Chemical Resistance Data Sheets

VOLUME 2

Edited by
R.P. Brown and L.T. Butt

RAPRA
Rubber and Plastics Research Association of Great Britain
Shawbury Shrewsbury SY4 4NR England

Contents

DATA SHEETS

Each sheet is identified by the letters RA, RB, PA or PB, indicating the series to which it belongs, and one of the serial numbers given below:

REFERENCE SHEETS:

Introduction

In the course of its everyday work, RAPRA receives many enquiries from Member companies on specific problems of chemical attack and swelling. In dealing with these some use is made of published charts and tables which indicate in general terms which plastics or rubbers are likely to resist a given fluid. Though such qualitative tables have proved helpful, their criteria of chemical resistance are unspecified and their assessments are not clearly defined. Terms such as "resistant", "attacked", "good", "poor", and "fair" are subjective and could be applied to a fairly broad range of conditions. Furthermore, comparison of these tables sometimes reveals contradictory assessments.

POLICY

However, there also exists a considerable amount of published information giving quantitative evaluations of the behaviour of polymers in fluids, e.g. swelling tests, effects of immersion on mechanical properties, and stress-cracking studies, and we are attempting to bring together such data in a systematic form, mainly for use in answering specific enquiries. It is true that quantitative assessments themselves can, on occasion, be misleading and that the criteria used may not be the most realistic in a given situation. Nevertheless, short of first-hand experience, this is the best type of information available at present. In the end, it is the user who must decide whether a particular plastics or rubber is likely to meet the requirements of his particular application, and we feel that if he is given reliable figures for the performance of a defined material under known conditions and interprets them carefully, his decision will be made on a reasonably sure basis.

The data sheets in this volume are a by-product of the RAPRA file and must be regarded in the light of the policy indicated above: the figures quoted have been obtained from many different sources and discretion should be used in comparing the performances of the various polymers. As a general rule we have selected data for the longest period of continuous immersion of a material of known composition and characteristics in a given fluid, at room temperature and at the highest temperature for which figures are available. The values quoted are, therefore, not necessarily the best that might be achieved but they are believed to be sufficiently representative to enable an accurate opinion to be reached regarding the suitability of the material for a given application. Where insufficient information has been found in the literature, tests have been specially run in the RAPRA laboratories.

PROGRAMME

We hope to publish a series of sets of data sheets during the next few years. All will be in loose-leaf form, suitable for insertion in the special binder which is available to subscribers. The collection is expected eventually to comprise 8 sets, consisting of 24 data sheets (plus bibliographical material), each sheet listing data on the resistance of 6 plastics or rubbers to a given fluid:

Revised: January 1971

Part 1 (Serial numbers RA1 to 24): Data on a first series of 24 fluids for 6 rubbers
Part 2 (Serial numbers PA1 to 24): Data on a first series of 24 fluids for 6 plastics
Part 3 (Serial numbers RA25 to 48): Data on a second series of 24 fluids for first series of 6 rubbers
Part 4 (Serial numbers PB25 to 48): Data on a second series of 24 fluids for first series of 6 plastics
Parts 5 to 8 (Serial numbers RB, PB 1 to 48): Data on 48 Fluids for two further series of rubbers and plastics.

The fluids chosen are those for which most data are available in the literature; they are representatives of the main types of industrial chemicals: inorganic and organic acids, alkalis, salts, esters, ketones, hydrocarbons etc. Ultimately, 48 fluids in all will be covered and these are expected to correspond roughly to the fluids listed in specifications such as ISO Recommendation R175-1961 and ASTM D543-67.

The polymers selected for study are those believed to be of most interest from the point of view of chemical plant, oil-seals, tubing and hose, and similar applications. They will ultimately number 12 rubbers and 12 plastics.

In addition to the synoptic type of data sheet, it is felt that there is a need to bring together information on the chemical resistance of certain individual polymers from different sources, to enable studies to be made of the differences in results due to such factors as compounding variables, test conditions, polymer crystallinity, and so on. Consideration is, therefore, being given to the publication of "monographs" on a few of the more common plastics and rubbers, summarising whatever data we have in our files at the time of publication.

The above programme represents a formidable amount of work: to fill the weight or volume change column alone on all the data sheets will require over 2000 values. It is too much to expect that all these will be found in the published literature and RAPRA is carrying out practical work to fill some of the inevitable gaps. However, the facilities we can devote to this purpose are limited and we hope that interested Members, who may themselves have carried out tests, will be prepared to contribute their results. Some, indeed, have already done so and we expect to incorporate their data in future parts of this publication or in the monographs. Any readers interested in helping with this project are invited to write for further details.

ACKNOWLEDGEMENTS

The sources used in the compilation of the present sets of data sheets are listed in the bibliographical section. Most of them are readily available trade publications but we would particularly like to acknowledge the cooperation of Farbenfabriken Bayer AG and Imperial Chemical Industries Ltd. in allowing us to make use of publications with more restricted circulation. We also wish to thank Mr. V. Evans of Prodorite Ltd. and Mr. J.D.D. Morgan and Mr. D. Street of ICI Ltd., Mond Division for valuable comments.

Chemical Resistance of Rubbers and Plastics

The practical applications of chemical resistance so far as high polymers are concerned are so subject to variation that it would be misguided to attempt to produce a text book. For this reason, it must be emphasized that the present volume in no way seeks to do this. It is rather a compilation of reliable published data from which the chemical engineer may be helped to reach a decision on the possibility of using high polymers in the chemical environments detailed in the following pages.

The ways in which polymers can be attacked are basically two in number.

SWELLING BY INERT LIQUIDS

Recent work directed towards the prediction of a polymer's resistance to swelling fluids on theoretical grounds is well-known. For a convenient account of this, the reader's attention is directed towards the paper by Beerbower, Kaye and Pattison (1), which deals with the use of what are termed the 'three solvency indices', solubility parameter (i.e. the square root of the cohesive energy density), hydrogen bonding and dipole moment. This is not the place to deal with these concepts, but it may be remarked that although such theoretical treatment can be of great use as a preliminary sorting process, in the final analysis the practical plant designer will not be satisfied with this. It is certain that if materials for a component which is vital to the successful operation of a process have to be examined, then practical measurement of the environment's effect on physical properties is required.

CHEMICAL ATTACK

In addition to attack from swelling agents there is chemical attack by degradation, in which instance the application of 'solvency indices' is clearly of little relevance. Degradation implies an alteration of the chemical structure of the polymer, whether by simple chain scission or by more complex alteration of molecular structure. In such cases, testing is essential.

