BRITISH STANDARD

BS IEC 61624:1997

Guidance on the development of lists of maximum allowable temperatures for polymeric compounds used in electrotechnical equipment —

ICS 19.020; 29.035.20

National foreword

This British Standard reproduces verbatim IEC 61624:1997 and implements it as the UK national standard.

The UK participation in its preparation was entrusted by Technical Committee GEL/15, Insulating materials, to Subcommittee GEL/15/5, Methods of test, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the IEC title page, pages ii to iv, pages 1 to 10 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 May 1998

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Amendments issued since publication

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TECHNIQUE – TYPE 2

TECHNICAL REPORT – TYPE 2

IEC 61624

Première édition
First edition
1997-04

Guide pour le développement de listes des températures maximales autorisées concernant les composés polymères utilisés dans le matériel électrotechnique

Guidance on the development of lists of maximum allowable temperatures for polymeric compounds used in electrotechnical equipment

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

Contents

Foreword

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

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The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard, for example “state of the art”.

Technical reports of types 1 and 2 are subject to review within three years of publication to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

IEC 61624, which is a technical report of type 2, has been prepared by subcommittee 15E: Methods of test, of IEC technical committee 15: Insulating materials.

The text of this technical report is based on the following documents:

Committee draft	Report on voting
15E/4/CDV	15E/20A/RVC

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

This document is issued in the type 2 technical report series of publications (according to **G.4.2.2** of Part 1 of the IEC/ISO Directives) as a "prospective standard for provisional application" in the field of polymeric compounds because there is an urgent requirement for guidance on how standards in this field should be used to meet an identified need.

This document is not to be regarded as an "International Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the IEC Central Office.

A review of this type 2 technical report will be carried out not later than three years after its publication, with the options of either extension for a further three years or conversion to an International Standard or withdrawal.

Annex A and Annex B are for information only.

1 Scope

This technical report gives guidance to technical committees wishing to develop lists of maximum allowable temperatures for polymeric compounds under normal and abnormal operating conditions.

It discusses and makes recommendations concerning:

a) the factors which influence the choice of an appropriate method of describing polymeric compounds, bearing in mind the complex recipes of many compounds and the resulting wide ranging properties (see **5.1**);

b) the factors which influence the selection of data for inclusion in lists of maximum allowable temperatures for polymeric compounds under normal operating conditions (see **5.2** and **5.3**);

c) lists for the maximum allowable temperatures for polymeric compounds under abnormal operating conditions (see clause **6**).

In this report the term "temperature" is used, although it is realized that it is customary to use "temperature rise" for practical reasons. One may be converted into the other, given an appropriate reference point, e.g. 25 °C.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this technical report. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this technical report are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60216, *Guide for the determination of thermal endurance properties of electrical insulating materials (being revised).*

IEC 60335-1:1991, *Safety of household and similar electrical appliances — Part 1: General requirements.*

IEC 60695-2-1/0:1994, *Fire hazard testing — Part 2: Test methods — Section 1/sheet 0: Glow-wire test methods — General.*

IEC 60695-2-1/1:1994, *Fire hazard testing — Part 2: Test methods — Section 1/sheet 1: Glow-wire end-product test and guidance.*

IEC 60695-2-1/2:1994, *Fire hazard testing — Part 2: Test methods — Section 1/sheet 2: Glow-wire flammability test on materials.*

IEC 60707:1981, *Methods of test for the determination of the flammability of solid electrical insulating materials when exposed to an igniting source.*

ISO 75-2:1993, *Plastics — Determination of temperature of deflection under load — Part 2: Plastics and ebonite.*

ISO 178:1993, *Plastics — Determination of flexural properties.*

ISO 527-1:1993, *Plastics — Determination of tensile properties — Part 1: General principles.*

ISO 3673-1:1980, *Plastics — Epoxide resins — Part 1: Designation.*

ISO 7391-1:1987, *Plastics — Polycarbonate moulding and extrusion materials — Part 1: Designation.*

3 Definitions

For the purpose of this technical report, the following definitions apply.

