مؤسسة المواصفات والمقاييس الأردنية

الرقم م / عام / 3486
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الموافق 16 / 02 / 2025 م

معالي .....
عطوفة .....
سعادة .....

تحية طيبة وبعد،

أرجو معاليكم/عطوفتكم/ سعادتكم التكرم بالعلم بأن أسلوب العمل الفني المتبع في وضع المواصفات القياسية والقواعد الفنية الأردنية يقتضي تعميم مشروع التصويت على الجهات ذات العلاقة، وذلك لإبداء الرأي والتصويت عليه تمهيدا لعرضه على مجلس الإدارة لاعتماده كمواصفة قياسية أو قاعدة فنية أردنية.

لذا أرجو أن أرفق لكم نسخة عن مشروع التصويت للمواصفة القياسية الأردنية ٢٤١٣-٢/٢٠٢٥ الخاص **بألياف الخرسانة، الجزء ٢: الألياف البوليميرية ـ التعاريف والمواصفات والمطابقة**، الذي أعدته اللجنة الفنية الدائمة لمنتجات مواد البناء رقم (٥٦).

يرجى التكرم بالإيعاز لمن يلزم بعرض هذا المشروع على المختصين لديكم وموافاتنا بردكم عليه خلال شهرين من تاريخه، وذلك باستخدام بطاقة التصويت المرفقة، علما بأن عدم الرد خلال هذه المدة يعتبر موافقة من قبلكم على المشروع المذكور.

وتفضلوا بقبول فائق الاحترام

المديـــر العـــام
م. عبير بركات الزهير

غرفة تجارة عمان
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التاريخ: ١٧ شباط ٢٠٢٥
رقم الوارد: 881

المرفقات : مشروع التصويت
: بطاقة التصويت

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نسخة/ رئيس قسم فحص ومتابعة المواصفات
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غدير - ٢٠٢٥/٠٢/١٢

مؤسسة المواصفات والمقاييس الأردنية

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First edition

ع ت ٢٤١٣-٢/٢٠٢٥
الإصدار الأول

مشروع تصويت

ألياف الخرسانة

الجزء ٢: الألياف البوليميرية ــ التعاريف والمواصفات والمطابقة

Fibres for concrete

Part 1: Polymer fibres – Definitions, specifications and conformity

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مؤسسة المواصفات والمقاييس

المملكة الأردنية الهاشمية

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Foreword

Jordan Standards and Metrology Organization is the national standardization body in Jordan. The work of preparing Jordanian Standards is normally carried out by technical committees composed of the interested parties, which are involved in the scope of the standard. All the interested parties have the right to vote on the draft Jordanian Standard during the enquiry stage, taking into consideration the importance of harmonizing Jordanian Standards with the international, regional or national standards (as much as possible) for the purpose of eliminating technical barriers to trade and facilitating the international trade.

Jordanian Standards are drafted in accordance with the rules given in the Jordanian Directive 1-2:2005, part 2: Rules for the structure and drafting of Jordanian Standards*.

The permanent technical committee for construction materials products 56 has studied the prepared project 2413-2:2025 related to **"Fibres for concrete, part 2: Polymer fibres – Definitions, specifications and conformity"**, and has recommended to approve the amended project as a Jordanian Standard 2413-2:2025, according to article (12) of standards and metrology law No. (22) for the year 2000 and its amendments.

This Jordanian Standard 2413 includes the following parts under the same general title, **"Fibres for concrete"**:
- Part 1: Steel fibres – Definitions, specifications and conformity.
- Part 2: Polymer fibres - Definitions, specifications and conformity.

This Jordanian Standard 2413-1:2025 is a modified adoption of the European Standard 14889-2:2006 " **Polymer fibres for concrete — Definitions and specifications** ", using reprint method, single vertical bars (|) in the margins are used to indicate the applicable technical modifications of the European standard, and single vertical dotted bars (⋮) in the margins are used to indicate the applicable editorial modifications of the European standard which have been changed. Each variation is cross-referenced to the clause of the European standard together with reasons for these deviations listed below.

