

Glossary of

Terms used in the plastics industry —

Part 1: Polymer and plastics technology

UDC 678.5/.8:001.4

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Foreword

This Part of this British Standard has been prepared under the direction of the Plastics Standards Committee and is a revision of BS 1755-1:1967 and BS 1755:1951 which are therefore withdrawn. This Part of this British Standard is technically equivalent to ISO 472:1979 "*Plastics — Vocabulary*" published by the International Organization for Standardization (ISO) and only differs from ISO 472 in that extra terms are included in Appendix A. These are terms previously in BS 1755:1951 and BS 1755-1:1967 that are in current use and are not included in ISO 472. It is anticipated that these terms will eventually be included in addenda to ISO 472, they will then be inserted into the main text of this standard and deleted from Appendix A by amendment.

For ease of reproduction, the ISO English text has been used with minor changes made, as appropriate. Some terminology and certain conventions, therefore, are not identical with those used in British Standards. ISO 472:1979 in English/French is available for purchase from BSI Sales Department, 101 Pentonville Road, London N1 9ND.

The alphabetical index includes terms from both the main text and Appendix A.

NOTE BS 1755-2 is published separately.

Cross-references. The following references are given for information only.

International Standard	Corresponding British Standard
ISO 291:1977	BS 2782 <i>Methods of testing plastics</i> Part 0:1982 <i>Introduction</i> (Appendix A: Identical)
ISO 1139:1973	BS 946:1970 <i>Method for the designation of yarns</i> (Technically equivalent)
ISO 3534:1977	BS 5532:1978 <i>Statistics — Vocabulary and symbols</i> (Identical)

The technical committee has reviewed the provisions of the following International Standards and has decided that they are acceptable for use in conjunction with this standard.

IEC 50 (05), IEC 93, IEC 167, IEC 250, ISO 48, ISO 177, ISO 194 and ISO 1382
Related British Standards are as follows.

IEC 50(05):1956	BS 4727 <i>Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms</i> Part 1 <i>Terms common to power, telecommunication and electronics</i>
IEC 93:1958	BS 2782 <i>Methods of testing plastics</i> Method 230A:1982 ^a <i>Determination of volume resistivity</i> Method 231A:1982 ^a <i>Determination of surface resistivity</i>
IEC 250:1969	BS 2067:1953 <i>Determination of power-factor and permittivity of insulating materials (Hartshorn & Ward method) and</i> BS 4542:1970 <i>Method for the determination of loss tangent and permittivity of electrical insulating materials in sheet form (Lynch method)</i>
ISO 48:1979	BS 903 <i>Methods of testing vulcanized rubber</i> Part A26:1969 <i>Determination of hardness</i>
ISO 1382:1972	BS 3558:1980 <i>Glossary of terms used in the rubber industry</i>

^a In course of preparation.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 46, an inside back cover 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.

Scope and field of application

This British Standard defines terms used in the plastics industry.

All the terms in the main text are listed in ISO 194, together with the equivalent French and Russian terms.

NOTE 1 All terms are listed according to categories, for which the corresponding Universal Decimal Classification number is given. An index is provided in which the terms are listed alphabetically in normal word order; some terms are also listed in reverse word order.

NOTE 2 Symbols for certain polymers and copolymers are indicated in square brackets, for example, *polycarbonate* [PC]. For terms involving olefins, the name approved by IUPAC is given in square brackets following the name commonly used in the plastics industry, for example, *polyethylene* [polyethene] [PE].

NOTE 3 When a term has one or more permitted synonyms, the synonymous terms follow the preferred term. Deprecated synonymous terms are indicated by "(depreciated)". The expression "Refer to ..." is used to refer to another term (not a synonym) whose definition or note contains information related to the term preceding the expression.

NOTE 4 IUPAC rules for source-based names of polymers specify that when "poly" is followed by more than one word, enclosing marks are used. The IUPAC practice is followed in this International Standard. In common use, the enclosing marks are often omitted.

NOTE 5 Some terms in this British Standard have parenthetical information added to indicate a specific limitation of the term to a particular field.

Explanation of references

IUPAC — The designation "IUPAC" after a definition indicates that it is based on nomenclature developed by the Macromolecular Commission of the International Union of Pure and Applied Chemistry (references 1 to 5).

IUPAP Symbol — The symbols shown are those recommended by the International Union of Pure and Applied Physics (reference 6).

IEC — The designation "IEC" after a definition indicates that it is based on nomenclature developed by the International Electrotechnical Commission (references 7 to 10).

References

1 Report on Nomenclature in the Field of Macro-molecules, International Union of Pure and Applied Chemistry, *Journal of Polymer Science* **8**, pp. 257 to 277 (March 1952).

2 Report on Nomenclature Dealing with Steric Regularity in High polymers, M. L. Huggins, G. Natta, V. Desreux, and H. Mark, *Journal of Polymer Science* **56**, pp. 153 to 161 (1962); *Pure and Applied Chemistry* **12**, pp. 645 to 656 (1966).

Report of the Committee on Nomenclature of the International Commission on Macromolecules, M.L. Huggins, Chairman, *Journal of Polymer Science/Polymer Letters* **6**, p. 257 (1968).

4 IUPAC Information Bulletin No. 35, *Stereochemistry* (June 1969).

5 Basic definitions of terms relating to polymers, 1974. Recommended by the IUPAC Macromolecular Nomenclature Commission. *Pure and Applied Chemistry* **40**, No. 3, pp. 477 to 491 (1974).

6 *Symbols, units, and nomenclature in physics*, International Union of pure and Applied Physics, Document U.I.P. 11 (S.U.N. 65-3), 1965.

7 IEC Publication 50 (05), *International Electrotechnical Vocabulary* (2nd Edition), Group 05, *Fundamental Definitions*.

8 IEC Publication 93, *Recommended methods of test for volume and surface resistivities of electrical insulating materials*.

9 IEC Publication 167, *Methods of test for the determination of the insulation resistance of solid insulating materials*.

10 IEC Publication 250, *Recommended methods for the determination of the permittivity and dielectric dissipation factor of electrical insulating materials at power, audio and radio frequencies including metre wavelengths*.