3.1
maximum allowable temperature for polymeric compounds under normal operating conditions

the maximum allowable temperature for a specific polymeric compound for safe use in a general electrotechnical application when used under normal operating conditions

3.2
normal conditions

expected most severe thermal conditions that may exist over the long term under which the equipment operates according to its intended use

3.3
abnormal conditions

short-term thermal conditions, with a severity significantly exceeding that found under normal conditions, arising from faults and/or expected short-term abuse

NOTE Abnormal conditions may exist for periods ranging from a few seconds to 10 h during unattended operation (see clause **6**).

3.4
long term

a period of time of the same magnitude as the expected operational life of the equipment, for example for household appliances, in the range 50 h to 8 000 h

3.5
short term

a period of time that is much less than the expected operational life of the equipment

3.6
general electrotechnical applications

use of an electrotechnical product in an environment, where the predominant type of long-term degradation of the product is the result of thermally activated chemical reactions

4 General discussion

4.1 Background

The plastics industry worldwide manufactures upwards of one million different polymeric compounds, many of which find use in electrotechnical equipment as moulded, cast or machined parts.

The range and magnitude of temperature/time exposure over which these parts may be used are dependent upon the property levels that have to be retained for safe storage, handling and use. The properties of these types of materials change with time and temperature with the rate of change also being dependent on temperature. The different properties may change at different rates. Frequently the mode of use and the local environmental conditions also lead to additional stresses which have an effect on the useful life of the materials/parts.

A number of IEC committees have used normative lists of maximum allowable temperatures for parts made of insulating materials under normal operation for many years with apparent success and safety. However, these lists consisted of data for either products manufactured to other IEC standards which gave limiting conditions of use, or parts based on recognized and proven insulation systems, for example motor windings, or insulating materials of the thermosetting type. Thermoplastic insulating materials were specifically excluded from these lists.

Parts made from thermoplastic materials were required to be tested separately with requirements being based on actual temperatures that had been measured during normal and abnormal operation.

The question has now to be asked whether these lists can be safely extended to include thermoplastic materials as well as a wider selection of thermosetting types.

In order to attempt an answer to this question and give guidance, a first requirement is to recognize the major differences between thermosetting and thermoplastic polymers. Thermoplastics can be softened by the action of heat in a reversible manner (Figure 1) and can be more deleteriously affected by common everyday materials than thermosetting types. These, when once formed as cross-linked entities, cannot be melted and are resistant to exposure to many classes of chemicals and everyday environments.

A natural consequence of this behaviour is that under conditions of unforeseen overheating or of unforeseen exposure to deleterious environmental materials in an equipment, thermoplastic parts are likely to present much more of a hazard than parts made from thermosetting types. It is suspected that this factor is the main reason why specific temperatures for thermoplastic materials were excluded from the lists in IEC 60335-1.

Therefore, it is suggested that

a) the present lists should be extendible to include a wider range of thermosetting polymers, and

b) a more detailed analysis of the difficulties surrounding the inclusion of thermoplastic types should be made.

