regulated properties at the start of production;
- planning, execution and documentation of a production control plan in order to verify that the values obtained in those initial tests are maintained, including sampling and autocontrol and contrast tests on the final product as part of this internal control;
- execution by an accredited inspection body of an initial inspection of the factory and of its production control plan;
- continual surveillance, checking and approval by this same accredited body, of the production control carried out by the factory;
- execution, by an external accredited, authorised laboratory of contrast tests on samples taken by the accredited inspection body.

The frequency and details of the procedure for evaluating conformity are those indicated in Standard UNE EN 197-2 and in the UNE Standard for cement and which are summarised in table AVII.2.1.

**Table AVII.2.1. Evaluation of conformity of cements according to
Standard UNE EN 197-2**

STAGES	MANUFACTURER		CERTIFYING BODY		
	Duration of control period	Autocontrol sample tests	Factory inspection	Evaluation of autocontrol tests	Contrast sample tests
Initial period	3 months UNE-EN 197-2 5.6.1	According to the table on the product standard UNE-EN 197-2 4.3.1(*)	1		≥1/month UNE-EN 197-2 5.4.2
Normal period	12 months UNE-EN 197-2 5.3.3 (*)	According to the table on the product standard UNE-EN 197-2 4.3.1(*)	1/year UNE-EN 197-2 5.2.2	≥2/year UNE-EN 197-2 5.3.2	≥6/year UNE-EN 197-2 5.4.2
Corrective action period	2 months UNE-EN 197-2 6.1	Double that indicated for the normal period UNE-EN 197-2 6.1			Double that indicated for the normal period (= 1/month) UNE-EN 197-2 6.1

(*) Refers to the section "Conformity criteria" of the corresponding product standard

AVII.3.Parameters controlled by the CE marking and Regulatory Requirements.

The conformity of the tests run on the cement is established with respect to:

- constituents and composition;
- compressive strength;
- setting time;
- insoluble residue (only for CEM I and CEM III);
- loss on ignition (only for CEM I and CEM III);
- soundness:
 - expansion;
 - SO₃ content.
- chloride content;
- pozzolanicity (only for CEM IV pozzolanic cements).
- if appropriate, restrictions on hexavalent chrome soluble in the water in cement (Article 11).
- durability (with reference to concrete, mortar, grouts and other cement mixtures, in accordance with application rules valid in the place of use).

By way of information, it is specified that the sample plans established in the applicable standards establish the probability of acceptance that has been determined (5 %) of non-compliant batches (consumer risk).

ANNEX VIII

RECOMMENDATIONS FOR USE

AVIII.1. General

These recommendations are fundamentally intended for designers and optional management with the aim of providing a selection of cements to be used, and they refer to considerations relating to the types, strength classes and aptitude with respect to the different aggressive environments that are most likely to be seen in the different types of applications.

The recommendations given in this Annex must be considered as applicable to white cements and cements with additional characteristics of the same type and strength class. In this sense, white common cements can be used as appropriate, considering that they are the same common cements that also comply with the whiteness specification.

The cements recommended for structural concretes are those indicated in Section AVIII.2. It includes some specific recommendations according to the concrete conditions and exposure class, which are general for other type of applications contained in the other sections, and are therefore to be considered.

Use of cements with a strength class of 42.5N or better is recommended for the manufacture of prefabricated concrete elements.

For use of calcium aluminate cement, the provisions given with respect to the current Structural Concrete Code must be considered.

Cements that are specifically not recommended for concrete applications can be used, as long as there is no reason why their use should be specifically inadvisable, taking special technical precautions.

For cements that are not subject to CE marking and included in the relevant harmonised standards, or cements still subject to certification of conformity with the regulatory requirements and that are legally marketed in any Member State, or which have CE marking on the basis of a European technical assessment, will apply current national regulation for its use on the products in which the cement is included.