For the purposes of this Jordanian standard, the following Technical changes have been made:
- Adding "Lists of prohibited and restricted chemicals, issued by Ministry of health and their amendments." in clause 2, because the referring for the lists mentioned in clause 5-10.
- Replace "Materials used in products shall not release any dangerous substances in excess of the maximum permitted levels specified in a relevant European Standard for the material or permitted in the national regulations of the member state of destination." in clause 5-10 by "For content and release of substances from the hardened grout dangerous to health, hygiene and the environment see Lists of prohibited and restricted chemicals, issued by Ministry of health and their amendments." to confirm with national requirement.
-Adding clause 7"Packaging and package marking" and Figure 1"Example for Package marking", To confirm with national requirement and the Jordanian Technical regulation 119:2022, Label – Industrial products label.

For the purposes of this Jordanian standard, the following editorial changes also have been made:
- Substitution of "this European Standard" and "this document" by "this Jordanian standard".
- Addition of "clause" before each referenced sub clause, applying the Jordanian Directive 1-2:2005, part 2: Rules for the structure and drafting of Jordanian Standards.

- Renumbering of sub clauses in clause 3, applying the Jordanian Directive 1-2:2005, part 2: Rules for the structure and drafting of Jordanian Standards.
- Adding the Symbols mentioned in the document into table 1, Clarification for the whole symbols mentioned in the document.
- Deletion of note in clause 6-2-2 and clause ZA, it is not applicable in Jordan because it is for EU construction directive.

Admixtures for concrete, mortar and grout
Part 2: Polymer fibres for concrete — Definitions and specifications

1- Scope

This Jordanian Standard specifies requirements for polymer fibres for structural or non-structural use in concrete, mortar and grout.

Note: Structural use of fibres is where the addition of fibres is designed to contribute to the load bearing capacity of a concrete element. This standard covers fibres intended for use in all types of concrete and mortar, including sprayed concrete, flooring, precast, in-situ and repair concretes

2- Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

- ISO 11357-3, Plastics – Differential scanning calorimetry (DSC) – Part 3: Determination of temperature and enthalpy of melting and crystallization.
- EN 10002-1, Metallic materials – Tensile testing – Part 1: Method of test at ambient temperature.
- EN 13392, Textiles – Monofilaments – Determination of linear density.
- EN 14845-1, Test methods for fibres in concrete – Part 1: Reference concretes.
- EN 14845-2, Test methods for fibres in concrete – Part 2: Effect on concrete.
- EN ISO 2062, Textiles – Yarns from packages – Determination of single-end breaking force and elongation at break (ISO 2062:1993).
- JS 1651-3 EN 12350-3, Concrete – Testing fresh concrete – Part 3: Vebe test.
- Lists of prohibited and restricted chemicals, issued by Ministry of health and their amendments.

3- Terms and definitions

For the purposes of this Jordanian standard, the definitions and following terms definitions apply:

3-1

Polymer

polymeric material such as polyolefin, e.g. polypropylene or polyethylene, polyester, nylon, pva, polyacrylic, aramids and blends of them

3-2

polymer fibres

straight or deformed pieces of extruded, orientated and cut material which are suitable to be homogeneously mixed into concrete or mortar

3-3

length

distance between the outer ends of the fibre

3-4

developed length (for deformed fibres with irregular cross section)

length of the deformed fibre after straightening the fibre without deforming the cross section

3-5

equivalent diameter

diameter of a circle with an area equal to the mean cross sectional area of the fibre

Note: For circular fibres, the equivalent diameter is equal to the diameter of the fibres.

3-6

aspect ratio

ratio of length (l) to equivalent diameter of the fibre

3-7

fibre shape

specific outer configuration of the fibres, both in the longitudinal direction and in the shape of the cross section and also the possible surface coatings and/or bundling of fibres

3-8

tensile strength of fibre

stress corresponding to the maximum force that one fibre can resist

Note: The methods concerning how to determine the tensile strength are explained in clause 7-3. The tensile strength is calculated by dividing the maximum force a fibre can resist by the mean cross-sectional area of the fibre.