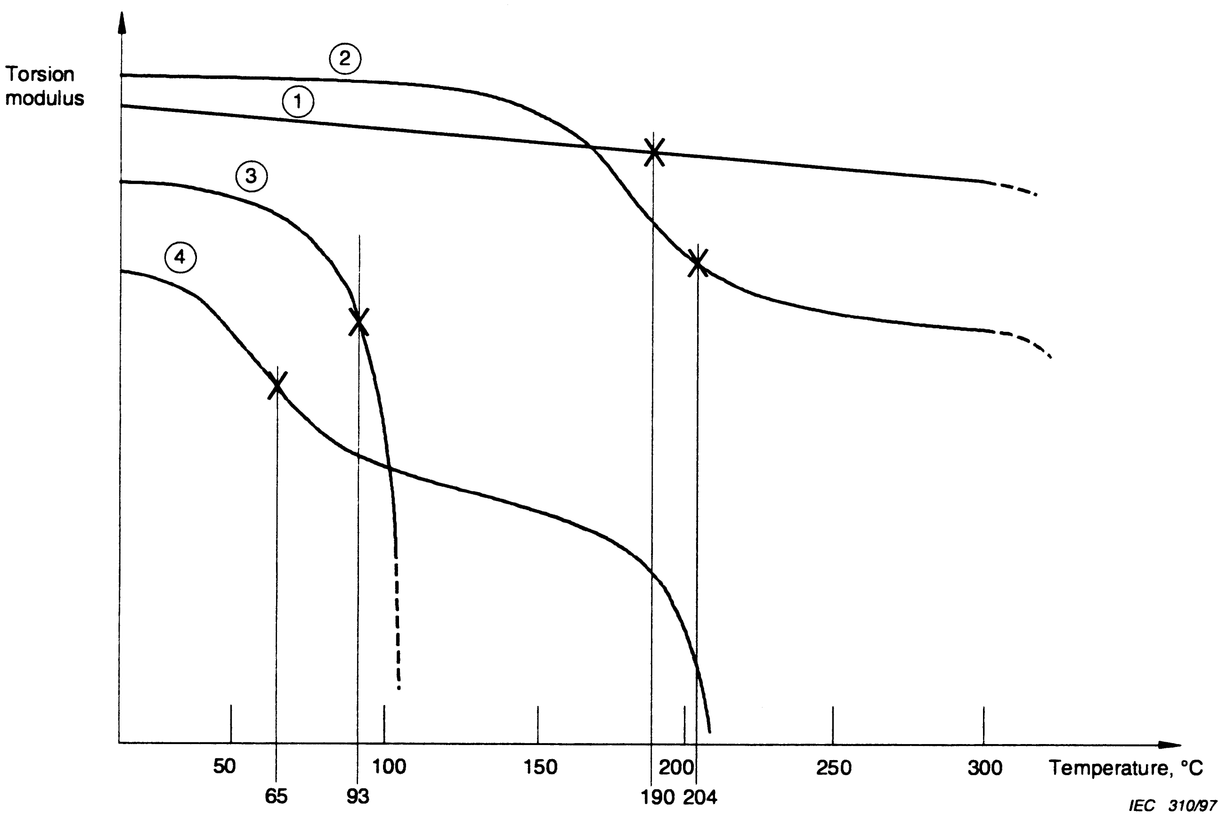
4.2 Thermoplastics

4.2.1 *Materials*

These materials are usually fabricated at elevated temperatures where the viscosity has fallen to a value appropriate to the shaping process. A wide range of additives including other polymers, may be added during that process to tailor the properties of the resulting product to the requirements of the application. Many of the basic polymers are relatively unstable under mildly elevated temperatures and part of the compounding process is usually to incorporate stabilizers to give the degree of thermal endurance required in perceived applications.

As the materials can be re-softened, various cycles of reworking and re-cycling are practised, including the re-use of polymer from end-of-life products after sorting and regrinding operations which may change the properties in a significant manner.

Copolymers, ter-polymers, mixtures of polymers and polymeric alloys are all used in the quest to realize commercially attractive portfolios of properties and improve the price/property ratio, but from the aspect of this report, all add to the complexity of adequately designating a product in a generic manner.



1 Mineral filled phenolic thermoset resin

2 Mineral filled epoxy novolac thermoset resin

3 PMMA: Polymethylmethacrylate

4 Polyamide 6

NOTE DTUL (deflection temperature under load) indicated by "X" on curves.

Figure 1 — Dynamic shear (torsion) modulus versus temperature for representative thermosets and thermoplastics, showing deflection temperature under load at 264 p.s.i. (Modern plastics encyclopaedia) [1]

[1] Modern plastics encyclopedia, McGraw-Hill, 1983-1984, p.405.