AVIII.2. Cements recommended for structural concretes

AVIII.2.1. Generic structural applications

Table AVIII.2.1 specifies the cements recommended for use in manufacturing the types of structural concrete reported

TABLE AVIII.2.1

APPLICATION	RECOMMENDED CEMENTS
Unreinforced concrete	All common cement, except CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM II/B-T and CEM III/C. Special purpose cements ESP VI-1 ⁽¹⁾
Reinforced concrete	All common cements except CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM II/B-T, CEM III/C and CEM V/B.
Pre-stressed concrete including structural prefabricated elements	Common cements ⁽²⁾ CEM I, CEM II/A-D, CEM II/A-V, CEM II/A-P and CEM II/A-M (V-P) ⁽³⁾
Structural prefabricated elements of reinforced concrete	Common cements ⁽²⁾ of types CEM I, CEM II/A are very suitable, and the common cement type CEM IV/A is suitable when thus is shown by a specific experimental study.
Large volumes of unreinforced and reinforced concrete	Common cements CEM III/B and CEM IV/B are very suitable and common cements CEM II/B, CEM III/A, CEM IV/A and CEM V/A are suitable. Special purpose cements ESP VI-1. If appropriate, the additional characteristics of low heat (LH) and very low heat (VLH) are highly recommended.
High strength concrete	CEM I cements are very suitable and CEM II/A-D and CEM II/A 42.5 R cements are suitable. Other CEM II/A cements may be inappropriate if so proven by a specific experimental study.
Concrete for quick repairs emergency	CEM I, CEM II/A-D cements and calcium aluminate cement (CAC).
Concretes for formwork and quick uncasing	Common cements ⁽²⁾ CEM I, and CEM II.
Projected concrete	CEM I and CEM II/A common cements.
Concretes with potentially reactive aggregates ⁽⁴⁾	Common cements CEM III, CEM IV, CEM V, CEM II/A-D, CEM II/B-S and CEM II/B-V are very satisfactory and common cements CEM II/B-P and CEM II/B-M are suitable.

⁽¹⁾ In the case of large volumes of unreinforced concrete.

⁽²⁾ Of those specified, those with high early strength are preferable.

⁽³⁾ The inclusion of cements CEM II/A-V, CEM II/A-P and CEM II/A-M (V-P) as able to be used for the application of pre-stressed concrete is coherent with the possibility, envisaged by the current Structural Concrete Code, to use the addition to pre-stressed concrete of fly ash, in a quantity of no more than 20 % of the cement mass.

⁽⁴⁾ For this use, low alkaline content cements or those mentioned in the table, are recommended.

AVIII.2.2. Specific structural applications

AVIII.2.2.1. Foundations

Table AVIII.2.2.1 specifies the cements recommended for use in manufacturing of concretes for foundations.

Table AVIII.2.2.1

APPLICATION	RECOMMENDED CEMENTS
Unreinforced concrete foundations	<p>Common cement types CEM IV/B are very satisfactory and the remainder of common cements are satisfactory, except CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM II/B-T and CEM III/C.</p> <p>The additional property of low heat (LH) is recommendable in all cases.</p> <p>It is necessary to comply with the requirements on the use of the additional characteristic of sulfate resistance (SR/SRC) ⁽¹⁾ or sea-water resistance (MR) where appropriate.</p>
Reinforced concrete foundations	<p>Common cement types CEM I and CEM II/A are very satisfactory and the remainder of common cements are satisfactory, except CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM III/B, CEM III/C and CEM IV/B.</p> <p>It is necessary to comply with the requirements on the use of the additional characteristic of sulfate resistance (SR/SRC) ⁽¹⁾ or sea-water resistance (MR) where appropriate.</p>

⁽¹⁾ In accordance with Standard UNE-EN 197-1 or UNE 80303-1, as applicable.

AVIII.2.2.2. Port and maritime works

Table AVIII.2.2.2 specifies the cements recommended for use in the manufacture of cements intended for the construction of unreinforced, reinforced or pre-stressed concrete that is part of port and maritime works.

TABLE AVIII.2.2.2

APPLICATION	TYPE OF CONCRETE	RECOMMENDED CEMENTS
Port and maritime works	Unreinforced	Common cement except CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM II/B-T and CEM III/C.
	Reinforced	Common cements except CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM II/B-T, CEM III/C and CEM V/B.
	Pre-stressed	Common cements ⁽¹⁾ of types CEM I, CEM II/A-D, CEM II/A-P, CEM II/A-V and CEM II/A-M(V-P).