11 ISO 177, *Plastics — Determination of migration of plasticizers*.

12 ISO 291, *Plastics — Standard atmospheres for conditioning and testing*.

13 ISO 1139, *Textiles — Designation of yarns*.

14 ISO 1382, *Rubber vocabulary*.

15 ISO 3534, *Statistics — Vocabulary and symbols*.

16 *Multilingual collection of terms for welding and allied processes*, Commission of Terminology, International Institute of Welding (IIW), 32 Bd. de la Chapelle, F 75018 PARIS, France.

17 *Nomenclature in Thermal Analysis*, Talanta **16** pp. 1227–1230 (1969). Recommendations of the International Confederation for Thermal Analysis (ICTA).

1 Materials and products

1.1 CHEMICAL NAMES OF MATERIALS¹⁾ (UDC 678.5/8)

1.1.1 acetal plastic: A plastic based on polymers in which the repeated structural units in the chains are of the acetal type, or on copolymers in which acetal and other types of repeated structural units are present in the chains, the acetal component(s) being in the greatest amount by mass.

Refer to *polyoxymethylene plastic* (No. 1.1.74).

1.1.2 acetone resin: A resin made by polycondensation of acetone with another compound, for example formal-dehyde or phenol.

1.1.3 acrylic plastic: A plastic based on polymers made with acrylic acid or a structural derivative of acrylic acid, or their copolymers with other monomers, the acrylic monomer(s) being in the greatest amount by mass.

1.1.4 acrylonitrile-butadiene-styrene [ABS] plastic: A plastic based on terpolymers and/or blends of polymers and copolymers made with acrylonitrile, butadiene and styrene.

1.1.5 acrylonitrile/methyl methacrylate [A/MMA] plastic: A plastic based on copolymers of acrylonitrile and methyl methacrylate.

1.1.6 allyl plastic: A plastic based on allyl resins.

1.1.7 allyl resin: A resin made by polymerization of chemical compounds containing the allyl group.

1.1.8 amino resin: A resin made by polycondensation of a compound containing amino groups, such as urea or melamine, with an aldehyde, such as formaldehyde, or an aldehyde-yielding material.

1.1.9 aminoplastic: A plastic based on amino resins.

1.1.10 aniline-formaldehyde resin: An amino resin made by polycondensation of aniline with formaldehyde.

1.1.11 butylene [butene²⁾] plastic: A plastic based on polymers made by the polymerization of butylene [butene²⁾] or copolymerization of butylene [butene] with other monomers, the butylene [butene] units being in the greatest amount by mass in the copolymer.

1.1.12 carboxymethyl cellulose [CMC]: A glycolic acid ether of cellulose.

1.1.13 casein [CS]: A protein material precipitated from skimmed milk by the action of either rennet or dilute acid.

1.1.14 cellulose acetate [CA]: An acetic acid ester of cellulose.

1.1.15 cellulose acetate butyrate [CAB]: A mixed acetic and butyric acid ester of cellulose.

1.1.16 cellulose acetate propionate [CAP]: A mixed acetic and propionic acid ester of cellulose.

1.1.17 cellulose nitrate [CN]: A nitric acid ester of cellulose.

1.1.18 cellulose propionate [CP]: A propionic acid ester of cellulose.

1.1.19 cellulosic plastic: A plastic based on derivatives of cellulose.

1.1.20 chlorofluorocarbon plastic: A plastic based on polymers made with monomers composed of chlorine, fluorine and carbon only.

1.1.21 chlorofluorohydrocarbon plastic: A plastic based on polymers made with monomers composed of chlorine, fluorine, hydrogen and carbon only.

1.1.22 coumarone resin: A resin made by polymerization of one or more compounds of a type represented by coumarone, indene, their homologues, and their derivatives.

1.1.23 cresol resin: A resin of the phenolic type made by the polycondensation of cresol with aldehydes or ketones.

1.1.24 cresol-formaldehyde [CF] resin: A resin of the phenolic type, made by the polycondensation of cresol with formaldehyde.

1.1.25 epoxy [EP] plastic: A plastic based on epoxy resins.

1.1.26 epoxy [EP] resin: A resin containing epoxy groups capable of crosslinking.

1.1.27 ester plastic: A plastic based on polymers in which the repeated structural units in the chains are of the ester type, or on copolymers in which ester and other types of repeated structural units are present in the chains, the ester component(s) being in the greatest amount by mass.

1.1.28 ethylcellulose [EC]: An ethyl ether of cellulose.

1.1.29 ethylene [ethene²⁾] plastic: A plastic based on polymers of ethylene [ethene²⁾] or copolymers of ethylene [ethene] with other monomers, the ethylene [ethene] being in the greatest amount by mass.

1.1.30 fluorocarbon plastic: A plastic based on polymers made with monomers composed of fluorine and carbon only.

¹⁾ When there is no risk of ambiguity, in common usage the words "plastics" and "resin" are omitted and the plural form of the chemical name used, for example "acetals" and "phenolics".

²⁾ Official IUPAC terminology.

1.1.31 fluorohydrocarbon plastic: A plastic based on polymers made with monomers composed of fluorine, hydrogen and carbon only.

1.1.32 fluoroplastic: A plastic based on polymers made with monomers containing one or more atoms of fluorine, or copolymers of such monomers with other monomers, the fluoro-monomer(s) being in the greatest amount by mass.

1.1.33 furan plastic: A plastic based on furan resins.

1.1.34 furan resin: A resin in which the furan ring is an integral part of the polymer chain, the furan monomer being in the greatest amount by mass.

1.1.35 furfural resin: A resin made by the polymerization or polycondensation of furfural alone or with other compounds, the furfural being in the greatest amount by mass.

1.1.36 hydrocarbon plastic: A plastic based on polymers made with monomers composed of carbon and hydrogen only.

1.1.37 isocyanate plastic: A plastic based on polymers made by the reaction of polyfunctional isocyanates with other compounds.

NOTE Reaction of isocyanates with hydroxyl-containing compounds produces polyurethanes having the urethane group —NH—CO—O— . Reaction of isocyanates with amino-containing compounds produces polyureas having the urea group —NH—CO—NH— .

1.1.38 isocyanurate plastic: A plastic based on polymers in which trimerization of isocyanates incorporates six-membered isocyanurate ring groups in a chain.

NOTE In commercial polyisocyanurate cellular plastics, 10 to 30 % of the available isocyanate groups are reacted with polyols to introduce urethane groups into the chain.

1.1.39 lignin plastic: A plastic based on lignin resins.