While it is our belief that the data sheets which follow will prove useful, there are certain generalisations which must be borne in mind when using them.

(i) Effects of Temperature

We have here given measurements which have been obtained at ambient and at elevated temperature. Inevitably, cases will arise where information on a polymer's behaviour at very low or high temperatures is required. In these cases, it is not sufficient to carry out a mental extrapolation. At low temperatures, a rubber hardens and its rigidity (as shown by modulus measurements) increases. This effect would be critical in an application involving its use as a seal. Similarly, a plastic material such as PVC would become more susceptible to impact, and the risk of a curtailed life thus increased.

At elevated temperatures chemical attack is accelerated and other complicating features arise, such as oxidation, cross-linking and chain scission. The accuracy of accelerated immersion tests carried out in industrial laboratories must be open to question, owing to the possible complexity of degradation processes and the complications produced by sample thicknesses, e.g. variable degrees of oxidation, although Orzhakhovskii (2) has predicted the service life of thin films in simple chemical environments by extrapolation techniques.

Similarly, in the case of inert swelling agents, temperature can affect both the penetration rate and the equilibrium swelling value. For a discussion of this aspect, the reader is referred to a paper recently published by Blow, Exley and Southwart (3).

(ii) Effects of Pressure and Stress

Polymers are not often used as constructional materials in plants which deviate greatly from ambient pressures, although their importance for ancillary purposes remains, particularly their use as sealants, when their permeability to gases has to be considered.

However, the effects of inbuilt stress on plastics being used in contact with chemical media has recently come into prominence owing to a number of plant failures. In particular stress-cracking has been observed on or near weld areas. Quite clearly, it is not possible to gain information on this point from normal immersion tests; however, the Bell Telephone Laboratories test gives a rapid relative assessment of the ability of liquids to crack polyethylenes (ASTM D 1693-66) and Manin and his co-workers (4) have proposed methods to indicate the corrosion resistance of rigid and semi-rigid plastics both under static and under dynamic oscillating loads.

(iii) Compounding and Cure of Rubber

This subject introduces many variables which, however, probably need only be taken into consideration when the question of use is not clear-cut. That is to say, when an elastomer is known to be perfectly chemically resistant to an environment compounding exerts relatively little influence; the same obviously applies in cases of severe attack. In the instances where some attack is recorded, and when no better material is available, then compounding and processing can tip the balance.

In the case of swelling agents it is evident that reduction of available rubber by an increase of compounding ingredients will in itself reduce the volume increase.

The following factors are possibly of most importance:

(a) Fillers

Quite clearly only inert fillers must be used at any time where chemical attack is involved. When choosing between blacks on the one hand, and possible non-reinforcing alternatives on the other, it will be apparent that the former present advantages in that they are lighter and therefore more economical when purchasing by weight. Further, while siliceous fillers are normally classified as inert materials, they are susceptible to attack by certain fluorine compounds and hot concentrated alkalies.

Zuev (5) has examined the behaviour of stressed vulcanisates in corrosive media while varying the type and amount of filler used. It was found that when employing fillers which increase the chemical strength and stability of the vulcanisate a higher stress is required to cause break in a given time.

Apart from this, a comparison (6) of the behaviour of a white clay compound of EPR with a carbon black compound when immersed under no stress in a variety of fluids, both organic and inorganic, leads to the general conclusion that when attack occurs it is normally more severe in the former case. However, in the particular instance of swelling fluids, it is known that graphite, by virtue of its laminar structure can impede penetration and use of this fact has been made in, for example, certain commercially available ebonite linings.

(b) Vulcanising systems

Where resistance to heat is a prime requirement, a suitable system will automatically be employed. Insofar as pure resistance to chemical attack is concerned, it will be generally good practice to obtain the 'tightest' possible cure. A maximum of cross-links will also keep swelling to a minimum.

(c) Plasticisers and extenders

These can frequently be leached out of compounds particularly when in contact with organic fluids. The use of plasticisers is particularly widespread in the case of nitrile rubbers and when used for applications such as oil resistance considerable losses may occur. However, in practice, as long as drying out of the material does not occur failure for this cause is unlikely since the plasticiser is replaced by the fluid.

(iv) Compounding of Plastics

In general the compounding of plastics is less complex than conventional rubber compounding although plasticised PVC compounds are an exception. These are not normally employed where solvent resistance is required since, for example, plasticiser migration can readily occur. However, they are quite extensively used for linings under acid conditions, particularly in metal descaling and pickling tanks. Unplasticised PVC is extensively used in chemical plant construction, and here the factor of greatest importance will be polymer type, in particular whether it is a copolymer or whether a second polymer has been introduced for other reasons. Similarly, in the case of polyethylenes, molecular weight is a critical factor in determining resistance to environmental stress-cracking.

Use of Tables

The properties of non-metallic materials in general are not nearly so well known to engineers as those of metals. Ignorance of polymers' properties both on the part of design and plant operating engineers must be responsible for many plant failures and consequent loss of production. Whenever the factory is large enough to justify the employment of a materials specialist the engineer should turn to him for advice. In cases where there is no such person available it is worth while consulting an independent testing laboratory, the raw material supplier or a professional consultant. These tables are intended principally for the materials specialist, but other technical personnel may also find it necessary to make use of them. Many polymer manufacturers are now publishing actual test data, but to our knowledge these have not previously been gathered together in one volume.

The suitability of a polymer depends essentially on the end-use. In the important field of rubber linings Droge (7) suggests that weight changes, measured over a minimum 28 day period, may be interpreted as follows:

Less than ± 1% - practically resistant
± 1% to ± 5% - fairly resistant
± 5% to ± 12% - doubtful ("nicht besonders beständig")
Over 12% - not resistant

These are possibly a little conservative. However, an assessment of weight or volume change together with any alteration in hardness is a good guide for lining materials which do not have to stand stresses, although additional tensile tests are of great use as supporting evidence. In the case of swelling agents tests should be continued until equilibrium is attained. It is further necessary to define the surface area/volume ratio, as well as the temperature of test.

When plastics are to be used for structural purposes in chemical plant physical test data are essential. Long term rupture tests on plastics laminates should be carried out after immersion in the media. At present, figures available are mainly those derived from tensile tests, but an increasing body of opinion appears to favour the use of flexural strength determinations.

