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 particularly 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 AII.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 (Na_2O + 0.658 K_2O) 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 AII.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 C_3A 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 pozzolanic cements CEM IV/A and CEM IV/B and in composite cements CEM V/A and CEM V/B the main constituens 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_3A 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 CEM I-SR 3 CEM I-SR 5	= 0 ≤ 3 ≤ 5	95-100	-	-	-	0-5
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_3A 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 C_3A 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 C_3A 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	-						

[1] Strength class only defined for CEM III.
[2] 1 N/mm^2 = 1 MPa.
[3] Only for low heat (LH) cements.

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 AI.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 guiven 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 AI.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_3A 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_3A of clinker from an analysis of a final cement is being studied.

4) In the specific case of CEM I, the C_3A content of the clinker may be calculated through a chemical analysis of the cement. The C_3A content shall be calculated using the formula: $C_3A = 2.65\ A - 1.69\ F$, where A and F are the percentages by mass of aluminium oxide (Al_2O_3) and iron oxide (III) (Fe_2O_3) of the clinker, respectively, determined in accordance with Standard UNE-EN 196-2.

5) Until completion of the test method, the C_3A 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	
$\geq$ 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_2O_3)	UNE-EN 196-2	35 % ≤ Al_2O_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_2O equivalent (Na_2O + 0.658 K_2O).

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 AI.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.

AI.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

AI.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 AI.4.3a.

Table AI.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 t 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 AI.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 AI.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 ≤ air content ≤ 22	≥ 80
MC 12.5 X MC 22.5 X	≤ 6[1)]	≥ 75

[1)] The control of the masonry cement manufacturing process ensures that this upper limit is not exceeded.

AI.4.4. Chemical specifications

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

Table AI.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
Chloride content (expressed as Cl^-)		MC 5	No requirement
		MC 12.5 MC 12.5 X MC 22.5 MC 22.5 X	≤ 0.10

AI.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.

AI.5.Reference standards for cements subject to CE marking

AI.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

AII.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.

AII.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).

AII.2.1. Composition and specifications

Sulfate resisting cements are those prepared using a clinker that complies with the conditions described in Table AII.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_3A %	C_3A % + C_4AF %
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 C_3A and (C_3A + C_4AF) refer to percentages in mass of clinker. The C_3A and C_4AF 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:

a) the ratio between SiO_2/(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.

b) siliceous fly ash or Blaine fine-milled natural pozzolana equivalent to that of the reference cement with a tolerance of± 200 cm^2/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;

c) 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).

AII.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.

AII.3.1. Composition and specifications

Sea-water resisting cements are those whose composition uses a clinker that complies with the conditions described in Table AII.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 AII.2.1.

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

<table>
<tr><th rowspan="2">Types</th><th colspan="2" rowspan="2">Names</th><th rowspan="2">Designations</th><th colspan="2">Specifications of sea-water resisting cements (MR)</th></tr>
<tr><th>C_3A %</th><th>C_3A % + C_4AF %</th></tr>
<tr><td>I</td><td colspan="2">Sea-water resisting Portland cements</td><td>I</td><td>≤ 5.0</td><td>≤ 22.0</td></tr>
<tr><td>II</td><td rowspan="8">Portland cements with additives, sea-water resisting</td><td rowspan="2">With blastfurnace slag (S)</td><td>II/A-S</td><td rowspan="7">≤ 8.0</td><td rowspan="7">≤ 25.0</td></tr>
<tr><td>II</td><td>II/B-S</td></tr>
<tr><td>II</td><td>With silica fume (D)</td><td>II/A-D</td></tr>
<tr><td>II</td><td rowspan="2">With natural pozzolana (P)</td><td>II/A-P</td></tr>
<tr><td>II</td><td>II/B-P</td></tr>
<tr><td>II</td><td rowspan="2">With fly ash (V)</td><td>II/A-V</td></tr>
<tr><td>II</td><td>II/B-V</td></tr>
<tr><td>III</td><td rowspan="6">Cements with additives, sea-water resisting</td><td rowspan="3">With blastfurnace slag (S)</td><td>III/A</td><td>≤10.0</td><td>≤ 25.0</td></tr>
<tr><td>III</td><td>III/B</td><td colspan="2">None</td></tr>
<tr><td>III</td><td>III/C</td><td colspan="2">None</td></tr>
<tr><td>IV</td><td rowspan="2">Pozzolanic cements (D+P+V)</td><td>IV/A</td><td>≤8.0</td><td>≤ 25.0</td></tr>
<tr><td>IV</td><td>IV/B</td><td rowspan="2">≤ 10.0</td><td rowspan="2">≤ 25.0</td></tr>
<tr><td>V</td><td>Composite cements (S+P+V)</td><td>V/A</td></tr>
<tr><td colspan="6">The specifications on C_3A and (C_3A + C_4AF) refer to percentages in mass of clinker. The C_3A and C_4AF content shall be determined by calculation in accordance with Standard UNE 80304, from tests on clinker in accordance with UNE-EN 196-2.</td></tr>
</table>

AII.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).

AII.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.

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

AII.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.

AII.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 AII.2.2 and AII.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.

AII.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 AII.4.

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

AII.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 AII.4.2.1.

Table AII.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.

AII.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

AII.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 AII.4.