1.1.40 lignin resin: A resin made by heating lignin or by reaction of lignin with chemicals or resins, lignin being in the greatest amount by mass.

1.1.41 melamine-formaldehyde [MF] resin: An amino resin made by the polycondensation of melamine with formaldehyde or a compound that is capable of providing methylene bridges.

1.1.42 olefin plastic: A plastic based on polymers made with an olefin (or olefins) or copolymers of such monomers with other monomers, the olefin monomer (or monomers) being in the greatest amount by mass.

1.1.43 perfluoro(ethylene/propylene) [FEP] plastic: A plastic based on copolymers of tetrafluoroethylene and hexafluoropropylene.

1.1.44 phenol-formaldehyde [PF] resin: A resin of the phenolic type, made by the polycondensation of phenol with formaldehyde.

1.1.45 phenol-furfural resin: A resin made by the poly-condensation of phenol with furfural.

1.1.46 phenolic plastic: A plastic based on phenolic resins.

1.1.47 phenolic resin: Generally, a class of resins made by the polycondensation of phenol, its homologues and/or derivatives, with aldehydes or ketones.

1.1.48 polyacetal: A polymer in which the repeated structural unit in the chain is of the acetal type.

Refer to *polyoxymethylene* (No. 1.1.73).

1.1.49 polyacrylate: A polymer of an ester of acrylic acid or of esters of acrylic acid homologues or substituted derivatives.

1.1.50 polyacrylic plastic: An acrylic plastic based on polymers in which the repeated structural units in the chains are essentially all of the acrylic type.

1.1.51 polyacrylonitrile: A polymer of acrylonitrile.

1.1.52 polyamide [PA]: A polymer in which the repeated structural unit in the chain is of the amide type.

1.1.53 polyamide [PA] plastic: A plastic based on polymers in which the repeated structural units in the chains are essentially all of the amide type.

1.1.54 polybutylene [polybutene³⁾]: A polymer of butylene [butene³⁾].

1.1.55 polybutylene [polybutene³⁾] plastic: A butylene [butene³⁾] plastic based on polymers made with butylene [butene] as essentially the sole monomer.

1.1.56 polycarbonate [PC]: A polymer in which the repeated structural unit in the chain is of the carbonate type.

1.1.57 polycarbonate [PC] plastic: A plastic based on polymers in which the repeated structural units in the chains are essentially all of the carbonate type.

1.1.58 polychlorotrifluoroethylene [PCTFE]: A polymer of chlorotrifluoroethylene.

1.1.59 poly(diallyl phthalate) [PDAP]: A polymer of diallyl phthalate.

1.1.60 polyester: A polymer in which the repeated structural unit in the chain is of the ester type.

1.1.61 polyester plastic; alkyd plastic (deprecated): An ester plastic based on polymers in which the repeated structural units in the chains are essentially all of the ester type.

³⁾ Official IUPAC terminology.

1.1.62 polyether: A polymer in which the repeated structural unit in the chain is of the ether type.

1.1.63 polyethylene [polyethene⁴⁾] [PE]: A polymer of ethylene [ethene⁴⁾].

1.1.64 poly(ethylene oxide) [PEOX]: A polymer of ethylene oxide.

1.1.65 polyethylene [polyethene⁴⁾] [PE] plastic: An ethylene [ethene⁴⁾] plastic based on polymers made with ethylene [ethene] as essentially the sole monomer.

1.1.66 poly(ethylene terephthalate) [PETP]: A polymer made by the polycondensation of ethylene glycol and terephthalic acid.

1.1.67 polyisobutylene [poly-2-methylpropene] [PIB]: A polymer of isobutylene [2-methylpropene].

1.1.68 polyisocyanurate

Refer to *isocyanurate plastic* (No. 1.1.38).

1.1.69 poly(methyl methacrylate) [PMMA]: A polymer of methyl methacrylate.

1.1.70 poly(methyl methacrylate) [PMMA] plastic: An acrylic plastic based on polymers made with methyl methacrylate as essentially the sole monomer.

1.1.71 polyolefin: A polymer of an olefin (or olefins).

1.1.72 polyolefin plastic: An olefin plastic based on polymers made with an olefin (or olefins) as essentially the sole monomer (or monomers).

1.1.73 polyoxymethylene [POM]; polyformaldehyde: A polymer in which the repeated structural unit in the chain is oxymethylene.

NOTE Polyoxymethylene is theoretically the simplest member of the generic class of polyacetals.

1.1.74 polyoxymethylene [POM] plastic: An acetal plastic based on polymers in which oxymethylene is essentially the sole repeated structural unit in the chains.

1.1.75 polypropylene [polypropene⁴⁾] [PP]: A polymer of propylene [propene⁴⁾].

1.1.76 polypropylene [polypropene⁴⁾] [PP] plastic: A propylene [propene⁴⁾] plastic based on polymers made with propylene [propene] as essentially the sole monomer.

1.1.77 polystyrene [PS]: A polymer of styrene.

1.1.78 polystyrene [PS] plastic: A styrene plastic based on polymers made with styrene as essentially the sole monomer.

1.1.79 polytetrafluorethylene [PTFE]: A polymer of tetrafluorethylene.

1.1.80 polyurethane [PUR]: A polymer in which the repeated structural unit in the chain is of the urethane type.

1.1.81 poly(vinyl acetal):

1 Generically, a class of polymers derived from polyvinyl esters in which some or all of the acid groups have been replaced by hydroxyl groups and some or all of these hydroxyl groups have been reacted with aldehydes to form acetal groups.

2 Specifically, poly(vinyl acetal) made by the reaction of the hydroxyl group with acetaldehyde.

1.1.82 poly(vinyl acetate) [PVAC]: A polymer of vinyl acetate.

1.1.83 poly(vinyl acetate) [PVAC] plastic: A vinyl acetate plastic based on polymers made with vinyl acetate as essentially the sole monomer.

1.1.84 poly(vinyl alcohol) [PVAL]: A polymer of the hypothetical vinyl alcohol; in practice, it is prepared by the hydrolysis of polyvinyl esters, usually poly(vinyl acetate).

1.1.85 poly(vinyl butyral) [PVB]: A poly(vinyl acetal) made by the reaction of the hydroxyl groups with butyraldehyde.

1.1.86 polyvinylcarbazole [PVK]: A polymer of vinylcarbazole.