In cases where 'some attack' has been recorded the following factors should be taken into consideration: size and shape of polymeric component, whether immersion is total or partial, pressure, temperature, concentration of aggressive medium and, finally, the existence of abrasive or erosive conditions. Chemical attack can also produce by initial degradation a surface layer of modified polymer. For example, the attack of chlorine on ebonites is initially degradative, but the chlorinated surface layer finally affords protection against further attack.

A thick component will withstand both chemical attack and swelling (8) better than a thin one; similarly attack will be slower if one side only is exposed. Conditions immediately above the surface of the contained liquid may be more severe than beneath it. Many instances are known, for example, of swollen rubber linings resulting from the effects of steam given off by a liquid at a comparatively low temperature and here the obvious remedy is to use a non-permeable elastomer such as butyl. It need hardly be stressed that the design temperature and pressure of the plant should be checked against the capabilities of the polymer. Useful guidance here can often be obtained from B.S.I. and similar publications, for example, B.S. Code of Practice CP 3003: Parts I, 4, 5 & 6; B.S.S. 1973 & 3506; Engineering Equipment Users Association Handbook No. 21.

Normally, purely chemical attack is reduced by dilution of the agressive reagent with an inert liquid. Similarly, the diffusion coefficient and the penetration rate of many swelling agents are concentration dependant, as may be illustrated by dilution with an inert liquid (3). This is, however, an ideal case and Ermolenko (9) has shown that in cases of some mixtures of nonpolar and strongly polar liquids (such as benzene and nitrobenzene) the swelling of vulcanisates reaches a maximum in the low concentration range of the polar component. The behaviour of certain rubbers and plastics in binary solvent mixtures was later examined by Bristow & Watson (10) who related the calculated cohesive energy density of the mixture range to the swelling produced, showing that swelling maxima do not occur at cohesive energy density values characteristic of the polymer.

In practice it is quite unsafe to assume that because a known swelling agent is present in small quantities in an otherwise inert environment its presence may be tolerated. There is a considerable risk that selective absorption of the agent by the polymer over a long period of time may result in eventual failure of the component.

Where there is a certain amount of degradation or swelling under abrasive or erosive conditions much thought should be given to the probability that the affected upper layers will be continually removed in service with consequent thinning of the component or protective coating. The use of thicker materials will only delay the ultimate failure and the best answer will be found by using other materials or altering the design of the system.

One additional point which is sometimes forgotten is the effect of the container or lining material on the chemicals being handled. This is not often a problem in heavy chemical production where both the low level of contamination and the final end-use can mean that this may be safely ignored. Exceptions occur, however, in the case of handling potentially explosive materials, pharmaceuticals and foodstuff. In the first instance organic materials are, as a general rule, best avoided; in the other two cases most users have their own specifications controlling the use of compounding ingredients which might be leached out during manufacture and, indeed, some countries (notably Germany and the U.S.A.) have national specifications which carry legal force.

Finally, polymers should be used with caution when handling highly toxic materials, such as cyanides, since these materials can be absorbed and retained by the lining, thus hindering maintenance and cleaning of the equipment.

References:

1. Beerbower, Kaye and Pattison - Chem. Eng. p. 121 (18-12-67).
2. Orzhakhovskii - Soviet Plastics No. 5, p. 60 (1966).
3. Blow, Exley and Southwart - J.I.R.I., 2, (6), 282 (1968).
4. Manin et al. - Soviet Plastics No. 1, p. 66 (1968).
5. Zuev & Borshchevskaya - Soviet Rubber Tech. 25, (1), 24 (1966).
6. Butt & English - Unpublished work.
7. Droge - De Nederlandse Rubberindustrie 27, (7), 1 (1966).
8. Southern - Chapter 4 "The Use of Rubber in Engineering", N.R.P.R.A. 1967.
9. Ermolenko et al. - Rubber Chem. & Tech. 28, (3), 833 (1955).
10. Bristow & Watson - Trans. I.R.I. 35, (3), 73 (1959).

Notes on Use of Data Sheets

Changes in weight or volume are positive, i.e. increases, unless otherwise indicated. As a general rule it will be found that swelling (or shrinkage) is expressed as a weight change in the case of plastics and as a volume change in the case of rubbers. Where the specific gravity of the liquid in question is close to that of the plastics or rubber, the values of weight and volume changes will not differ very greatly.

Abbreviations

EB = Elongation at break

HB = Brinell hardness (60 second reading)

NIS = Notched impact strength (nb = no break)

SBS = Shear strength in metal-metal adhesive bond.

TS = Tensile strength

All given as value retained after immersion expressed as percentage of value obtained before immersion (original value)

H = Increase (+) or decrease (-) in hardness of specimen after immersion, measured in International Rubber Hardness Degrees (IRHD) or points on the Shore A scale. For present purposes these two systems of units may be regarded as substantially identical.

The original values (before immersion) where known are given in the appropriate Reference Sheets.

ALPHABETICAL INDEX TO DATA SHEETS (including synonyms)

RAPRA Data Sheet PA 1

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ASTM Oil No. 1

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 6	RT	28	0	-	TS 96, EB 146.7
	G 6	70	28	0	-	TS 108.6, EB 92.5
Polyamides	H 5	RT	28	0	-	TS 99, EB 92
	H 5	70	28	-1.7	-	TS 144.7, EB 34.6
Polyethylene	I 11	RT	28	0.6	-	TS 82.8
	I 3	70	28	11.4	-	TS 81, EB 77, H-1
Polymethyl-methacrylate	J 4	RT	28	0	-	TS 103.3, EB 127
	J 4	70	28	0	-	TS 96.5, EB 100
Polypropylene	K 6	RT	28	0	-	TS 96.8, EB 158
	K6	70	28	2.6	-	TS 87.1, EB 261
PVC (Polyvinyl-chloride)	L 1(a)	RT	30	0.14	-	TS 111
	L 3	100	28	-1.3	-	TS 145, EB 54, H-3

* See notes overleaf

For explanation of abbreviation
see page (viii)

RAPRA Data Sheet PA 2

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ASTM Oil No. 3

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 1	RT	14	0.08	-	-
	G 6	70	28	0	-	TS 98.6, EB 55
Polyamides	H 5	RT	28	0	-	TS 105, EB 93.5
	H 5	70	28	-0.5	-	TS 161.5, EB 37
Polyethylene	I 11	RT	28	3.6	-	TS 115.5
	I 3	70	28	33.2	-	TS 66, EB 61, H-5
Polymethyl-methacrylate	J 4	RT	28	0	-	TS 111
	J 4	70	28	0	-	TS 101.5, EB 109
Polypropylene	K 6	RT	28	0.3	-	TS 97.5, EB 507
	K 6	70	28	13.4	-	TS 85, EB 367
PVC (Polyvinyl-chloride)	L 1(a	RT	30	0.33	-	TS 109
	L 3	100	28	1.1	-	TS 142, EB 48, H-3

