PLASTICS COMPONENTS

FOR

AUTOMOTIVE APPLICATION

AGREEMENT NO. 938-1241
DEPARTMENT OF INDUSTRY, TRADE AND COMMERCE

May 1980

F. T. GERSON LIMITED
CONSULTING ENGINEERS
67 YONGE STREET · TORONTO 1, CANADA

Government of Canada | Gouvernement du Canada

Industry, Trade and Commerce | Industrie et Commerce

Your file Votre référence

Our file Notre référence

May 14, 1981

The original version of this report was released in May 1980.

Since that time some additional suppliers have been identified by the vehicle builders and their names have been added at Appendix 4.

The balance of the report remains unchanged.

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May 16, 1980

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Dear Mr. Corthorn:

Agreement No. 938-1241
"Plastic Components for Automotive Application"

Following your instructions, we hereby submit our final report. We shall be glad to discuss the report and provide any other services you may require.

Again our sincere thanks for your cooperation throughout this work.

Very truly yours,
F.T. Gerson Limited

F. Gerson

Frederick T. Gerson
President

FTG/lr
Encl.

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2. EXECUTIVE SUMMARY

2.1 Conservative estimates show that the weight of plastics used in the average North American passenger automobile will advance from 166 pounds in 1979 to 262 pounds in 1990.

2.2 In 1979, some 10 per cent of total plastics products output in Canada was used in automobiles and trucks. That percentage is expected to remain unchanged through 1990 by which time output will have grown by 40 per cent.

2.3 Fuel efficiency standards mandated by regulation - and demanded by consumers- provide the principal impetus for increased use of lightweight materials in automobiles. On average, a pound of plastics used to replace steel in a motor car brings about a weight reduction of one pound. Each 200 lb reduction in vehicle weight induces a mileage improvement of approximately 1 km per gallon in mixed city and highway operation.

2.4 Initial lightweighting requirements were met mainly by downsizing. The rate of materials substitution is expected to accelerate starting in 1985. Since automotive innovation requires several years of lead time, the necessary development work must begin in 1980/81.

2.5 North American automobile companies face exceptionally heavy capital expenditures during the 1980's. During that period, they will be inclined to entrust above-average proportions of auto parts development and manufacturing to independent suppliers.

2.6 Development of innovative products and processes is deemed to offer the best opportunity for increased Canadian participation in the production of plastics auto parts.

2.7 The circumstances described in subsections 2.3 through 2.6 suggest that the early 1980's are a preferred period for developing novel plastics auto parts, for gaining the cooperation of major auto companies for such development work, and for promoting their acceptance of new parts suppliers and their products. After 1985, the rate of new plastics auto part development will tend to moderate.

2.8 Of the approximately 40 major generic types of plastics resins, 7 account for over 80 per cent of plastics auto part production; of these 7, three are resins for which world-scale production facilities are in place in Canada. Parts manufacturers should try to concentrate their forward plans on use of these three commodity resins (polypropylene, polyethylene and polyvinyl chloride) as they offer good chances for raw material price parity with competing US auto parts suppliers.

2.9 Filled and reinforced resins and composite materials offer advantages over "straight" resins because composites conduce to lower unit cost of material as well as improved and tailor-made mechanical and physical properties. They are especially suitable for large auto parts which offer maximum opportunity for weight saving.

2.10 Of the large variety of plastics processing methods and techniques, 7 account for over 95 per cent of plastics auto part production. All 7 of them are practiced in Canada, although 2 important techniques (TMC and RRIM) are under-represented in the Canadian plastics industry. However, a Canadian manufacturer is a recognised world leader in the production of reinforced plastics stampings, the fastest-growing manufacturing technique for plastics auto parts.

2.11 While today's North American passenger car, truck or van carries plastics parts throughout, the different components can be conveniently grouped under several categories which are described in Section 4.3

2.12 Except for a few specific applications, such as drive shafts, resins reinforced with carbon or graphite fibre are projected to be much less commonly applied than those reinforced with glass fibre, globules, mica, ferrous strip or calcium compounds.

2.13 Among 127 specifically identified manufacturers of plastics auto parts in Canada, 15 per cent are US owned but account for more than 50 per cent of total value of goods produced in a typical year. 82 per cent of the companies are Canadian owned but more than half of this number employ fewer than 100 employees and would need major help in order to obtain significant contracts for plastics auto parts.