1.1.87 poly(vinyl chloride) [PVC]: A polymer of vinyl chloride.

1.1.88 poly(vinyl chloride) [PVC] plastic: A vinyl chloride plastic based on polymers made with vinyl chloride as essentially the sole monomer.

1.1.89 poly(vinyl chloride co vinyl acetate) [VC/VAC]: A copolymer of vinyl chloride and vinyl acetate.

1.1.90 poly(vinyl fluoride) [PVF]: A polymer of vinyl fluoride.

1.1.91 poly(vinyl formal) [PVFM]: A poly(vinyl acetal) made by the reaction of the hydroxyl groups with formaldehyde.

1.1.92 poly(vinylidene chloride) [PVDC]: A polymer of vinylidene chloride.

1.1.93 poly(vinylidene chloride) [PVDC] plastic: A vinylidene chloride plastic based on polymers made with vinylidene chloride as essentially the sole monomer.

1.1.94 poly(vinylidene fluoride) [PVDF]: A polymer of vinylidene fluoride.

⁴⁾ Official IUPAC terminology.

1.1.95 propylene [propene⁵⁾] plastic: A plastic based on polymers of propylene [propene⁵⁾] or copolymers of propylene [propene] with other monomers, the propylene [propene] being in the greatest amount by mass.

1.1.96 silicone (SI) plastic: A plastic based on polymers in which the main polymer chain consists of alternating silicon and oxygen atoms.

1.1.97 styrene plastic: A plastic based on polymers of styrene or copolymers of styrene with other monomers, the styrene being in the greatest amount by mass.

1.1.98 styrene/acrylonitrile plastic: A plastic based on copolymers of styrene and acrylonitrile.

1.1.99 styrene/butadiene [S/B] plastic: A plastic based on copolymers of styrene and butadiene.

1.1.100 styrene/ α -methylstyrene [S/MS] plastic: A plastic based on copolymers of styrene and α -methylstyrene.

1.1.101 styrene-rubber plastic: A plastic based on styrene polymers and rubbers, the styrene polymers being in the greatest amount by mass.

1.1.102 thiourea-formaldehyde resin: An amino resin made by the polycondensation of thiourea (thiocarbamide) with formaldehyde.

1.1.103 unsaturated polyester [UP]: A polyester characterized by carbon-carbon unsaturation in the polymer chain, which permits subsequent crosslinking with an unsaturated monomer or prepolymer.

1.1.104 urea-formaldehyde [UF] resin: An amino resin made by the polycondensation of urea (carbamide) with formaldehyde.

1.1.105 urethane plastic: A plastic based on polymers in which the repeated structural units in the chains are of the urethane type, or on copolymers in which urethane and other types of repeated structural units are present in the chains.

1.1.106 vinyl acetate plastic: A plastic based on polymers of vinyl acetate or copolymers of vinyl acetate with other monomers, the vinyl acetate being in the greatest amount by mass.

1.1.107 vinyl chloride plastic: A plastic based on polymers of vinyl chloride or copolymers of vinyl chloride with other monomers, the vinyl chloride being in the greatest amount by mass.

1.1.108 vinyl resin: A resin made by polymerization of monomers containing the vinyl group.

1.1.109 vinylidene chloride plastic: A plastic based on polymers of vinylidene chloride or copolymers of vinylidene chloride with other monomers, the vinylidene chloride being in the greatest amount by mass.

1.1.110 xylenol resin: A resin of the phenolic type made by the polycondensation of a xylenol with an aldehyde or a ketone.

1.2 GENERAL NAMES OF MATERIALS AND PRODUCTS (UDC 678.00)

1.2.1 bristle: A relatively thick, short section cut from a monofilament.

1.2.2 casting resin: A resin in liquid form that can be poured or otherwise introduced into a mould and shaped without pressure into solid articles.

1.2.3 coating (product): A thin layer of a material applied by a coating process.

1.2.4 coating (process): The process of applying a thin layer of a material in the form of a fluid or powder upon a substrate.

NOTE Laminating is not considered coating.

1.2.5 composite: A solid product consisting of two or more discrete physical phases, including a binding material (matrix) and a particulate, fibrous, or laminar material.

1.2.6 compound: The intimate admixture of a polymer or polymers with other ingredients such as fillers, plasticizers, catalysts and colorants.

1.2.7 dispersion: A heterogeneous system in which a finely divided material is distributed in another material.

1.2.8 dry blend; powder blend: A free-flowing mixture prepared without fluxing or addition of solvent.

1.2.9 elastomer: A macromolecular material which returns rapidly to approximately its initial dimensions and shape after substantial deformation by a weak stress and release of the stress. [See ISO 1382 (Ref. 14).]

NOTE The definition applies to room temperature test conditions.

1.2.10 embossed sheet: A sheet with a textured pattern on one or both sides.

1.2.11 fibre: A unit of matter of relatively short length, characterized by a high ratio of length to thickness.

1.2.12 filament: A single textile element of small diameter and very long length, considered as continuous.

⁵⁾ Official IUPAC terminology.

1.2.13 film: A thin plane product of arbitrarily limited maximum thickness in which the thickness is very small in proportion to length and width, generally supplied in roll form.

Refer to *sheet* (No. 1.2.31).

NOTE The arbitrary thickness limit differs from country to country and often from material to material, but in some cases is 0,25 mm.

1.2.14 gel (noun): The initial jellylike solid phase that develops during the formation of a resin.

1.2.15 latex: A colloidal aqueous dispersion of a polymeric material.

1.2.16 monofilament: A single filament that is strong enough to function as a yarn in commercial textile operations or as an entity in other applications.

1.2.17 moulding (product): An object produced in a closed mould (for example by compression moulding, transfer moulding, injection moulding).

1.2.18 moulding compound: A compound that can be shaped by a moulding process.

1.2.19 multifilament; continuous filament: A class of textile materials consisting of assembled filaments.

1.2.20 non-rigid plastic: A plastic that has a modulus of elasticity in flexure or, if that is not applicable, then in tension, not greater than 70 MPa⁶⁾ under stated conditions.

NOTE Materials are usually classified at standard temperature and relative humidity in accordance with ISO 291 (Ref. 12).

1.2.21 organosol: A suspension of a finely divided polymer in a mixture of plasticizer and a volatile organic liquid.

Refer to *plastisol* (No. 1.2.24).