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 3

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Acetic acid (glacial)

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties	
				Weight	Volume		
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 1	RT	14	23.7	-	Softened, made more transparent	
	G 6	70	28	DESTROYED			
Polyamides	H 5	RT	28	4.9	-	TS 102, EB 88.8	
	H 5	70	28	26.8	-	Turned brown, corroded	
Polyethylene	I 1	27	84	0.81	-	TS 100, EB 113	*
	I 1	66	84	0.39	-	TS 99, EB 144	
Polymethylmethacrylate	J 1	20	3	DISSOLVES			
Polypropylene	K 1	22	90	1.3	-	No corrosion, browned	*
	K 1	100	30	0.67	-	No corrosion, mechanical properties affected.	
PVC (Polyvinylchloride)	L 2(a)	25	30	1.14	-	TS 96	
	L 2(a)	60	30	12.83	-	TS 37	

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 4

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Ammonium hydroxide (conc. = 30/35% NH_3)

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 3	20	365	5.8	-	NIS 108, HB 70
Polyamides	H 1	20	365	6.6	-	NIS nb, HB 43
Polyethylene	I 2	25	30	0.4	-	-
Polymethylmethacrylate	J 4	RT	28	0.8	-	
Polypropylene	K 1	22	180	0.5	-	Appearance unchanged
PVC (Polyvinylchloride)	L 6	RT	28	0.7	-	TS 84.1
	L 4(a)	45	28	-	-	TS 83

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 5

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Aniline

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 6	RT	28	DESTROYED		
Polyamides	H 1	20	365	20.1	-	NIS nb, HB 76
	H 5	70	28	4.3	-	TS 102.6, EB 85
Polyethylene	I 1	27	84	0.76	-	TS 98.3, EB 104.3
	I 1	66	84	1.45	-	TS 98.4, EB 160.9
Polymethyl-methacrylate	J 1	20	7	DISSOLVES		
Polypropylene	K 1	22	30	0	-	Appearance unchanged
	K 1	60	30	2.3	-	No corrosion; browned
PVC (Polyvinyl-chloride)	L 6	RT	28	25.5	-	TS 13.9 Specimens become rubber-like
	L 3	50	28	NOT RESISTANT		

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 6

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Benzaldehyde

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 1	RT	18	DISSOLVES		
Polyamides	H 3	RT	*	*	-	-
	H 5	70	28	2.1	-	TS 148.9, EB 31.6
Polyethylene	I 1	27	90	2.08	-	TS 93, EB 117.4
	I 1	66	90	4.60	-	TS 93.1, EB 165.2
Polymethyl-methacrylate	J 1	20	7	DISSOLVES		
Polypropylene	K 6	RT	28	0.9	-	TS 93.1, EB 188
	K 6	70	28	3.8	-	TS 87.5, EB 233
PVC (Polyvinyl-chloride)	L 6	RT	28	DESTROYED		

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 7

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Ethyl acetate

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene - styrene terpolymer)	G-6	RT	28	DESTROYED		
Polyamides	H 1	20	365	-0.9	-	NIS 52, HB 102
	H 5	70	28	1.0	-	TS 162.5, EB 43
Polyethylene	I 3	20	28	2.6	-	TS 82, EB 74, H 0
	I 5	60	4	1.86	-	
Polymethyl-methacrylate	J 1	20	3	DISSOLVES		
Polypropylene	K 3(a	20	7	5.6	-	-
	K 3(a	70	7	9.4	-	-
PVC (Polyvinyl-chloride)	L 3	20	28	DISINTEGRATES		

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 8

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Ethyl alcohol

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in: Weight	Change (%) in: Volume	Effects on properties
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 3	20	365	13.6	-	NIS 104, HB 23
	G 4	45	28	-	-	TS 23.7
Polyamides	H 1	20	365	14.3	-	NIS nb, HB 35
	H 5	70	28	8.2	-	TS 90.5, EB 132
Polyethylene	I 1	27	90	0.26	-	TS 99.6, EB 117.4
	I 3	50	20	0.2	-	TS 98, EB 107, H-2
Polymethyl-methacrylate	J 2	25	28	-	-	Surface softened, slightly dissolved
	J 4	70	28	60.7	-	Softened, swollen
Polypropylene	K 3(c	20	7	-	-	TS 102, EB 113
	K 3(c	70	7	-	-	TS 97, EB 100
PVC (Polyvinyl-chloride)	L 1(a	25	30	0.03	-	TS 108
	L 1(a	60	30	1.16	-	TS 103

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 9

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Hexane

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in: Weight	Change (%) in: Volume	Effects on properties
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 6	RT	28	6.4	-	TS 57.3, EB 120
	G 6	70	28	15.2	-	TS 56.1, EB 53
Polyamides	H 5	RT	28	0	-	TS 94.8, EB 35
	H 5	70	28	-1.9	-	TS 172, EB 28
Polyethylene	I 11	RT	28	10.4	-	TS 91.8, EB 52
	I 11	70	28	15.3	-	TS 60, EB 67
Polymethylmethacrylate	J 4	RT	28	0	-	TS 101.5, EB 81.7
	J 4	70	28	-0.4	-	TS 111.8, EB 63.5
Polypropylene	K 6	RT	28	11.9	-	TS 74.8, EB 350
	K 6	70	28	16.6	-	TS 67.5, EB 110
PVC (Polyvinylchloride)	L 1(a)	25	30	0.00	-	TS 112 *
	L 6	70	28	0	-	TS 104.8

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 10

Issued : April 1969
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Hydrochloric acid (10%)

Polymer	Ref. No.	Temp. (°C)	Time (days)	Changes (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 2 and G3	20	365	1.9	-	NIS 100, HB 89
	G 6	70	28	1.2	-	TS 101
Polyamides	H 2	RT	30	-	-	SBS 20 - 25
	H 5	70	28	DISSOLVES *		
Polyethylene	I 6(a)	25	28	0.01	-	
	I 11	70	28	0.01		TS 103.7, EB 54
Polymethyl-methacrylate	J 2	25	28	-	-	No change in appearance
	J 4	70	28	1.1	-	TS 99, EB 81
Polypropylene	K 4	22	30	0.013	-	-
	K 6	70	28	0.2	-	TS 103.4, EB 171
PVC (Polyvinyl-chloride)	L 6	RT	28	0.1	-	TS 104.6
	L 6	70	28	1.4	-	TS 100.2