2.14 The entire Canadian plastics processing industry is estimated to comprise 1,500 establishments of which more than half achieve annual sales lower than $1 million while those with sales of $3 million or more per annum account for about three quarters of the total value of industry shipments estimated at $3.5 billion in 1979. Approximately one quarter of the establishments are located in the Province of Quebec and generate one quarter of annual industry shipments by value. Some 50 per cent of the establishments are in Ontario and these ship goods to the value of about two thirds of total annual industry output.

2.15 Plastics auto parts manufacturers are even more concentrated in Central Canada than plastics processors as a whole. This situation results from the need to locate reasonably close to the major automobile manufacturing centres in the midwestern United States.

2.16 Among existing Canadian producers of auto parts, the best chances for significant growth and expansion are enjoyed by middle- and large sized companies who are willing and able to commit meaningful investments and who are prepared to accept the risks and difficulties inherent in supplying the highly cyclic automobile industry.

2.17 Although the demands of OEM auto parts purchasers are generally more onerous than those in the aftermarkets, the OEM customers provide a surer outlet for volumes of manufactured plastics components sufficient to exert a meaningful influence on Canada's deficit in North American auto parts trade.

2.18 Certain sizeable and well qualified Canadian plastics processors do not manufacture auto parts; some of them have in the past refused to respond to invitations from major auto companies to bid on plastics parts programs for which the Canadian processors were particularly well equipped and staffed. It could prove productive to approach some of these Canadian firms and draw their attention to the changed and more favourable conditions currently prevailing in the plastics auto parts field.

2.19 Several multinational manufacturers of metal auto parts in Canada do not process plastics here although their affiliates in the United States do so. Among these are Canadian companies who are well acquainted with and introduced at major auto makers but have not as yet entered the plastics field in this country.

2.20 The Auto Parts Division of the Department of Industry, Trade and Commerce has valuable know-how and experience to contribute to plastics auto parts producers. The Division should not worry unduly about the fact that it knows so much more about metals than about plastics, either as used in the form of raw material or in terms of processes, techniques, tooling or finishing. The similarities between the two fields appear to outnumber the differences.

2.21 Government support for increased auto parts manufacturing in Canada can take the form of financial, technical and other assistance to R&D, market and product planning as well as the creation of joint ventures and possible consolidations. Plastics development offers substantial growth opportunities for certain small operators, and these should not be overlooked. Support must extend to product and design engineering and prototyping as these activities typically require four or five times as much funding as R&D.

2.22 Structural, strategic, financial and psychological barriers impede the progress of auto parts production by Canadian plastics processors. However, most of these can be identified and overcome without undue difficulty, provided one has the patience to repeat one's message many times over because the world seems to forget so very quickly.

2.23 Since innovation is a recognised key to increased plastics auto part manufacture, one would imagine Canada to be especially well qualified in this regard since we claim many "firsts" e.g. the telephone and ball point pen. Unfortunately we seem to lose our inventions to others who exploit them more astutely. We don't even utilise the design data published by our own National Research Council. Examples are given and a case history of a recent Canadian development which could become an important stepping stone to increased plastics auto parts production in this country.

2.24 Canadian manufacturers could benefit from putting more of their energies into innovative leadership and less into keeping close watch on what is being developed in the US. While there are historical reasons to rely on resin manufacturers as a source of new materials and techniques, those reasons are not as valid as they once were.

2.25 Canadian producers of plastics auto parts - current and prospective - require the services of a good agent in Detroit. Although neither government nor the SPI can supply such an agent, both can help identify and engage one.

2.26 Among longer-term markets, the electric vehicle (passenger and light truck) represents a potential target for new plastics products supplied by Canadian producers.

2.27 Manufacture of auto parts from cast iron, steel and other "heavy" raw materials will be reduced by substitution in favour of plastics. However, many forecasters exaggerate the extent of that subtitution because they underestimate the capabilities of high-strength-low-alloy steels and other high performance alloys to regain automotive parts applications lost to plastics because the latter can be more quickly developed and adapted.

2.28 Producers of metal auto parts can take various steps to ensure the preservation of existing volume and future growth of output. A list is given of 35 auto part classifications slated for lightweighting and other re-design. The most serious potential for loss of business faced by Canadian auto parts manufacturers lies in the tendency to adopt a wait-and-see attitude.