1.2.22 plastic (noun): A material which contains as an essential ingredient a high polymer and which at some stage in its processing into finished products can be shaped by flow.

NOTE 1 Elastomeric materials, which are also shaped by flow, are not considered as plastics.

NOTE 2 In some countries, particularly in the United Kingdom, the official position now is that it is a permitted option to use the term "plastics" as the singular form as well as the plural form.

1.2.23 plastigel: A gel-like suspension of a finely divided polymer in a plasticizer.

1.2.24 plastisol: A suspension of a finely divided polymer in a plasticizer.

Refer to *organosol* (No. 1.2.21).

NOTE The polymer does not dissolve appreciably in the plasticizer at room temperature but does so at elevated temperatures to form a homogeneous plastic mass (externally plasticized polymer).

1.2.25 preform: A coherent, shaped mass of powdered granular or fibrous plastic moulding compounds, or of a fibrous filler material with or without resin.

1.2.26 premix: An admixture of resin, reinforcement, fillers, etc., not in web or filamentous form, usually prepared by the moulder shortly before use.

1.2.27 resin: A solid, semisolid, or pseudosolid organic material that has an indefinite and often high relative molecular mass, exhibits a tendency to flow when subjected to stress, usually has a softening or melting range, and usually fractures conchoidally. In a broad sense, the term is used to designate any polymer that is a basic material for plastics.

1.2.28 rigid plastic: A plastic that has a modulus of elasticity in flexure or, if that is not applicable, then in tension, greater than 700 MPa⁶⁾ under stated conditions.

NOTE Materials are usually classified at standard temperature and relative humidity in accordance with ISO 291 (Ref. 12).

1.2.29 rubber: An elastomer which can be, or already is modified to a state in which it is essentially insoluble (but can swell) in boiling solvent such as benzene, methyl ethyl ketone, and ethanol-toluene azeotrope. [See ISO 1382 (Ref. 14).]

NOTE A rubber in its modified state cannot be easily remoulded to a permanent shape by the application of heat and moderate pressure; free of diluents, it retracts within 1 min to less than 1,5 times its original length after being stretched at normal room temperature (18 to 29 °C) to twice its length and held for 1 min before release.

1.2.30 semirigid plastic: A plastic that has a modulus of elasticity in flexure or, if that is not applicable, then in tension, between 70 and 700 MPa⁶⁾ under stated conditions.

NOTE Materials are usually classified at standard temperature and relative humidity in accordance with ISO 291 (Ref. 12).

1.2.31 sheet; sheeting: A thin, generally plane product in which the thickness is small in proportion to length and width.

Refer to *film* (No. 1.2.13) and *sheeting* (No. 1.2.32).

1.2.32 sheeting:

1 sheet made in continuous lengths and generally supplied in roll form.

2 A synonym for *sheet* (No. 1.2.31).

1.2.33 shell moulding resin: A resin used in admixture with sand or a ceramic powder in the foundry industry to make thin-walled moulds in which to cast metals.

⁶⁾ 1 MPa = 1 N/mm² · 10 kgf/cm²

1.2.34 suspension: A dispersion of a solid in a liquid.

Refer to *dispersion* (No. 1.2.7).

1.2.35 thermoplastic (noun): A plastic that has thermoplastic properties.

Refer to *thermoplastic* (adjective) (No. 3.5.31).

1.2.36 thermoset (noun): A plastic which, when cured by heat or other means, changes into a substantially infusible and insoluble product.

NOTE This term includes both thermosetting plastics and thermoset plastics.

1.2.37 thermoset plastic: A plastic that has been cured by heat or by other means such as radiation, catalysts, etc., into a substantially infusible and insoluble state.

1.2.38 thermosetting plastic: A plastic that has thermosetting properties.

Refer to *thermosetting* (No. 3.5.32).

1.2.39 unplasticized poly(vinyl chloride): poly(vinyl chloride) without any plasticizer.

NOTE Ingredients added to poly(vinyl chloride), such as stabilizers, lubricants, etc., are not considered as plasticizers in the usual technical sense.

1.2.40 vulcanized fibre: A nearly homogeneous material consisting of hydrated cellulose, made by subjecting cellulose to a parchmentizing process.

1.3 POLYMER TERMINOLOGY (UDC 678.01:541.6)

NOTE Real polymers deviate more or less from ideality on the molecular level. In the following definitions, such deviations are neglected. Nevertheless, these definitions may be applied as well to the predominating structural features of real polymer molecules.

1.3.1 addition polymer: A polymer made by addition polymerization. (IUPAC, Ref. 1.)

1.3.2 addition polymerization; polyaddition: Polymerization by a repeated addition process. (IUPAC, Ref. 4.)

Refer to *polyaddition* (No. 1.3.57).

NOTE The repeated addition process takes place without the splitting off of water or other simple molecules.

1.3.3 alternating copolymer: A copolymer in whose molecules two species of monomeric units are distributed in alternating sequence.

1.3.4 alternating copolymerization: Polymerization in which an alternating copolymer is formed.

1.3.5 A-stage: An early stage in the preparation of certain thermosetting resins, in which the material is still soluble in certain liquids, and fusible.

Refer to *B-stage* (No. 1.3.16), *C-stage* (No. 1.3.31), *resol* (No. 1.3.68).

1.3.6 atactic block: A regular block that has a random distribution of equal numbers of the possible configurational base units. (IUPAC, Ref. 5.)

1.3.7 atactic polymer: A regular polymer whose molecules have a random distribution of equal numbers of the possible configurational base units. (IUPAC, Ref. 5.)

1.3.8 bead polymerization; pearl polymerization: Polymerization in which the monomer is dispersed as relatively large droplets in water or other suitable inert diluent, resulting in a beadlike product.

Refer to *suspension polymerization* (No. 1.3.77).

1.3.9 bipolymer: A polymer derived from two species of monomer. (IUPAC, Ref. 5.)

1.3.10 block: A portion of a polymer molecule comprising many constitutional units that has at least one constitutional or configurational feature not present in the adjacent portions. (IUPAC, Ref. 5.)

See note to *block polymer* (No. 1.3.13).

NOTE The definitions that relate to polymer may also be applied to block.

1.3.11 block copolymer: A block polymer derived from more than one species of monomer. (IUPAC, Ref. 5.)

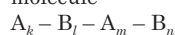
See note to *block polymer* (No. 1.3.13).