3-9

elongation of the fibre

elongation of the fibre is defined as the ratio of the length change of the fibre to the initial length expressed as a percentage

Note: The length change should be measured on the fibre itself.

3-10

elastic modulus of the fibre

initial slope of the tensile stress versus tensile strain curve

3-11

linear density

mass per unit length of a yarn or filament expressed in tex or its multiples or submultiples

Note: 1 tex = 1g/1000 m.

3-12

tenacity

breaking force of a fibre divided by its linear density

3-13

melting point

temperature at which a polymer becomes liquid

3-14

point of ignition

temperature at which combustion is initiated

3-15

residual flexural strength

notional stress at the tip of the notch which is assumed to act in an uncracked mid-span section, with linear stress distribution, of a prism subjected to the centre-point load Fj corresponding to CMODj where CMODj > CMODδ; or to δj where $\delta j > \delta F$L (j = 1,2,3,4)

Note: F_L is the load at LOP (see EN 14651).

3-16

crack mouth opening displacement

CMOD

linear displacement measured by a transducer installed on a prism subjected to a centre-point load F

3-17

declared value

value for a product property, determined in accordance with this Jordanian standard, that a manufacturer is confident of achieving within the given tolerances taking into account the variability of the manufacturing process

4- Symbols

For the purposes of this Jordanian standard, the symbols and definitions in Table 1 apply.

Table 1 — Symbols and definitions

Symbols	Definitions	Unit
w	width of the fibre	mm
t	thickness of the fibre	mm
A	area of the cross section of the fibre	mm^2
d	diameter of a fibre with a circular cross section	mm
d_e	equivalent diameter of the fibre	mm
l	measured length of the fibre	mm
l_d	developed length of the fibre	mm
λ	aspect ratio of the fibre (λ = l/d)	
m	mass of the fibre	g
ρ	density of polymer	kg/m^3
T_s	Melting point of the polymer	C°
T_i	Point of ignition of the polymer	C°
P_{max}	Maximum tensile load carrying capacity of the fibre	N
R_m	tensile strength of the fibre	MPa
ε	Elongation of the fibre	%
$CMOD$	crack mouth opening displacement	mm
E	Elastic modulus of the fibre	Mpa

5- Requirements

5-1 Classification of fibres

Polymer fibres shall be characterised by the manufacturer in accordance with their physical form:
Class Ia: Micro fibres: < 0,30 mm in diameter; Mono-filamented
Class Ib: Micro fibres: < 0,30 mm in diameter; Fibrillated
Class II: Macro fibres: > 0,30 mm in diameter
Note :Class II fibres are generally used where an increase in residual flexural strength is required.

5-2 General

5-2-1 polymer type

The basic polymer(s) or blends of polymers of the fibre shall be declared.

5-2-2 shape

Polymer fibres may be either straight or deformed. The type of deformation shall be declared.

5-2-3 bundled polymer fibres

The type and size of the fibre bundle (e.g. glued, wrapped) shall be declared.

5-2-4 surface treatment or coating

Any surface treatment or coating (type and quantity), and any chemical or physical treatment of polymer fibres shall be declared and controlled.
Note: Spin finish is a term used to describe the addition of chemical(s) used to coat the fibres that will then help the fibre to disperse in concrete. Without this coating some fibres will not easily disperse in concrete and will tend to ball up. However some types of chemical used to coat the fibres can induce air into the concrete or mortar. It is therefore important that any coating added to the fibre is controlled and is recorded as part of the initial type testing and as part of the factory control procedures.

5-3 Dimensions and tolerances

5-3-1 General

The length, diameter and aspect ratio shall be declared for all fibres. The linear density shall be declared for Class I fibres.
Specimens of fibres, when sampled in accordance with clause 6-2-2 and measured in accordance with clauses 5-3-2 and 5-3-3 shall not deviate from the declared value by more than the tolerances given in Table 2.