For example, an indication of the wide range of compounds, based on propylene as the main monomer, that are available from one polymer manufacturer is given in Annex A. It can be seen that the tensile yield stress (ISO 527-1, 50 mm/min) ranges from 15 MPa to 101 MPa, with corresponding figures for flexural modulus (ISO 178, 10 mm/min) being 0,95 GPa to 7,6 GPa and temperature of deflection under load (ISO 75-2, methods A and B, 1,8 MPa and 0,45 MPa) of 51 °C/93 °C to 153 °C/160 °C. Some 12 different general purpose compounds are made for the domestic appliance market in addition to many specific application grades. These materials will have widely different maximum allowable temperatures under normal operating conditions.

4.2.2 *Polymer property data*

Manufacturers of thermoplastic polymers and polymer suppliers do give advice on the properties of their products to aid designers of equipment and frequently collaborate to develop "application specific" compounds but they do not give any guarantee of safe performance because the demands of designers vary widely. They argue that the manufacturers of equipment have to take that responsibility. In doing so manufacturers of equipment lay down specific limits to the conditions and manner of storage, shipping and use.

Some polymer manufacturers assess the properties of specific grades of polymeric materials with respect to the effect of long-term thermal stresses according to IEC 60216, using stereo-typed end-point criteria, e.g. 50 % retention of tensile strength, and/or impact strength and/or breakdown voltage. These data are frequently included in sales brochures but may not be applicable to the specific application or end-use.

However, the IEC 60216 protocol was deliberately designed to be a simple, basic system to enable comparative data on materials to be obtained. The tests are made on specimens with no additional stressing and the environment is laboratory air in a darkened oven, i.e. it does not simulate use in an equipment where, whilst both standing and in operation, additional stresses are present.

Thus the temperature index (TI), derived according to IEC 60216 cannot be used to indicate the maximum safe working temperature for a polymeric compound, because of the lack of any specific relationship between the chosen end-point criteria and the needs of the part in service. Furthermore, problems of compatibility with adjacent materials and the working environment are not addressed.

Other polymer manufacturers assess the properties of specific grades of polymer with respect to the maximum use temperature by comparative assessment procedures utilizing reference materials of known performance in certain types of application. Relative tests on the candidate material and the reference material are made using similar ageing procedures to those of IEC 60216, but the reported result is based on the performance of the reference material in service, modified by the relative behaviour of the two materials in the ageing tests. Additional short-term tests are made to expose any undue weaknesses in the candidate material's overall property portfolio.

However, even when these additional factors are taken into account, the resulting data is used only for guidance. Long-term performance tests are still made on sub-assemblies or complete equipments.

Whilst equipment manufacturers receive advice from polymer manufacturers, they make their own series of long-term tests using both functional devices, sub-assemblies and complete equipments as part of the development process and to ensure adequate safe long-term performance of their products.

4.3 Summary

It has been seen that:

a) IEC 60335-1 specifically excludes any normative limits for the maximum allowable temperature of thermoplastic polymers under normal operating conditions, requiring specific equipment tests instead;

b) manufacturers of thermoplastic and thermosetting polymers do not guarantee any lower or upper limiting safe working temperatures for their products because these temperatures are very dependent on the requirements of the design;

c) there is no known accepted protocol in the field of international standards which, as a result of tests, would give a normative figure for the maximum allowable temperature under normal operating conditions of thermoplastic polymers. Existing test protocols are used as guidance only;

d) the temperature difference between the maximum safe working temperatures and the temperature where the properties start to fall off rapidly is much smaller for thermoplastic materials than thermosetting types because of the fundamental difference in the shape of the various property/temperature curves (see Figure 1);

e) thermoplastics are more affected by commonly available materials than thermosetting types.

On the basis of the arguments that have been presented:

1) It is not recommended that lists of maximum allowable temperatures for polymeric compounds, especially thermoplastic compounds, used under normal operating conditions should be given normative status because such a recommendation would imply that parts, made of all of the materials falling within the designation and having been shown to be satisfactory in the short term, would give safe performance over the long term under normal conditions in general applications at temperatures up to the listed maximum.

It is acknowledged that careful selection of the listed temperatures, responsible design of parts coupled with the use of recognized grades of polymer would most likely result in safe behaviour and allow the lists to be normative. However, problems of the complex relationship between polymeric compound type and properties, the occasional ill-chosen selection and use of material and attempts to reduce the cost of items giving reduced safety margins would appear to preclude their adoption.