⁽¹⁾ Of those specified, those with high early strength are preferable.

The use of one or another type of cement, with the additional characteristic of MR where applicable, will depend on the needs of the concrete and as long as there are no special circumstances that make its use inadvisable.

All SR and SRC cements are also sulfate resisting and sea-water resisting. Therefore, when specifying the use of a sea-water resisting cement, MR, an SR cement can be used instead.

AVIII.2.2.3. Dams

Table AVIII.2.2.3 specifies the cements recommended for use in manufacturing of concretes for damming.

TABLE AVIII.2.2.3

APPLICATION	RECOMMENDED CEMENTS
Vibrated concrete dams	Common cements of types CEM II/A, CEM III/A, CEM III/B and CEM IV/A.
Compacted concrete dams	Common cements of types CEM III, CEM IV and CEM V. Special purpose cements ESP VI-1. Very low heat special cements VLH III, VLH IV and VLH V. Low early strength blastfurnace slag cements L.

Cement types CEM I may also be used when sufficient quantities of an additive are added to the concrete in accordance with project requirements.

It is recommended that the cements to be used as low strength class (32.5) and the heat of hydration must be particularly considered, meaning that, as a general rule, the use of cements with the additional characteristic of low heat and very low heat is advisable.

AVIII.2.2.4. Hydraulic works other than dams

Table AVIII.2.2.4 specifies the cements recommended for use in the manufacture of cements intended for the construction of structures for the carrying of water, which are not part of the dam bodies.

TABLE AVIII.2.2.4

APPLICATION	TYPE OF CONCRETE	RECOMMENDED CEMENTS
Concrete pipes, canals and other hydraulic applications	Unreinforced	Common cement except CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM II/B-T and CEM III/C. Special purpose cements ESP VI-1 ⁽¹⁾
	Reinforced	Common cements except CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM II/B-T, CEM III/C and CEM V/B.
	Pre-stressed	Common cements CEM I, CEM II/A-D, CEM II/A-V, CEM II/A-P and CEM II/A-M (V-P).

⁽¹⁾ In lining large canals with glidant formwork machines.

AVIII.2.3. Cements recommended in certain concreting circumstances

Table AVIII.2.3 specifies the cements recommended for use in manufacturing of structural concrete for certain concreting circumstances.

TABLE AVIII.2.3

CONCRETING CIRCUMSTANCES	RECOMMENDED CEMENTS
Cold weather concreting ⁽¹⁾ ⁽²⁾	Common cements CEM I ,CEM II/A and CEM IV/A. The use of cements with a high or medium strength class (52.5 and 42.5) is recommended.
Concreting in dry and windy environments and, in general, in conditions that facilitate the drying of concrete ⁽²⁾	CEM I and CEM II/A common cements.
Strong insulation or concreting in hot weather ⁽²⁾	Common cements CEM II, CEM III/A, CEM IV/A and CEM V/A.

⁽¹⁾ Under these circumstances, it is not advisable to add the additional property of low heat (LH).

⁽²⁾ In these circumstances, it is essential to take the suitable measures as specified in the corresponding regulation, during the execution or installation and, if applicable, in the current Structural Concrete Code.

AVIII.2.4. Cements recommended according to the different exposure classes

Table AVIII.2.4 gives the cements recommended for the manufacture of concretes according to the exposure classes considered in the current Structural Concrete Code, to which they will be subject.