Table 2 — Tolerance limits for the dimensions of the fibres

Property		Symbol	Deviation of the individual value relative to the declared value	Deviation of the average value relative to the declared value
Length and developed length (all fibres)	> 30 mm	l, ld (If applicable)	± 10 %	± 5 %
	≤ 30 mm		-	± 1,5 mm
Class II fibres > 0,30 mm	(equivalent) diameter)	de	± 50 %	± 5 %
	length/diameter ratio	λ	± 50 %	± 10 %
Class I fibres ≤ 0,30 mm	linear density	ρ_L	± 10 %	± 10 %

5-3-2 length

The length shall be measured with a marking gauge with an accuracy of 0,1 mm.

In the case of an irregular cross section, the developed length of the fibre shall be determined.

5-3-3 Determination of (equivalent) diameter

5-3-3-1 Fibre with circular cross section

For Class I fibres with a diameter less than 0,3 mm, the diameter shall be measured using optical measuring equipment.

For Class II fibres with a diameter greater than 0,3 mm, the diameter of the fibre shall be measured with a micro meter to a precision of 0,001 mm.

5-3-3-2 Fibre with elliptical cross section

The diameter of the fibre shall be measured with a micro meter, in two directions, approximately at right angles, to a precision of 0,001 mm. The fibre diameter shall be the mean of the two diameters.

5-3-3-3 Rectangular fibres

The width (w) and thickness (t) of the fibres shall be measured with a micrometer to a precision of 0,001 mm.

The equivalent diameter, d_e, is calculated as $d_e = \sqrt{\frac{4 \cdot w \cdot t}{\pi}}$

5-3-3-4 Fibres with irregular cross section

The mass, m_f [g], and the developed length, l_d [mm], of the fibre shall be determined. The mass shall be determined to an accuracy of 0,001 g and the length to an accuracy of 0,01 mm. The equivalent diameter shall be computed from the mass and the developed length using the following formula with the nominal density of the fibre, ρ, in [g/cm^3]:

$$d_e = \sqrt{\frac{4 \cdot m_f \cdot 10^6}{\pi \cdot l_d \cdot \rho}}$$

Note: The nominal density ρ of Polypropylene is 0,9 g/cm^3.

5-3-4 Linear density

The linear density of Class I fibres shall be determined in accordance with EN 13392 and shall be declared.

5-3-5 shape of fibres

The manufacturer may freely choose the shape of the fibre. The control and tolerances on the shape shall be declared for each different shape. Control may be carried out using optical equipment.

5-4 Tensile properties

5-4-1 Tenacity of class I fibres

The tenacity of Class I fibres shall be determined by either method A or method B of EN ISO 2062. 30 individual fibres shall be tested and all results for the breaking force shall be included in the calculation for the average and standard deviation. The tenacity shall be calculated from the mean breaking force divided by the linear density determined by Clause 5-3-4.

5-4-2 Tensile strength of class II fibres

The tensile strength, R_m, shall be determined in accordance with the method according to EN 10002-1, except that the rate of extension shall not exceed 10 mm/min, and shall be declared.

The tensile strength shall be determined on individual fibres which have a minimum length of 20 mm. 30 individual fibres shall be tested and all results shall be included in the calculation for the average and standard deviation.

The accepted tolerance on the declared value of R_m shall be 15 % for individual values and 7,5 % for the mean value.

5-5 Modulus of elasticity

The modulus of elasticity for polymer fibres shall be tested according to EN 10002-1 and shall be declared. The modulus shall be calculated using the stress and deformation at 10 % and 30 % of Rm.30 individual strands shall be tested and all results shall be included in the calculation for the average and standard deviation. The acceptable tolerance on the declared value of the Modulus of Elasticity is 15 % for individual values and 10 % for the mean value.

5-6 Melting point and point of ignition

The melting point and point of ignition shall be determined in accordance with ISO 11357-3 and shall be declared.

Note: The melting point is an important characteristic where the fibre is to be used to modify the performance of concrete in fire.

5-7 Effect on consistence of concrete

The effect of fibres on the consistence of a reference concrete conforming to EN 14845-1 shall be determined.

The consistence according to JS 1651 EN 12350-3 shall be determined on the reference concrete without fibres and then on an identical mix with fibres. The effect on consistence shall be declared.