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 11

Issued : April 1969
Revised: July 1970

Hydrochloric acid (conc. = 37%)

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 3	20	365	33.2	-	NIS 15, HB 102
	G 6	70	28	13.4	-	TS 93.1, EB 56
Polyamides	H 3	RT	DISSOLVES			
Polyethylene	I 1	27	90	0.037	-	TS 99.6, EB 95.7
	I 1	66	90	-0.027	-	TS 99.8, EB 130.4
Polymethyl-methacrylate	J 2	25	28	-	-	No change in appearance
	J 4	70	28	1.8	-	TS 117
Polypropylene	K 1	22	90	0.5	-	Slightly browned, no corrosion
	K 1	80	10	0.9	-	do.
PVC (Polyvinyl-chloride)	L 2(a)	25	30	0.40	-	TS 101
	L 2(a)	60	30	2.15	-	TS 94

* See notes overseaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 12

Methyl alcohol

Issued : April 1969
Revised: July 1970

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 1	RT	365	26 to 28	-	Swollen, whitened
	G 6	70	28	DESTROYED		
Polyamides	H 1	20	365	14.9	-	NIS nb, HB 37
	H 5	70	28	11.3	-	TS 85.5, EB 122.4
Polyethylene	I 7	20	<u>ca</u>. 7	0.1	-	-
	I 3	50	20	0	-	TS 94, EB 96, H-2
Polymethyl-methacrylate	J 1	20	168	20	-	-
	J 4	70	28	DISSOLVES		
Polypropylene	K 1	22	30	0.2	-	Appearance unchanged
	K 1	60	30	0.1	-	do.
PVC (Polyvinyl-chloride)	L 6	RT	28	0	-	TS 98.9
	L 3	50	20	1.8	-	TS 105, EB 114, H-3

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 13

Issued : April 1969
Revised: July 1970

Methyl ethyl ketone

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 6	RT	28	DESTROYED		
Polyamides	H 5	RT	28	-0.3	-	TS 123, EB 19
	H 5	70	28	-1.2	-	TS 131.6, EB 16
Polyethylene	I 3	20	20	2.2	-	TS 86, EB 89, H-2 *
	I 11	70	28	5.5	-	TS 29.1, EB 23
Polymethyl-methacrylate	J 4	RT	28	DESTROYED		
Polypropylene	K 1	50	*	-	-	*
	K 6	70	28	1.6	-	TS 37, EB 143
PVC (Polyvinyl-chloride)	L 3	20	4	DESTROYED		

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 14

Issued : April 1969

Revised: July 1970

Nitric acid (10%)

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 3	20	365	3.9	-	NIS 100, HB 91
	G 6	70	28	3.2	-	TS 63
Polyamides	H 2	RT	30	-	-	SBS 0
	H 5	70	28	DISSOLVES		
Polyethylene	I 6(a)	25	28	0.01	-	-
	I 4 (a), (b)	45	28	-	-	TS 102
Polymethyl methacrylate	J 3 (a), (b)	25	8	0.9	-	-
	J 4	70	28	1.9	-	TS 103
Polypropylene	K3(c	20	7	-	-	TS 100, EB 100 *
	K3(c	100	7	-	-	TS 82, EB 74
PVC (Polyvinyl chloride)	L 6	RT	28	0.2	-	TS 115
	L 6	70	28	5.0	-	TS 98.9

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 15

Nitric acid (70%)

Issued : April 1969
Revised: July 1970

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in: Weight	Change (%) in: Volume	Effects on properties
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 1	RT	14	-	-	Yellowed, spongy partly disintegrated
Polyamides	H 5	RT	28	DISSOLVES		
Polyethylene *	I 6(a)	25	28	1.3	-	-
	I 7(a)	60	7	17.5	-	TS 10, EB 0
Polymethyl-methacrylate	J 2	25	28	-	-	Slightly dissolved swollen, blistered
Polypropylene	K 3(c)	20	7	-	-	TS 100, EB 100
	K 3(c)	100	7	DESTROYED		
PVC (Polyvinyl-chloride) *	L 2(a)	25	30	0.41	-	TS 97
	L 2(a)	60	30	2.33	-	TS 103

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 16

Issued : April 1969

Revised: July 1970

Nitrobenzene

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 6	RT	28	DESTROYED		
Polyamides	H 5	RT	28	0	-	TS 106.6, EB 18
	H 5	70	28	-10.1	-	TS 170, EB 38
Polyethylene	I 1	27	90	2.25	-	TS 96.2, EB 130.4
	I 1	66	90	3.47	-	TS 95.9, EB 173.9
Polymethylmethacrylate	J1	20	7	DISSOLVES		
Polypropylene *	K 3(c	20	7	-	-	TS 97, EB 98
	K 3(c)	100	7	-	-	TS 57, EB 14
PVC (Polyvinyl-chloride)	L 6	RT	28	DESTROYED		
	L 3	50	7	DESTROYED		

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 17

Issued : April 1969

Revised: July 1970

Perchloroethylene

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene - styrene terpolymer)	G 6	RT	28	131.0	-	TS 27, EB 90
	G 6	70	28	223.8	-	Too swollen to test
Polyamides	H 4	RT	*	2	-	-
	H 5	70	28	-1.3	-	TS 84.5, EB 38
Polyethylene	I 3	20	28	47.1	-	TS 56, EB 54, H-3
	I 3	50	28	128.7	-	TS 54, EB 37, H-26
Polymethyl-methacrylate	J 4	RT	28	0.9	-	TS 93.4
	J 4	70	28	148.7	-	Too soft to test
Polypropylene	K 6	RT	28	42.1	-	TS 23.9, EB 155
	K 6	70	28	70.2	-	TS 56, EB 333
PVC (Polyvinyl - chloride)	L 3	20	28	3.6	-	TS 122, EB 78, H-4
	L 3	50	28	45.9	-	TS 43, EB 270, H-16

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 18

Issued : April 1969
Revised: July 1970

Petrol

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 2	20	365	1.0	-	NIS 122, HB 104
	G 6	70	28	14.1	-	TS 65.6, EB 63
Polyamides	H 1	20	365	1.1	-	NIS nb, HB 72
	H 5	70	28	-2.9	-	TS 165, EB 44
Polyethylene	I 8	25	30	6	-	TS 85
	I 9	80	7	9.8	-	-
Polymethyl-methacrylate	J 3 (a), (b)	25	8	0.2	-	-
	J 4	70	28	-0.3	-	TS 115
Polypropylene	K 3(c)	20	7	-	-	TS 90, EB 97
	K 3(c)	70	7	-	-	TS 110, EB 120
PVC (Polyvinyl-chloride)	L 6	RT	28	0	-	TS 90.6
	L 6	70	28	-0.2	-	TS 122