1.3.12 block copolymerization: Polymerization in which a block copolymer is formed. (IUPAC, Ref. 5.)

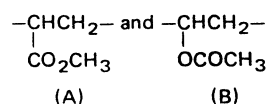
1.3.13 block polymer: A polymer whose molecules consist of blocks arranged linearly.

Refer to *block copolymer* (No. 1.3.11).

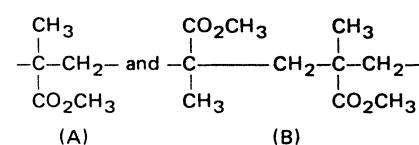
NOTE The blocks are connected directly or through a constitutional unit that is not part of the blocks. In the polymer molecule



A_k , B_l , A_m and B_n are blocks, and the individual blocks are regular. In this block polymer molecule, A and B may be, for example:



The block polymer whose molecules consist of these blocks is a block copolymer because A and B arise from different monomer species. On the other hand, A and B may be, for example:



These blocks are stereoblocks and the block polymer whose molecules consist of these blocks is not a block copolymer because A and B arise from the same monomer species.

1.3.14 block polymerization: Polymerization in which a block polymer is formed. (IUPAC, Ref. 5.)

1.3.15 branched polymer: A polymer composed of molecules having a branched structure, chainlike between branch junctions and between each chain end and a branch junction. (IUPAC, Ref. 1.)

NOTE The branches are composed of mers.

1.3.16 B-stage: An intermediate stage in the reaction of certain thermosetting resins in which the material swells when in contact with certain liquids and softens when heated, but may not entirely dissolve or fuse.

Refer to *A-stage* (No. 1.3.5), *C-stage* (No. 1.3.31), *resitol* (No. 1.3.67).

1.3.17 bulk polymerization; mass polymerization: Polymerization in which the monomer (gas, liquid or solid) is in a homogeneous phase without solvent or dispersing medium.

1.3.18 chain length: The total length of a chain molecule measured from atom to atom along the chain. (IUPAC, Ref. 1.)

NOTE This term should not be used for the direct distance between the ends of the molecule.

1.3.19 chirality: The property of non-identity of a molecule with its mirror image.

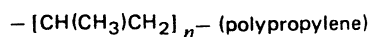
NOTE A molecule in a given configuration or conformation is termed chiral when it is not identical with its mirror image. All asymmetric molecules are chiral; however, not all chiral molecules are asymmetric, since some molecules having axes of rotation are chiral. Chiral and pro-chiral atoms are sites or potential sites, respectively, of stereoisomerism. (IUPAC, Ref. 4.)

1.3.20 condensation polymer; polycondensate: A polymer made by condensation polymerization. (IUPAC, Ref. 1.)

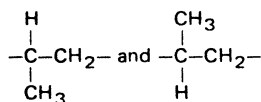
1.3.21 condensation polymerization; polycondensation: Polymerization by a repeated condensation process (i.e. with the elimination of simple molecules). (IUPAC, Ref. 5.)

1.3.22 configurational base unit: A constitutional repeating unit whose configuration is defined at least at one site of stereoisomerism in the main chain of a polymer molecule. (IUPAC, Ref. 5.)

NOTE In a regular polymer, a configurational base unit corresponds to the constitutional repeating unit. In the regular polymer molecule



the constitutional repeating unit is $-\text{CH}(\text{CH}_3)\text{CH}_2-$ and the configurational base units are



These two configurational base units are enantiomeric to each other.

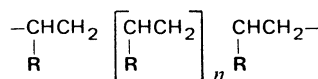
1.3.23 configurational repeating unit: The smallest set of one, two, or more successive configurational base units that prescribes configurational repetition at one or more sites of stereoisomerism in the main chain of a polymer molecule. (IUPAC, Ref. 5.)

See notes to *isotactic polymer* (No. 1.3.46) and *syndiotactic polymer* (No. 1.3.78).

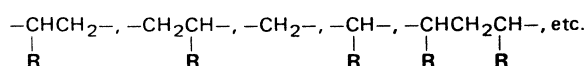
1.3.24 configurational unit: A constitutional unit having one or more sets of defined isomerism. (IUPAC, Ref. 5.)

1.3.25 constitutional repeating unit: The smallest constitutional unit whose repetition describes a regular polymer. (IUPAC, Ref. 5.)

NOTE The polymer chain



can provide the following constitutional units:



Only the first two constitutional units are the smallest ones completely describing this polymer chain. Either of these two constitutional units is a constitutional repeating unit and the polymer whose molecules can be described by the polymer chain shown above is a regular polymer.

1.3.26 constitutional unit: A species of atom or group of atoms present in a chain of a polymer or oligomer molecule. (IUPAC, Ref. 5.)

See note to *constitutional repeating unit* (No. 1.3.25).

1.3.27 copolymer: A polymer derived from more than one species of monomer. (IUPAC, Ref. 5.)

1.3.28 copolymerization: Polymerization in which a copolymer is formed. (IUPAC, Ref. 5.)

1.3.29 crosslink (verb): To form multiple intermolecular covalent or ionic bonds between polymer chains.

1.3.30 crosslinking: The process of multiple intermolecular covalent or ionic bonding between polymer chains.

1.3.31 C-stage: The final stage in the reaction of certain thermosetting resins, in which the material is practically insoluble and infusible. The resin in a fully cured thermoset moulding is in this stage.

Refer to *A-stage* (No. 1.3.5), *B-stage* (No. 1.3.16), *resite* (No. 1.3.66).

1.3.32 degree of polymerization:

1 The (average) number of base units per molecule if the molecules are composed of regularly repeating units.

2 The (average) number of mers (real or hypothetical) per molecule if the molecules have been (or could hypothetically be) produced by polymerization from identical monomers. (IUPAC, Ref. 1.)

NOTE The two definitions are not necessarily equivalent; for example, for polyethylene, the base unit is CH_2 ; the mer is C_2H_4 .

1.3.33 degree of polymerization of a molecule of a polymer: The number of monomeric units in a molecule of a polymer. (IUPAC, Ref. 5.)

1.3.34 degree of polymerization of a polymer: The average value of the degree of polymerization of the molecules of a polymer. (IUPAC, Ref. 5.)

NOTE The method of averaging must be stated; for example number-average or mass-average degree of polymerization.