The amount of fibres added shall be declared by the manufacturer and shall be the minimum amount of fibres needed to obtain the required strength specified in clause 5-8. If a plasticiser or superplasticiser is needed in order to meet the consistence requirements when determining the required addition level of fibres, the amount and type shall also be declared by the manufacturer.

The fibre manufacturer may additionally declare the consistence for the reference concrete with a range of dosages of fibres.

5-8 Effect on the strength of concrete

The effect on strength shall be determined according to EN 14845-2 using a reference concrete conforming to EN 14845-1. The unit volume of fibres in kg/m³ shall be declared by the manufacturer that achieves a residual flexural strength of 1,5 MPa at 0,5 mm CMOD (equivalent to 0,47 mm central deflection) and a residual flexural strength of 1MPa at 3,5 mm CMOD (equivalent to 3,02 mm central deflection).

5-9 Mixing

Mixing instructions shall be supplied by the manufacturer which recommend the mixing sequence to be adopted when introducing the fibre into both a centrally mixed concrete plant and for a dry batch truck mixed plant.

5-10 Release of dangerous substances

For content and release of substances from the hardened grout dangerous to health, hygiene and the environment see Lists of prohibited and restricted chemicals, issued by Ministry of health and their amendments.

6- Evaluation of conformity

6-1 General

The conformity of a fibre to the requirements of this standard and with the declared values shall be demonstrated by the manufacturer by carrying out both:

- initial type testing of the product (see clause 6-2).
- factory production control (see clause 6-3).

Alternative methods of test to the methods specified in this standard may be adopted except for the initial type tests and in case of dispute, provided that these alternative methods satisfy the following:

a) a correlation can be shown to exist between the results from the specified test and those from the alternative test and,
b) the information on which the relationship is based is available.

6-2 Initial type testing (ITT)

6-2-1 General

Initial type testing shall be performed to show conformity with this standard. Tests previously performed in accordance with the provisions of this standard (same product, same characteristic(s), test method, sampling procedure, system of attestation of conformity, etc.) may be taken into account.
The appropriate initial tests shall be repeated whenever a change in the basic materials or manufacturing procedures occurs, or a new product type is being produced.
The tests to be conducted shall be the tests and/or calculations as described in this standard for the following properties:
– dimensions and tolerances (see clause 5-3);
– shape (see clause 5-3-5);
– tensile properties (see clause 5-4);
– modulus of elasticity (for Class II only, see clause 5-5);
– melting point and point of ignition (see clause 5-6);
– effect on consistence (see clause 5-7);
– effect on strength of concrete (for Class II only, see clause 5-8).
The results of initial type tests shall be recorded and be available for inspection. Sampling for initial type testing shall be in accordance with clause 6-2-2.

6-2-2 Sampling

The minimum sample size shall be as given in Table 3 and shall be drawn at random to be representative of the batch or consignment. Pre-production samples may be used for initial type tests where it is possible to demonstrate that the characteristics of performance are representative of products from the full production process.

Table 3 - Sampling — number of specimens

Type test			Minimum number per test
Clause	Normative (N), or Optional (O)	Characteristic	
5-3	N	Dimensions; tolerances	30 fibres
5-3-4	N	Shape; tolerances	30 fibres
5-3	N	Tensile properties; tolerances	30 fibres or fibre bundles
5-5	O	Modulus of elasticity (Class II only)	30 fibres
5-6	N	Melting point and point of ignition	30 fibres
5-7	N	Consistence	mean value of 3 tests
5-8	N	Effect on strength of concrete (Class II only)	12 beams

6-3 Factory production control (FPC)

6-3-1 General

The manufacturer shall establish, document and maintain a FPC system to ensure that the products placed on the market conform to the requirements of this standard and the declared performance characteristics. The FPC system shall consist of procedures, regular inspections, tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product.

Subsequently, any fundamental changes in basic materials, manufacturing procedures or the control scheme that affects the properties or use of a product shall be recorded in the manual or relevant document, together with the test data that identifies the new characteristics of the fibre.