A purist approach would require all lists to be informative, but practically, a more balanced view may be possible without risking safety levels. It is perceived that the margin of safety resulting from the use of responsibly developed normative lists could be adequate for low power, low force electrotechnical products but may tend towards inadequacy as the levels of power and energy are increased.

It is therefore recommended that product committees, with their superior knowledge of their product range and conditions of usage, specify whether any list relating to generic compounds should be normative or informative.

2) A second list should be given showing what operational temperatures had been safely achieved with specific compounds conforming with the listed material designation.

It must be recognized that in the event of a list being developed, because vast ranges of compounds have been developed from most of the generically based polymers, a comprehensive system of designation will be required to differentiate these adequately in a safe manner and also to cover the use of reworked and recycled materials.

5 Lists

The recommended layout for any lists is given in Table 1.

The following subclauses make specific recommendations on the content and structure of clauses associated with lists.

5.1 Selection of data for inclusion under column 1 headed "Material designation"

The object of any proposed list would be to publish guidance as to the maximum safe working temperature of a specific type of polymeric compound where the actual manufacturers' name/commercial polymer designation could not be published.

The designation would need to be sufficiently comprehensive such that any compound falling into the category would meet the indicated performance. The foregoing clauses have shown a need for a comprehensive designation system, but a balance could be expected — the more conservative the list, the less comprehensive the designation required — although presumably this would carry the penalty of a reduced degree of usefulness.

Table 1 — Recommended layout for lists

(Column 1)	(Column 2)	(Column 3)
Material designation	**Maximum allowable temperature for polymeric compound under normal operating conditions**[1)] °C	**Realized performance for specific commercial compounds, used in equipment under normal conditions, and complying with the designation**[1)] °C

[1)] In drafting Table 1, it has been assumed that:

a) there are no extreme geometric or mechanical factors that might have significant effects on the long-term performance e.g. material thinness, high mechanical stress, vibration, fatigue, creep;

b) there are no deleterious environmental materials e.g. excess oxygen, ozone or other gases, excess water or moisture, oils, refrigerants, solvents, food substances, detergents, acids, bases, oxidants, reducers, catalysts;

c) there are no deleterious special environmental radiations e.g. microwaves, IR, intense light, U-rays, X-rays, gamma rays, high energy particles;

d) there are no deleterious special biological factors.

It has to be recognized that the formulation of polymeric compounds is a highly skilled science: components that are included to improve one property can easily give unwanted side-effects and influence other properties. The components of a polymeric formulation can include in addition to the generic base homo/co/terpolymer, additional polymers as mixtures or alloys, heat stabilizers, fillers, reinforcing agents, nucleating agents, curing agents, monomeric/polymeric plasticizers, pigments, flame/fire retardents, etc.

Account would also need to be taken of the frequent differences in additive levels and property values between new material, re-worked material and recycled material.

It may be the case that IEC has published systems of designation and specifications for some of the materials (if so, serious consideration should be given to using those systems). A series of specifications for a range of insulating materials has already been published but to date no standards have been published on polymeric moulding compounds. Systems of designation and classification have been published by ISO, e.g. ISO 7391-1, ISO 3673-1, etc. but there are few corresponding sets of specifications or requirements. Nevertheless, the ISO system of designation and classification for polymers appears comprehensive and could be appropriate as a basis of a listing system (see example in Annex B).

5.2 Selection of data for inclusion under column 2 headed "Maximum allowable temperature for polymeric compounds under normal operating conditions"

In selecting the temperatures due account shall be taken of the normally expected long-term changes in the properties of materials, e.g. mechanical, electrical and flammability properties.

The figures should be based on proven service experience or be relative temperature indices (IEC 60216), recognizing however that any compound falling within the designation and taking into account the caveats, must give satisfactory service over the life of the product, in relation to the influence of the long-term thermal stresses and their effect on the material properties, when used at normal temperatures not exceeding those in column 2.