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 19

Phenol

Issued : April 1969
Revised: July 1970

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in: Weight	Change (%) in: Volume	Effects on properties
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 1	RT	18	DISSOLVES		
Polyamides	H 3	RT	-	DISSOLVES		
Polyethylene	I 1	27	90	0.27	-	TS 99.9, EB 104.3
	I 1	66	90	0.54	-	TS 102.8, EB 126.1
Polymethyl-methacrylate	J 1	20	7	DISSOLVES		
Polypropylene	K 1	22	90	2.6	-	Slightly swollen
	K 6	70	28	1.8	-	TS 47, EB 233
PVC (Polyvinyl-chloride)	L 6	RT	28	0.6	-	TS 48
	L 1(a)	60	30	30.37	-	TS 34

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 20

Potassium permanganate (25%) *

Issued : April 1969
Revised: July 1970

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 3	20	365	21.2	-	NIS 104, HB 77
	G 6	70	28	-51.1	-	TS 61.4 (Sample very corroded)
Polyamides	H 1	20	365	*	-	NIS nb, HB 38
	H 5	70	28	-66.1	-	TS 42, EB 31
Polyethylene	I 10	25	7	0.02	-	-
	I 11	70	28	-51.5	-	TS 117.8, EB 52
Polymethyl-methacrylate	J 4	RT	28	1.3	-	TS 84
	J 4	70	28	21.8	-	TS 14 (Sample blistered)
Polypropylene	K 3(c)	20	7	-	-	TS 82, EB 90
	K 3(c)	100	7	-	-	TS 85, EB 8
PVC (Polyvinyl-chloride)	L 6	RT	28	0.3	-	TS 109.8
	L 6	70	28	2.2	-	TS 103.1

* See notes overleaf

For explanation of abbreviation see page (viii)

RAPRA Data Sheet PA 21

Issued : **July 1970**

Sulphuric acid (70%)

Polymer	Ref. No.	Temp. (°C)	Time (days)	Dimensional change (%)		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene styrene terpolymer)	G 6	RT	28	-0.3	-	TS 114
	G 6	70	28	-2.6	-	TS 86.6
Polyamides	H 55	RT	28	DISINTEGRATES		
Polyethylene	I 11	RT	28	0	-	TS 94.7, EB 54
	I 11	70	28	0	-	TS 93.1, EB 139
Polymethyl methacrylate	J 4	RT	28	DISSOLVES		
Polypropylene	K 6	RT	28	0	-	TS 106.4, EB 93.3
	K 6	70	28	0	-	TS 107.7, EB 250
PVC (Polyvinyl chloride)	L 6	RT	28	0	-	TS 115
	L 6	70	28	0.3	-	TS 98.9

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 22

Issued : April 1969
Revised: July 1970

Sulphuric acid (98%)

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 1	RT	14	-	-	CARBONISED AND DISINTEGRATED
Polyamides	H 3	RT	-	DISSOLVES		
Polyethylene	I 7(a)	20	90	< 0.1	-	TS, EB: "no change." Becomes brown
	I 3	50	84	1.8	-	TS 86, EB 50, H-4
Polymethyl-methacrylate	J2	25	28	SOFTENED, ALMOST COMPLETELY DISSOLVED		
Polypropylene	K 5	22	30	-0.2	-	-
	K 5	60	30	-0.2	-	-
PVC (Polyvinyl-chloride)	L 2(a)	25	30	21.29	-	TS 57
	L 2(a)	60	30	38.37	-	TS 61

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 23

Issued : April 1969

Revised: July 1970

Toluene

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 6	RT	28	DESTROYED		
Polyamides	H 1	20	365	1.0	-	NIS 104, HB 69
	H 5	70	28	-0.9	-	TS 159.7, EB 32
Polyethylene	I 1	27	90	4.40	-	TS 88.2, EB 156.5
	I 1	66	90	5.58	-	TS 89.3, EB 187
Polymethyl-methacrylate	J 1	20	7	DISSOLVES		
Polypropylene	K 3(c)	20	7	-	-	TS 87, EB 92
	K 3(c)	100	7	-	-	TS 59, EB 61
PVC (Polyvinyl-chloride)	L 3	20	28	55.9	-	TS 8.8, EB 70, H-32
	L 3	50	28	69.3	-	TS 5, EB 55, H-49

* See notes overleaf

For explanation of abbreviations see page (viii)

RAPRA Data Sheet PA 24

Issued : April 1969
Revised: July 1970

Water (distilled)

Polymer	Ref. No.	Temp. (°C)	Time (days)	Change (%) in:		Effects on properties
				Weight	Volume	
ABS (Acrylonitrile-butadiene-styrene terpolymer)	G 2	20	365	5.2	-	NIS 100, HB 84
	G 3	70	365	36.8	-	NIS 37, HB 28
Polyamides	H 1	20	365	8.6	-	NIS nb, HB 43
	H 1	90	365	5.8	-	NIS *, HB 55
Polyethylene	I 1	27	90	0.024	-	TS 98.5, EB 108.7
	I 1	66	90	0.016	-	TS 100.4, EB 139.1
Polymethyl-methacrylate	J 3 (a)(b)	20	336	1.5	-	-
	J 4	70	28	1.9	-	TS 86.1
Polypropylene	K 5	22	30	0.7	-	-
	K 5	60	30	0.2	-	-
PVC (Polyvinyl-chloride)	L 5(a)	20	32	0.95	-	TS 98, EB 80
	L 5(a)	60	32	11.74	-	TS 74, EB 46

* See notes overleaf

For explanation of abbreviations see page (viii)

Reference Sheet G

Issued: April 1969

ABS (Acrylonitrile-butadiene-styrene terpolymer)