1.3.35 emulsion polymerization: Suspension polymerization in which emulsifying agents are used to disperse and stabilize the monomer as very fine droplets, resulting in the production of a latex.

1.3.36 enantiomeric configurational unit: Either one of two configurational units that are mirror images at the plane containing the main-chain bonds.

1.3.37 graft copolymer: A graft polymer derived from more than one species of monomer. (IUPAC, Ref. 5.)

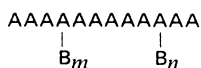
See note to *graft polymer* (No. 1.3.39).

1.3.38 graft copolymerization: Polymerization in which a graft copolymer is formed. (IUPAC, Ref. 5.)

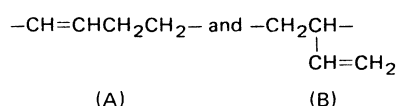
1.3.39 graft polymer: A polymer whose molecules have one or more species of block connected to the main chain as side chains, these side chains having constitutional or configurational features different from the constitutional units comprising the main chain, exclusive of junction points. (IUPAC, Ref. 5.)

Refer to *graft copolymer* (No. 1.3.37).

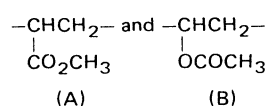
NOTE In the graft polymer molecule



the A-chain, B_m and B_n are regular blocks, the A-chain is the main chain, and B_m and B_n are the side-chain grafts. The — A — units are junction points and are considered to be part of the main chain. Where A and B are derived from the same monomer, for example:



the polymer is a graft polymer. The graft polymer whose molecules consist of



is a graft copolymer.

1.3.40 graft polymerization: Polymerization in which a graft polymer is formed. (IUPAC, Ref. 5.)

1.3.41 high polymer: A substance composed of polymers of high relative molecular mass. (IUPAC, Ref. 1.)

NOTE In general, a linear polymer of a given series is considered a high polymer if its physical properties (especially its viscoelastic properties) do not vary markedly with the relative molecular mass. This term is customarily shortened to “polymer”.

1.3.42 homopolymer: A polymer derived from one species of monomer. (IUPAC, Ref. 5.)

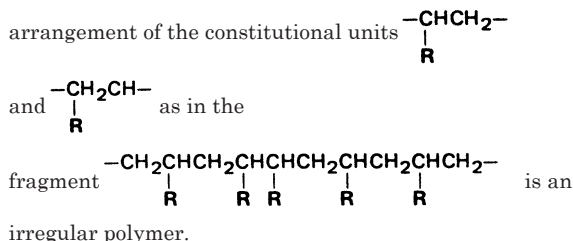
1.3.43 homopolymerization: Polymerization in which a homopolymer is formed. (IUPAC, Ref. 5.)

1.3.44 irregular block: A block that cannot be described by only one species of constitutional repeating unit in a single sequential arrangement. (IUPAC, Ref. 5.)

1.3.45 irregular polymer: A polymer whose molecules cannot be described by only one species of constitutional unit in a single sequential arrangement. (IUPAC, Ref. 5.)

Refer to *regular polymer* (No. 1.3.65).

NOTE The polymer whose molecules consist of a random arrangement of the constitutional units

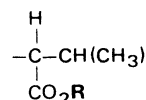


1.3.46 isotactic polymer: A regular polymer whose molecules can be described by only one species of configurational base unit (having chiral or prochiral atoms in the main chain) in a single sequential arrangement. (IUPAC, Ref. 5.)

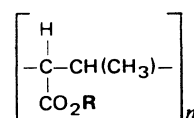
See note to *stereorepeating unit* (No. 1.3.74).

Refer to *chirality* (No. 1.3.19), *sequential arrangement* (No. 1.3.69).

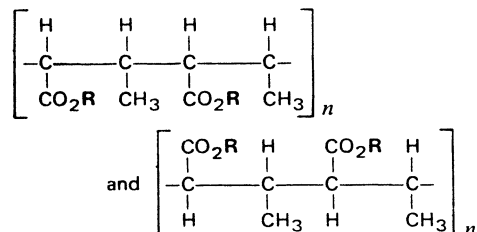
NOTE In an isotactic polymer molecule the configurational repeating unit is identical with the configurational base unit. In the polymer $[\text{CH}(\text{CO}_2\text{R})\text{CH}(\text{CH}_3)]_n$ —, if only one main-chain stereoisometric site of each constitutional repeating unit is defined, as in



it is a configurational repeating unit and the corresponding polymer



is an isotactic polymer. It is not a stereoregular polymer because the configuration at the stereoisometric centre – $\text{CH}(\text{CH}_3)$ – is not defined. The following diisotactic polymers are stereoregular:



1.3.47 ladder polymer; double-strand polymer:

A polymer that has a double-stranded main chain.

1.3.48 linear polymer: A polymer in which the mers are bound to each other in a chain having no branches.

1.3.49 macromolecule: A very large molecule (organic or inorganic). (IUPAC, Ref. 1.)

Refer to *polymer* (No. 1.3.58), *high polymer* (No. 1.3.41).

1.3.50 monomer: A compound consisting of molecules each of which can provide one or more constitutional units. (IUPAC, Ref. 5.)

1.3.51 monomeric unit; mer: The largest constitutional unit contributed by a single monomer molecule in a polymerization process. (IUPAC, Ref. 5.)

1.3.52 network: The interlacing structure produced by crosslinking of polymer chains.

Refer to *network polymer* (No. 1.3.53).

1.3.53 network polymer: A polymer in which a three-dimensional structure is formed by interchain covalent bonds.

1.3.54 novolak: A phenolic resin containing less than a 1 : 1 ratio of formaldehyde to phenol so that normally it remains thermoplastic until heated with an appropriate amount of a compound (for example formaldehyde or hexamethylenetetramine) capable of giving additional linkages, thereby producing an infusible material.

Refer to *resol* (No. 1.3.68).

1.3.55 oligomer: A substance composed of molecules containing a few of one or more species of atoms or groups of atoms (constitutional units) repetitively linked to each other. (IUPAC, Ref. 5.)

NOTE The physical properties of an oligomer vary with the addition or removal of one or a few of the constitutional units from its molecules.

1.3.56 oligomerization: The process of converting a monomer or a mixture of monomers into an oligomer. (IUPAC, Ref. 5.)