It is recommended that the following caveats are included adjacent to any table and indicated to be applicable to both entries under this heading and also to those entered according to **5.3**.

The figures in column 2 are necessarily conservative because of the imprecise designations of the materials.

(A method to determine the maximum allowable temperature for polymeric compounds under normal operating conditions, in use in general electrotechnical applications is under consideration.)

5.3 Selection of data for inclusion under column 3 headed "Realized performance for specific commercial compounds, used in equipment under normal conditions, and complying with the designation"

The temperature figures should be based on measurements made on a piece of electrotechnical equipment that has a proven satisfactory service record. The object of the column is to indicate what can be achieved by selection of a commercial compound, falling within the designation. It is assumed that a high performance formulation will be selected to contrast with the necessarily conservative figures included in column 2.

It is recommended that any such column 3 should be referenced to the following paragraph:

> The figures for the maximum allowable temperatures under normal operating conditions in this column 3, which are EXEMPLARY and INFORMATIVE, have been realized in satisfactory long-term service for specific grades of polymers that conform to the generic class. Such temperatures as these are only allowable given proven service experience with the grade of material in use under normal operating conditions in the actual or very similar equipment.

6 Consideration of lists for "Maximum allowable temperatures for polymeric compounds under abnormal operating conditions"

As defined in **3.3**, abnormal conditions are caused by faults and/or foreseeable abuse. They are expected to exist for periods of time not exceeding 10 h for equipment working under "unattended operation" and otherwise for very much shorter periods.

The mechanical stability of parts made from thermoplastic polymeric compounds under abnormal operating conditions is limited by temperatures at which the properties reduce drastically and/or the materials begin to melt. Whilst amorphous thermoplastics normally show a steep decrease of stiffness above a critical temperature, compounds based upon semicrystalline thermoplastics mostly soften stepwise before they finally melt. Technical data concerning the short-time thermal behaviour of materials should always be examined before testing is undertaken.

Because of the potentially large influence of design details on the behaviour of polymers when in use under abnormal conditions, and because such conditions arise from foreseeable causes and only last for periods not exceeding 10 h, the proposals for the extension of the lists to include numerical data giving the maximum allowable temperatures for polymeric compounds under abnormal operating conditions for polymeric compounds is not accepted as either necessary or advisable.

It is recommended that test laboratories should evaluate these short-term effects by simulation. The currently used ball pressure test, measurements of leakage current, and of withstand voltage (see for example IEC 60335-1) all appear to be viable and necessary. The glow wire (IEC 60695-2-1) and/or a flame test (IEC 60707) could be a useful addition to ensure adequate retention of fire resistance properties.

Annex A (informative) Indication of the available range of thermoplastic compounds based on the polymerization of propylene as the only or main monomer

Types of polymers	Homopolymers, random and block copolymers.
Main monomer	Propylene.
Comonomer	Ethylene up to 5 %.
Other types	Elastomer modified.
Reinforcing agent	Coupled glass to 40 %.
Fillers	Calcium carbonate, talc, glass beads, mica, flame retardent glass filled/coupled, mixed minerals, etc.
Range of filler levels	5 % to 40 %.
Levels of stabilization	Light/general purpose/long-term heat endurance, in exacting environments
Range of tensile yield stress (ISO 527, 50 mm/min)	15 MPa to 101 MPa.
Range of flexural modulus (ISO 178, 10 mm/min)	0,95 GPa to 7,6 GPa.
Range of temperature of deflection under load (ISO 75-2, methods A and B, 1,8 MPa/0,45 MPa)	51 °C/93 °C to 153 °C/160 °C.