Ref. No.	Polymer type and characteristics	Original mechanical properties. (Test specimen)	Source
G 1	(Cycolac)	Tensile strength 315 kgf/cm^2 Elongation at break 169% Tension set 132% (Dumb-bell, from 1/8" moulded sheet) (Weight change: probably 1/8" sheet)	ANCHOR CHEMICAL CO. LTD., "Cycolac High-Impact Thermoplastic ABS Polymer", Tech. Rept. CY-2A/3, Manchester 1964.
G 2	(Novodur W)	Notched impact strength 27 kgf. cm/cm^2 Brinell hardness (60 sec.) 570 kgf/cm^2 (Weight change: disc 60 x 1 mm)	H. EBNETH, Gummi, Asbest, Kunststoffe, 1963, No. 6, 522, 524, 526, 528, 530, 532, 534.
G 3	(Novodur W)	Impact strength) as Hardness) G 2. (Weight change: disc 50 x 1 mm)	FARBENFABRIKEN BAYER, A. G. "Bayer Plastics", 3rd Edn. Leverkusen, 1963, pp. 488-505.
G 4	-	Tensile strength 435 kgf/cm^2 (specimen 0.063" thick)	P.R. McCLURE, Rubb. World, 1962, <u>147</u>, No. 3, 72-5.
G 5	10 grades for injection moulding, extrusion and pipe applications.	- (specimens as ASTM D543-56T	U.S. RUBBER CO., NAUGATUCK CHEMICAL DIVN, and STO-CHEM LTD. "Kralastic ABS polymers" (Resin Guide No. 1) and "Kralastic 400".

Reference Sheet G cont.

Issued: July 1970

ABS (Acrylonitrile - butadiene - styrene terpolymer)

Ref. No.	Polymer type and characteristics	Original mechanical properties (Test specimen)	Source
G 6	(Vulkide A)	Tensile strength 337 kgf/cm^2 Elongation at break 10% (Specimen cut from $^1/_8$" thick sheet)	RAPRA Chemical Resistance Test Project TM 9 (1969 - 70)

Reference Sheet H

Polyamides

Issued: April 1969
Revised: July 1970

Ref. No.	Polymer characteristics	Original mechanical properties. (Test specimen)	Source
H 1	(Durethan BK 28F)	Notched impact strength 23 kgf.cm/cm^2 Brinell hardness (60 sec.) 680 kgf/cm^2 (Weight change: disc 50 x 1 mm)	FARBENFABRIKEN BAYER, A.G. "Bayer Plastics", 3rd Edn. Leverkusen, 1963, pp. 488-505.
H 2	(Versalon 1112) (" 1175) Soluble, low-mp. (190-205°C).	(Tested as 0.005" film in metal-metal lap joints)	CRAY VALLEY PRODUCTS LTD.; CORNELIUS CHEMICAL CO. LTD. "Versalon Polyamide Resins", St. Mary Cray, 1965.
H 3	(Ultramid B) (type 6)	- (Weight change: disc 60 x 1 mm)	BADISCHE ANILIN- & SODA FABRIK A.G.; ALLIED COLLOIDS LTD. "Utramid, a material for the Engineer". Ludwigshafen, 1961.
H 4	Types 6; 6,6; 6,10 and 11	-	C.D. WEISKE, Kunststoffe, 1964, 54, No. 10, 626-34; German Plastics, 1964, 54, No. 10, 6-13.
H 5	Type 6,6	Tensile strength 497 kgf/cm^2 Elongation at break 33% (Specimen cut from 1/8" thick sheet)	RAPRA Chemical Resistance Test Project TM 9 (1969 - 70)

Reference Sheet I

Issued: April 1969

Polyethylene

Ref. No.	Polymer characteristics	Original mechanical properties. (Test specimen)	Source
I 1	(Marlex 50) HD. s.g. 0.96 MFI 0.6 - 0.8	Tensile strength 325 kgf/cm^2 (Dumb-bell to ASTM D638; injection moulded; weight change: 1" x $\frac{1}{4}$" x 1/8")	R. J. MARTINOVICH, P. J. BOEKE; Mod. Packag., 1957, 31, October, 167-73,176.
I 2	(Lupolen) s.g. 0.96 MFI 1.5	-	BADISCHE ANILIN- & SODA-FABRIK, AG., "Lupolen", B 240d, Ludwigshafen am Rhein, 1959.
I 3	(Lupolen H) s.g. 0.915	Tensile strength 162 kgf/cm^2 Elongation at break 350% Hardness (Shore A) 97 (Weight change: disc 36 x (?) 2 mm)	H. J. JAHN, 'Die Quellbëstandigkeit von Vulkanisaten verschiedener Elastomerer". Leverkusen, 1961.
I 4	(a) (CAB-XL) LD. containing 240 phr MT black; cross-linked. (b) HD.	Tensile strength (a) 200 kgf /cm^2 (b) 182 kgf/cm^2 (Specimen 0.063" thick)	P.R. McCLURE Rubb. World. 1962, 147, No. 3, 72-5.
I 5	HD, s.g. 0.95 MFI probably 0.3 at 190°C and 2.16 kgf	- (Weight change: 2" x 1" x 0.040")	HERCULES POWDER CO. INC., CELLULOSE PRODUCTS DEPT., "Hi-fax Hercules high density polyethylene, what it is....." publ. 10M 12-576276, Wilmington, Del., 1957.

Reference Sheet I cont.

Polyethylene

Issued: April 1969

Ref. No.	Polymer characteristics	Original mechanical properties (Test specimen)	Source
I 6	(a) Low viscosity paper-coating grade; s.g. 0.92; m.w. 2000; m.p. ca. 106°C. (b) As above but m.p. ca. 96°C; low cloud-pt. grade	- (Weight change: threaded cylindrical castings ¾" dia. x ¾" long)	ALLIED CHEMICAL, SEMET-SOLVAY PETROCHEMICAL DIVN.; "A-C Polyethylene, a unique highly versatile low molecular weight polymer", Rev. edn. 116 R; New York, 1958.
I 7	(a) LD. s.g. 0.92; MFI* 2.0 (b) as (a) but MFI 20 (c) Medium density s.g. 0.94 MFI 0.7 (* BS2782 Method 105 C)	Tensile strength (a) 128 kgf/cm^2 (b) 90 kgf/cm^2 (Dumb-bell, BS 903 type C; weight change: 4" x 1" x 1/16")	IMPERIAL CHEMICAL INDUSTRIES LTD., PLASTICS DIVN. "Alkathene brand of polythene: properties" 2nd Edn. Welwyn Garden City, 1964.
I 8	HD injection moulding grade s.g. 0.96. MFI 0.6 (ASTM D1238)	Tensile strength: at yield 275 kgf/cm^2 at break 183 kgf/cm^2 (Dumb-bell to ASTM D638)	CELANESE CORP. of AMERICA, PLASTICS DIVN.; "Celanese Fortiflex, a new polyolefin resin", NA 6-293, Newark NJ, 1957.
I 9	(Hostalen GM 5010) s.g. 0.94. Pipe grade	-	E. GAUBE, W. MÜLLER, G. DIEDRICH, Kunststoffe, 1966, 56, No. 10, 673-9; German Plastics, 1966, 56, No. 10, 1-5.
I 10	HD general purpose moulding grade. s.g. 0.95 - 0.97. MFI probably 1-3 (ASTM D1238)	- (Weight change: as ASTM D543)	KOPPERS CO. INC., CHEMICAL DIVN. "Super Dylan polyethylene", Tech. Bull. C-6-216, Pittsburgh, 1956.