The results of inspections, tests or assessments requiring action shall be documented, as shall any action taken. The action to be taken when control values or criteria are not met shall be recorded.

Note: An FPC system conforming with the requirements of the relevant part(s) of EN ISO 9001, and made specific to the requirements of this standard, is considered to satisfy the above requirements.

6-3-2 Equipment

All weighing, measuring and testing equipment shall be calibrated and regularly inspected according to documented procedures, frequencies and criteria.

6-3-3 Raw materials

The specifications of all incoming raw materials shall be documented, as shall the inspection scheme for ensuring their conformity.

6-3-4 Design process

The factory production control system shall document the various stages in the design of products, identify the checking procedure and those individuals responsible for all stages of design.

During the design process itself, a record shall be kept of all checks, their results, and any corrective actions taken. This record shall be sufficiently detailed and accurate to demonstrate that all stages of the design phase, and all checks, have been carried out satisfactorily.

6-3-5 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the declared values of the characteristics are maintained, as confirmed by the initial type tests.

The characteristics that shall be controlled are:

– coating (see clause 5-2-4)
– shape (see clause 5-3-4)
– dimensions and tolerances (see clause 5-3)
– tensile properties (see clause 5-4)
– elastic modulus (see clause 5-5)

The frequency and volume of testing shall be at least that given in Table 3.

Table 4 — Minimum number of units for production control

Characteristic	Clause	Assessment method	Number of units		
			Tightened control T	Normal control N	Reduced control R
Shape	5-3-4	5-3-4	1 test/shift/machine	1 test /day /machine	3 tests /week/machine
Control of shape	-	-	1 test/shift/machine	1 test /day /machine	3 tests /week/machine
Coating	5-2-4	Depending on type of coating	1 test / shift /machine	1 test/day/machine	3 tests/week/machine
Dimensions and tolerances	5-3	5-3	1 test / shift /machine	1 test/day/machine	1 test/week/machine
Tensile properties	5-4	5-4	1 test per shift.	1 test per day.	3 tests per week.
Elastic modulus	5-5	5-5	1 test per shift.	1 test per day.	3 tests per week.
Note :By machine is meant that operation that cuts the fibre to its final dimension. By shift is meant a continuous period of production of up to 8 h.					

The data, together with details and results of inspection, checks and tests shall be recorded. The conditions for switching between the type of control are given in Annex A.

Where possible and applicable, the results of inspections, checks and tests shall be interpreted statistically by attributes or by variables to determine whether the corresponding production conforms to the requirements in this standard and the declared values for the products.

6-3-3 Traceability

Systems of traceability and control of designs, incoming materials, and the use of materials shall be given in the manual or relevant document.

The stock control system of manufactured products shall be given in the manual or relevant document.

6-3-7 Corrective actions for non-conforming products

The immediate actions to be taken when incoming materials or finished products do not conform to the specified requirements shall be described and recorded.

These actions shall include the steps necessary to rectify the deficiency, modify the manual or relevant document if required, identify and isolate the deficient raw or incoming materials and finished products and determine whether they shall be discarded or re-specified under a concessionary system.

7- Packaging and package marking

The material shall be packaged to provide adequate protection during normal handling and transportation, and each package shall contain only one type and size of material unless otherwise agreed upon. The type of packaging and gross mass of containers shall, unless otherwise agreed upon, be at the manufacturer's discretion, provided that they can ensure acceptance by common or other carriers for safe transportation at the lowest rate to the delivery point.

Each shipping container shall be marked with the material, size, type, specification designation, net mass, standard No., manufacturing date, the manufacturer's name or trademark and country of origin.

It shall be marked with the following:

Polymer fibres for structural use are produced under Factory Production Control under surveillance of a Certifying Body as described in JS 2413-2:2024 or equivalent standard.