1.3.57 polyaddition: Broadly, synonymous with *addition polymerization* (No. 1.3.2). In a restricted sense, the chemical reaction in which polymers are formed by addition of monomers other than those containing carbon-carbon unsaturated bonds (for example, reactions of epoxy, isocyanate, or lactam monomers).

1.3.58 polymer: A substance composed of molecules characterized by the multiple repetition of one or more species of atoms or groups of atoms (constitutional units) linked to each other in amounts sufficient to provide a set of properties that do not vary markedly with the addition or removal of one or a few of the constitutional units. (IUPAC, Ref. 5.)

1.3.59 polymerization: The process of converting a monomer or a mixture of monomers into a polymer. (IUPAC, Ref. 5.)

1.3.60 prepolymer: A polymer of degree of polymerization intermediate between that of the monomer or monomers and the final polymer.

1.3.61 quaterpolymer: A polymer derived from four species of monomer. (IUPAC, Ref. 5.)

1.3.62 random copolymer: A copolymer in whose molecules two or more species of monomeric units are distributed in random sequence. (IUPAC, Ref. 5.)

1.3.63 random copolymerization:

Polymerization in which a random copolymer is formed. (IUPAC, Ref. 5.)

1.3.64 regular block: A block that can be described by only one species of constitutional repeating unit in a single sequential arrangement. (IUPAC, Ref. 5.)

See note to *block polymer* (No. 1.3.13).

1.3.65 regular polymer: A polymer whose molecules can be described by only one species of constitutional unit in a single sequential arrangement. (IUPAC, Ref. 5.)

See note to *constitutional repeating unit* (No. 1.3.25).

Refer to *irregular polymer* (No. 1.3.45).

1.3.66 resite: A phenol-formaldehyde resin in the final state of the curing process. In this stage it is insoluble in alcohol and acetone, and infusible.

Refer to *C-stage* (No. 1.3.31).

1.3.67 resitol: A phenol-formaldehyde resin in the transition state of the curing process. Under heating, it softens to rubberlike consistency, but without melting. It swells when it is immersed in alcohol or acetone, but does not dissolve.

Refer to *B-stage* (No. 1.3.16).

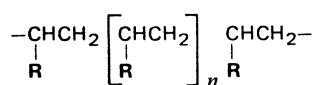
1.3.68 resol: A fusible, soluble, phenolic resin containing sufficient reactive methylol groups to enable the resin to become infusible on further reaction.

Refer to *A-stage* (No. 1.3.5), *novolak* (No. 1.3.54).

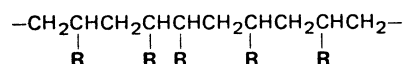
1.3.69 sequential arrangement (in polymer molecules): The arrangement of constitutional units in a polymer chain.

NOTE The constitutional unit $\begin{array}{c} \text{---CHCH}_2\text{---} \\ | \\ \text{R} \end{array}$ in the polymer

molecule represented by the fragment



is in one sequential arrangement only (head-to-tail). In the polymer molecule represented by the fragment



there is more than one sequential arrangement of the constitutional unit.

1.3.70 solution polymerization: Polymerization in which the monomer, dissolved in a solvent, reacts to form a polymer which may be soluble or insoluble in the solvent.

1.3.71 stereoblock: A regular block that can be described by one species of stereorepeating unit in a single sequential arrangement. (IUPAC, Ref. 5.)

1.3.72 stereoblock polymer: A polymer whose molecules consist of stereoblocks connected linearly. (IUPAC, Ref. 5.)

See note to *block polymer* (No. 1.3.13).

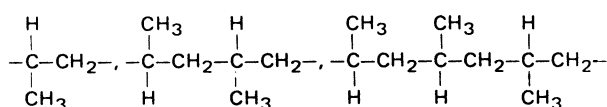
1.3.73 stereoregular polymer: A regular polymer whose molecules can be described by only one species of stereorepeating unit in a single sequential arrangement. (IUPAC, Ref. 5.)

See notes to *stereorepeating unit* (No. 1.3.74), *isotactic polymer* (No. 1.3.46), *syndiotactic polymer* (No. 1.3.78).

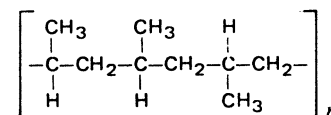
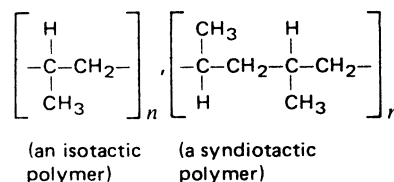
NOTE A stereoregular polymer is always a tactic polymer, but a tactic polymer is not always stereoregular since a tactic polymer need not have every site of stereoisomerism defined.

1.3.74 stereorepeating unit: A configurational repeating unit having defined configuration at all sites of stereoisomerism in the main chain of a polymer molecule. (IUPAC, Ref. 5.)

NOTE In a stereoregular polypropylene, the three simplest possible stereorepeating units are:



The corresponding stereoregular polymers are:



1.3.75 stereoselective polymerization:

Polymerization in which a polymer molecule is formed from a mixture of stereoisomeric monomer molecules by incorporation of only one stereoisomeric species. (IUPAC, Ref. 5.)

1.3.76 stereospecific polymerization:

Polymerization in which a tactic polymer is formed. (IUPAC, Ref. 5.)

1.3.77 suspension polymerization:

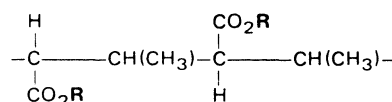
Polymerization in which the monomer is dispersed as fine droplets in water or other suitable inert diluent.

Refer to *bead polymerization* (No. 1.3.8).

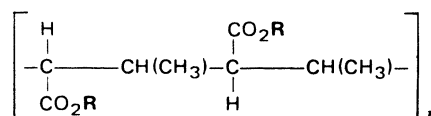
1.3.78 syndiotactic polymer: A regular polymer whose molecules can be described by alternation of configurational base units that are enantiomeric. (IUPAC, Ref. 5.)

See note to *stereorepeating unit* (No. 1.3.74).

NOTE In a syndiotactic polymer, the configurational repeating unit consists of two configurational base units that are enantiomeric. An example is the configurational repeating unit:



and the corresponding polymer is:



It is not a stereoregular polymer because the configuration at the stereoisomeric centre $\text{---CH(CH}_3\text{)---}$ is not defined. Similarly