Reference Sheet I cont.

Issued: July 1970

Polyethylene

Ref. No.	Polymer characteristics	Original mechanical properties. (Test specimen)	Source
I 11	(Alkathene low density PE; Melt flow index 1.4)	Tensile strength 454 kgf/cm^2 Elongation at break 17% (Specimen cut from $1/_8$" thick sheet)	RAPRA Chemical Resistance Test Project TM 9 (1969 - 70)

Reference Sheet J

Polymethylmethacrylate

Issued: April 1969
Revised: July 1970

Ref. No.	Polymer characteristics	Original mechanical properties. (Test specimen)	Source
J 1	(Perspex)	(Weight change: 4" x $\frac{1}{2}$" x $\frac{1}{4}$")	IMPERIAL CHEMICAL INDUSTRIES Ltd., PLASTICS DIVN., : "Perspex Acrylic Materials, Properties", Welwyn Garden City, 1965.
J 2	(Plexiglas 233)	-	P.R. SZIGETI, Anticorrosive Materials and Processes, Nov. 1963, No. 3, 16-17.
J 3	(Plexiglas) (a) sheet (b) moulded (c) 5% plasticiser ---	(c) flexural strength 300-500 kgf/cm^2	J. COURDURIÉ, Ind. Plast. Mod., 1953, 5, No. 5, 28-9.
J 4	(Perspex)	Tensile strength 770 kgf/cm^2 Elongation at break 4% (Specimen cut from $^1/_8$" thick sheet)	RAPRA Chemical Resistance Test Project TM 9 (1969 - 70)
J 5	(a) Oroglas V (s.g. 1.19) (b) Oroglas VM (s.g. 1.18) (c) Oroglas VS (s.g. 1.18)	(Tested according to ASTM-D 543)	LENNIG CHEMICALS LTD. "Oroglas Molding Powders for Injection Molding and extrusion, "Bulletin OR-165e, c. 1969.

Reference Sheet K

Issued: April 1969

Polypropylene

Ref. No.	Polymer characteristics	Original mechanical properties. (Test specimen)	Source
K 1	(Moplen) Mainly isotactic. MFI 0.3 - 3 at 230°C, 2.16 kgf.	-	MONTECATINI, SOC. GEN. PER L'IND. MINERARIA E CHIMICA, "Moplen Polypropylene Resin", Series on Plastics No. 15, Milan, 1962
K 2	-	Tensile strength 290 kgf/cm^2 (specimen 0.063" thick)	P.R. McCLURE, Rubb. World. 1962, 147, No. 3, 72-5.
K 3	(a) S.g. 0.889; crystallinity 42% LVN 1.84. (b) S.g. 0.908; crystallinity 65% LVN 1.84. (c) Isotactic index 97.5%. LVN 1.84; ash 0.02%.	- (Weight increase: (a), (b) 0.3 mm thick; (c) 1 mm thick)	P. PARRINI, L. PINTO, Mater. Plast. Elast., 1965, 31, No. 11, 1207-19, 1244
K 4	-	-	AVISUN CORP'N.; "Avisun polypropylene, the lightest commercial plastic known" Tech. data booklet AP-601, Philadelphia, 1961.
K 5	-	-	HERCULES POWDER CO.; "Pro-fax, information on Hercules Polypropylene", Wilmington, 1959.

Reference Sheet K cont.
Issued: July 1970

Polypropylene

Ref. No.	Polymer characteristics	Original mechanical properties. (Test specimen)	Source
K 6	(Vulkide B)	Tensile strength 234 kgf/cm^2 Elongation at break 6% (Specimen cut from $1/_8$" thick sheet)	RAPRA Chemical Resistance Test Project TM 9 (1969 - 70)

Reference Sheet L

Issued: April 1969

PVC (Polyvinylchloride)

Ref. No.	Polymer characteristics	Original mechanical properties. (Test specimen)	Source
L 1	(a) (Geon 8750) conforms to ASTM D-1784 Type I grade 2 Rigid (b) (Geon 8700 A) ASTM D1784: Type II Grade 1. High impact	(a) Tensile strength 460 kgf/cm^2	B.F. GOODRICH CHEM. CO.: "Geon Rigid Vinyl for Extruded Compounds", Cleveland, Ohio, 1959.
L 2	(a) (b) as for L 1	Tensile strength: (a) 460 kgf/cm^2 (b) 410 kgf/cm^2 (Dumb-bell to ASTM D638)	B.F. GOODRICH CHEM. CO.: "Chemical Resistance of Geon Rigid Vinyl", Cleveland, Ohio, 1965.
L 3	(Vestolit G) s.g. 1.390	Tensile strength 637 kgf/cm^2 Elongation at break 64% Hardness (Shore A) 100 (weight change: disc 36 x (?) 2 mm)	H.J. JAHN. "Die Quellbeständigkeit von Vulkanisaten verschiedener Elastomerer". Leverkusen, 1961.
L 4	(a) Rigid (ASTM Type I) (b) High impact ASTM Type II)	Tensile strength (a) 435 kgf/cm^2 (b) 350 kgf/cm^2 (specimen 0.063 thick)	P.R. McCLURE, Rubb. World 1962, 147, No. 3, 72-5.
L 5	(a) Rigid (b) Hostalit Z720	- (Tensile: dumb-bell; weight change: film 0.4 mm thick)	B. DOLEŽEL. Chem. prům., 1961, 11/36, No. 2, 106-9.

Reference Sheet L cont.

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PVC (polyvinylchloride)

Ref. No.	Polymer characteristics	Original mechanical properties (Test specimen)	Source
L 6	(Darvic Industrial)	Tensile strength 456 kgf/cm^2 (Specimen cut from $1/8$" thick sheet)	RAPRA Chemical Resistance Test Project TM 9 (1969 - 70)