Any Co Ltd, PO Box 21, B-1050		Country of origin, Name or identifying mark and registered address of the producer
JS 2413-2 or equivalent standard. Polymer fibres for structural use in concrete, mortar and grout Class Ib Length: 50 mm Diameter: 1,00 mm Shape: deformed Tensile strength: 1200 N/mm^2 Effect on strength of concrete: 30 kg/m^3 to obtain 1,5 N/mm^2 at CMOD = 0,5 mm and 1N/mm^2 at CMOD = 3,5 mm. Melting point and point of ignition= declared value. fibres: 2,3 %; Vebe time: 25 s with 30 kg/m^3.		Description of product Information on regulated characteristics

Figure 1 – Example for Package marking

Annex A

(Normative)

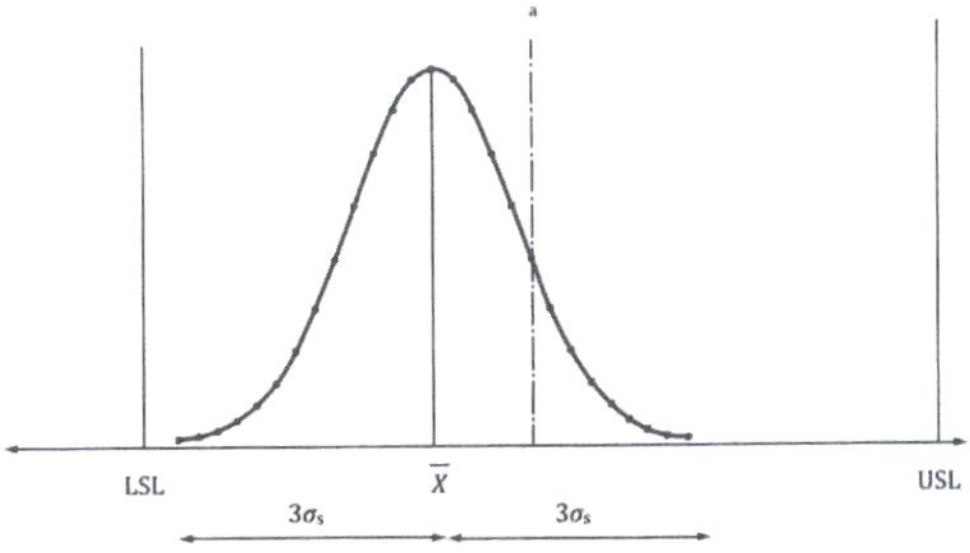
Condition for switching between the control regimes T-N-R

The T-regime shall be applied when starting up a new plant and for at least 6 months.
The manufacturer may switch from the T to the N-regime when all of the following conditions apply:
- Testing has been undertaken for at least 6 months under the T-regime;
-The fibres produced during the last 3 months of production conform to specification.
The manufacturer may switch from the N to the R-regime when all of the following conditions apply:
- the fibres fall within Groups I or II;
- testing has been undertaken for at least 12 months under the N-regime;
- the fibres produced during the last 12 months of production conform to specification;
- the Cpk's of tensile strength and dimensions, calculated from the 3-monthly period of production, are greater than 1 for the last two successive quarters.
The manufacturer shall switch back from R to the N regime if the Cpk on tensile strength or geometry for one quarter becomes smaller or equal to 0,67. Switching back to R is permitted if the Cpk for the next quarter is again higher than 0,67, and if results are according to specification.
Note: The Cpk is the capability index which accounts for process centering and is defined as the minimum of

$$\frac{USL - \overline{X}}{3\sigma_s} \text{ or } \frac{\overline{X} - LSL}{3\sigma_s}$$

USL: upper spread limit, is the declared value plus the deviation of the individual value from Table 1 (or clause 5-3) times the declared value
LSL: lower spread limit, is the declared value minus the deviation of the individual value from Table 1 (or clause 5-3) times the declared value

$\overline{X}$: average value of the characteristic (dimension, tensile strength) of the group of individual results (the number of group given in Table 3), taken over one quarter.
σ_s : standard deviation of the same group of results as the average value, taken over one quarter.



Key
a: Declared value.

Figure A — 1– Calculation of the Cpk-value

Annex B
(informative)
Bibliography

[1] EN ISO 9001, Quality management systems – Requirements – test (ISO 9001:2000).