TABLE AVIII.2.4

EXPOSURE CLASS	PROCESS TYPE (aggressive nature due to)	RECOMMENDED CEMENTS
I	None	All those recommended according to the intended purpose.
II	Corrosion of reinforcement of origin other than chloride	CEM I, any CEM II (preferably CEM II/A), CEM III/A, CEM IV/A.
III ⁽¹⁾	Corrosion of reinforcement due to marine origin chlorides	CEM II/S, CEM II/V are very satisfactory (preferably CEM II/B-V), CEM II/P (preferably CEM II/B-P), CEM II/A-D, CEM III, CEM IV (preferably CEM IV/A) and CEM V/A.
IV	Corrosion of reinforcement due to non-marine origin chlorides	Preferably CEM I and CEM II/A and also the same as for exposure class III.
Q ⁽²⁾	Concrete attack by sulfates	Same as for exposure class III.
Q	Leaching of concrete by pure water, acid or CO ₂ attack	Common cements CEM II/P, CEM II/V, CEM II/A-D, CEM II/S, CEM III, CEM IV and CEM V.
Q ⁽³⁾	Alkali-aggregate reactivity	Low alkali content cements (sodium and potassium oxides) where: $(Na_2O)_{eq} = Na_2O (\%) + 0.658 K_2O (\%) < 0.60$

⁽¹⁾ In this exposure class, it is necessary to comply with instructions on the use of the additional characteristic of sea-water resistance (MR) as laid down in the current Structural Concrete Code.

⁽²⁾ In this exposure class, it is necessary to comply with the instructions on the use of the additional characteristic of sulfate resistance (SR/SRC in accordance with Standard UNE-EN 197-1 or UNE 80303-1, as applicable) if the case of the specific class Qb or Qc, as established by the current Structural Concrete Code. In cases where the element is in contact with sea water, the instructions relative to the use of the additional characteristic of sea-water resistance (MR) must be applied.

⁽³⁾ The cements mentioned in Table AVIII.2.1 concretes with potentially reactive aggregates (which require low alkaline content cements), are also recommended.

AVIII.3. Cements recommended for use in road surfaces, ports and airports

Table AVIII.3 gives the cements recommended for use in constructing surfaces, both in stabilising flat soils in situ and crowning tops of graded areas, in forming base layers: soil cement,

gravel cement, vibrated lean concrete and compacted concrete, like vibrated concrete floorings exposed to direct traffic action.

TABLE AVIII.3

APPLICATION	RECOMMENDED CEMENTS
Vibrated concrete pavements	Common cements except: CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM II/B-T, CEM III/B, CEM III/C and CEM V/B
Soil cement and gravel cement and compacted concrete	Common cement types CEM II/B, CEM III, CEM IV and CEM V ⁽¹⁾ except CEM II/B-Q, CEM II/B-W and CEM II/B-T. Special purpose cement ESP VI-1. Low early strength blastfurnace slag cements (L).
Soil stabilisation ⁽²⁾	Special purpose cements ESP VI-1 and common cements type CEM II/B, CEM III, CEM IV/A, CEM IV/B and CEM V.

⁽¹⁾ These cements are also recommended for recycling in situ of cement surfaces.

⁽²⁾ When the aggressive nature of the soil, due to the presence of sulfates, so requires, cements must be used with the sulfate resisting additional characteristic (SR/SRC in accordance with Standard UNE-EN 197-1 or UNE 80303-1, as applicable).

AVIII.4. Cements recommended for non-structural concretes

Table AVIII.4 specifies the cements recommended for use in manufacturing the types of non-structural concrete types.

TABLE AVIII.4

APPLICATION	RECOMMENDED CEMENTS
Non-structural prefabricated elements	Common cement except CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM II/B-T and CEM III/C.
Flooring	Common cement except CEM I, CEM II/A-D, CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM II/B-T, CEM III/B and CEM III/C.
Cleaning and trench-filling concretes	Common cement except CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM II/B-T and CEM III/C.
Other non-structural applications performed in work	Special purpose cement ESP VI-1. Common cement except CEM II/A-Q, CEM II/B-Q, CEM II/A-W, CEM II/B-W, CEM II/A-T, CEM II/B-T and CEM III/C.

AVIII.5. Cements recommended for masonry mortars

Table AVIII.5 specifies the cements recommended for use in manufacturing of masonry mortars.

TABLE AVIII.5

APPLICATION	RECOMMENDED CEMENTS
Masonry mortars	Masonry cement. Common cements except CEM I and CEM III.

When the need for whiteness dictates, white cements will be used, as defined in A.2.4.2.