The requirement established in Table AII.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 AII.4.2.3. Requirements for fresh mortar

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

AII.5. Special purpose cement

Special purpose cement is as defined in Standard UNE 80307.

AII.5.1. Classification and composition

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

Table AII.5.1. Special purpose cement: composition and proportion by mass[1) 4)]

Type	Name	Designation	Clinker (K)	Blastfurnace 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

1) 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.

2) The natural pozzolana content shall not exceed 40 %.

3) Minor additional constituents may be lime or one or more of the main constituents, unless they are included as such in the cement.

4) 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.

AII.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.

AII.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 AII.5.3.

Table AII.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	≥ 22.5	≥ 60	≤ 10
32.5 N	≥ 22.5	≤ 42.5	≥ 32.5		
42.5 N	≥ 32.5	≤ 52.5	≥ 42.5		

AII.5.4. Chemical specifications

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

Table AII.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 %

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

AII.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.

AII.6.2. Conformity evaluation standards

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

AII.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: Determininationof the water-soluble chromium (VI) content of cements.
UNE-EN 413-2:2006	Masonry cements. Part 2 Test methods

AII.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, SiO_2, Al_2O_3, Fe_2O_3 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 [$3CaO.SiO_2$] and [$2CaO.SiO_2$], with the remainder made up of clinker containing aluminium, iron and other compounds. The ratio by mass $(CaO)/(SiO_2)$ shall be no less than 2.0 and the magnesium oxide content (MgO) shall not exceed 5.0 % by mass.

The tricalcium aluminate content (C_3A) 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:

If A/F > 0.64 $C_3A = 2.65\ A - 1.69\ F$

If A/F < 0.64 $C_3A = 0$

where A and F are percentages by mass of Al_2O_3 and Fe_2O_3, respectively of the clinker, determined in accordance with Standard EN 196-2.

Additionally, the tricalcium aluminate and tetracalcium ferritoaluminate content ($C_3A + C_4AF$) 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:

If A/F > 0.64 $C_4AF = 3.04\ F$

If A/F < 0.64 $C_4AF = 4.77\ A$

AIII.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 AII.1.1 and AII.2.1 of this Instruction.

AIII.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.

AIII.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, $S^{=}$, SO_3, Cl^-, Na_2O, K_2O, etc.). The main mineral component is monovalent calcium aluminate ($CaO.Al_2O_3$).

AIII.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 $(CaO + MgO)/(SiO_2)$ shall exceed 1.0 and the sum of calcium, magnesium and siliceous oxides ($CaO + MgO + SiO_2$) 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.

AIII.2.3. Pozzolanic materials (P, Q)

AIII.2.3.1. General

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

Pozzolanic 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 [$Ca(OH)_2$] 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 fumaces fired eith 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 eithin 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 bestated 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.

Table AV.5.2.2

Number of samples (*n*) P_k = 10 %	c_1	Number of samples (*n*) P_k = 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	• 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	• 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	• 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	• 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	• 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	• 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	• Requirements for identification of common cements of homonymous type (I to V) • C_3A and $C_3A + C_4AF$ clinker content (*)
SEA-WATER RESISTING CEMENTS	**TESTS**
I to V/MR	• Requirements for identification of common cements of homonymous type (I to V) • C_3A and $C_3A + C_4AF$ 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	• 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	• 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	• Mechanical strengths (at 6 hours and 24 hours) • Determination of alumina
MASONRY CEMENTS	**TESTS**
MC	• Mechanical strengths (at 7 and 28 days) (**)
SPECIAL PURPOSE CEMENTS	**TESTS**
ESP	• Mechanical strengths (at 28 and 90 days) • Determination of constituents
WHITE CEMENTS	**TESTS**
BL	• 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	• Soundness • Setting times • Insoluble residue • Sulfate content • Chloride content
CEM II	• Soundness • Setting times • Sulfate content • Chloride content

AVI.2.1. Common cements (continued)

CEM III	• Soundness • Setting times • Insoluble residue • Sulfate content • Chloride content
CEM IV	• Soundness • Setting times • Sulfate content • Chloride content
CEM V	• Soundness • Setting times • Sulfate content • Chloride content
LOW HEAT COMMON CEMENTS	**APPLICABLE TESTS**
CEM I to V - LH	• 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	• 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	• 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	• Soundness • Setting times • Insoluble residue • Sulfate content • Chloride content
VERY LOW HEAT SPECIAL CEMENTS	**APPLICABLE TESTS**
VLH III to V	• Soundness • Setting times • Sulfate content • Chloride content • Pozzolanicity (VLH IV)

AVI.2.3. Other cements (continued)

CALCIUM ALUMINATE CEMENTS	**APPLICABLE TESTS**
CAC	• Setting times • Determination of sulfates • Determination of chlorides • Determination of alkalis • Determination of aluminium oxide • Determination of sulphurs
MASONRY CEMENTS	**APPLICABLE TESTS**
MC	• There is no need for complementary tests
SPECIAL PURPOSE CEMENTS	**APPLICABLE TESTS**
ESP	• Soundness • Setting times • Determination of sulfates • Determination of chlorides
WHITE CEMENTS	**APPLICABLE TESTS**
BL	• 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 CO_2 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;
  - SO_3 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).