Annex B (informative) Designation system for thermoplastics

The designation system for thermoplastics is based on the following standardized pattern (ISO 7391-1):

Designation						
Description Block (optional)	Identity Block					
	International Standard	Individual Item Block				
	Number block	Data Block 1	Data Block 2	Data Block 3	Data Block 4	Data Block 5

It consists of an Optional Block, reading "thermoplastics", an Identity Block comprising the International Standard Number and an Individual Item Block. For unambiguous coding, the Individual Item Block is subdivided into five data blocks comprising the following information:

No. 1: Identification of the plastic by its symbol, e.g. PC for polycarbonate;

No. 2: Position 1: intended application or method of processing.
Position 2 to 4: important properties, additives and supplementary information;

No. 3: Designatory properties, e.g. for polycarbonate, the viscosity number, the melt flow rate and the impact strength;

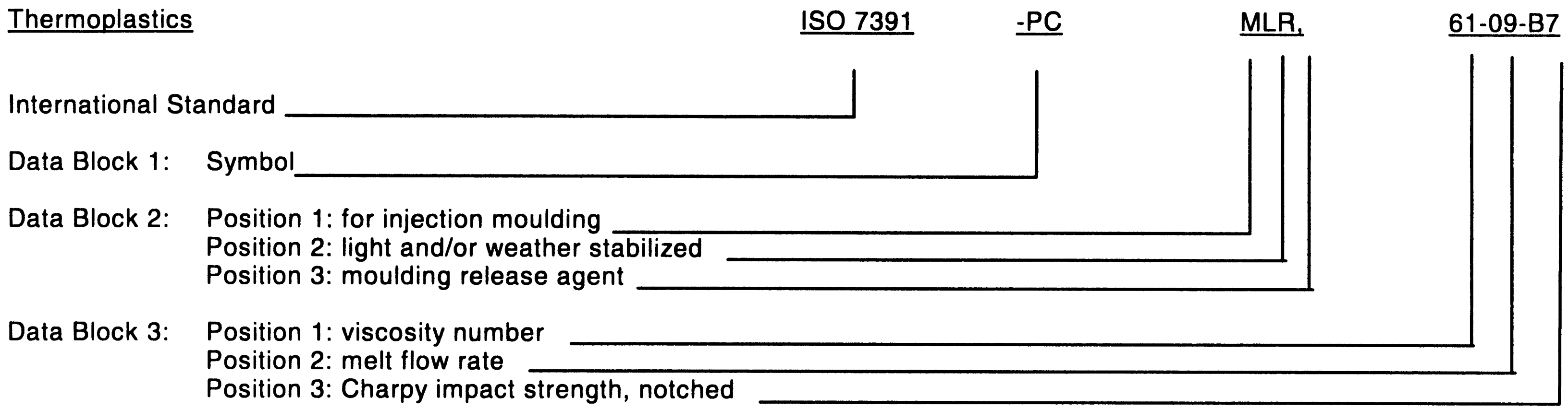
No. 4: Fillers and reinforcing materials and their nominal content;

No. 5: For the purpose of specifications, a fifth data block may be added containing additional information.

For example, from ISO 7391-1:

4 Coding examples

4.1 A polycarbonate (PC) injection moulding (M), light and/or weather stabilized (L), with a moulding release agent (R), with a viscosity number of 59 ml/g (61), a melt flow rate (MFR 300/1,2) of 9,5 g/10 min (09) and a Charpy impact strength, notched, of 35 kJ/m^2 (B7) would be designated:



Designation: ISO 7391-PC, MLR, 61-09-B7

4.2 A polycarbonate (PC) for general use (G) with special burning characteristics ((F),$_2$ with a viscosity number of 56 ml/g (55), a melt flow rate (MFR 300/1,2) of 5,5 g/10 min (05) and a Charpy impact strength, unnotched, of 35 kJ/m^2 (A3) and glass (G) fibre (F) content of 30 % (30) would be designated:

Thermoplastics — ISO 7391 -PC GF 55-05-A3 GF30

International Standard — ISO 7391

Data Block 1: Symbol — -PC

Data Block 2: Position 1: for general use — G
Position 2: special burning characteristics — F

Data Block 3: Position 1: viscosity number — 55
Position 2: melt flow rate — 05
Position 3: Charpy impact strength, unnotched — A3

Data Block 4: reinforced with glass fibres, 27,5 to 32,5 % (by weight) — GF30

Designation: ISO 7391-PC,GF,55-05-A3,GF30
or in shortened form: ISO 7391-PC...,GF30

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