2.29 Government support programs occasionally favour risk-weighers over risk-takers and thereby encourage the unduly cautious approach adopted by too many Canadian manufacturers. Such programs should also avoid the encouragement of mere duplication of production capacity in one part of the country at the expense of existing capacity in some other region which does not enjoy the benefit of financial and other public assistance. (E.g. the heavily subsidized Michelin tire facility in Nova Scotia).

2.30 Technology developed in the United States is not the only or the best means of upgrading Canadian capability for plastics auto parts production. In terms of productivity, quality assurance and technical innovation, Japanese plastics processors have outperformed their US counterparts during the 1970's.

2.31 Plastics auto parts to an estimated value of $60 million per annum are being exported from the United States to Japan; the volume is reported growing significantly. Exports to Japan, may become a viable option for Canadian producers of plastics auto parts.

2.32 Section 10.4 lists specific steps for follow-up action to this report. The suggested steps are grouped under five headings:

Program Changes
Innovation
Design, Pilot Plant and Prototype Engineering
Marketing
General

3. INTRODUCTION

3.1 Plastics in Automobiles

The plastics industry as well as the autoparts industry have been extensively and intensively studied in recent months. The reciprocal importance of these industries to each other is often documented by summaries.

MODEL YEAR	1979		1990	
	lb	%	lb	%
Steel	2270	71	1725	69
Cast Iron	610	19	300	12
Plastics	166	5	262	10.5
Aluminum	128	4	200	8
Zinc	26	1	13	0.5
Total	3200		2500	
Plastics vs Total		5.2		10.5

SOME MAJOR RAW MATERIALS USED IN
THE TYPICAL NORTH AMERICAN PASSENGER CAR
TABLE I

There is relatively little agreement between different sources; most of them optimistically assign higher weights and percentages of plastics per passenger unit, especially in the later (projected) model years. The foregoing summary is based on a detailed examination of passenger car components carried out by Market Search Inc. of Toledo Ohio. The base data are available on request.

The major causes for undue optimism with respect to future plastics usage include:

- arithmetic projection of historical growth rates
- projection of historical substitution rates
- failure to recognise that raw materials (e.g. steel) which have lost market share will begin to regain the same after some time lag.

However, even the relatively conservative estimate of 262 lb of plastics per 1990 passenger unit would correspond to an annual resin consumption of over 2.5 billion pounds for passenger automobile, truck and van use in a year during which 10 million units are produced. The corresponding quantity consumed during 1979 was 1.5 billion pounds.

At present, the automobile and truck industry represent approximately 10 per cent of the total North American market for plastics. Transportation is the 3rd largest end use segment for plastics after Packaging (33 per cent) and Building and Construction (22 per cent). While the consumption of plastics is slated for rapid growth during the decade of the 80's, the relative importance and ranking of the three abovementioned market sectors is not expected to undergo significant change. Transportation will still be the third-largest user of plastics in 1990, it will still account for some 10 per cent ot total North American plastics consumption. However, absolute plastics consumption is expected to have doubled during the ten years, a growth rate smaller than that experienced during the 1970's.

The foregoing numbers merely approximate the trend average for the general size of the North American automobile, truck and van market for plastics auto parts.

One reason for controversy as to the total weight of plastics used in an average Detroit passenger unit is that some observers include rubbers and elastomers in the total for plastics and others do not; some regard upholstery coverings as textiles while others class them as plastics. No absolute agreement exists as to what constitutes an average or typical North American car. These differences are, however, not material for the purpose of this report.

The term "Plastics Industry" is itself contentious; in everyday parlance, this expression includes raw material manufacturers (of resins, plasticisers, fillers, pigments, dies, catalysts and a whole range of modifiers) as well as fabricators (e.g. moulders, extruders, thermoformers, assemblers, welders), metallizers, painters, finishers and last but not least the great variety of machinery, equipment, mould and diemakers which specialise in plastics applications.

This report concentrates on firms which produce autoparts and therefore it deals only marginally with mouldmakers, machinery suppliers, or resin, filler or reinforcement manufacturers. Metallizers, painters and finishers are not included although they could make a meaningful contribution to increasing Canadian participation in autoparts production. These aspects could be dealt with in subsequent investigations as outlined in Section 10. The reader will appreciate that an increase in autoparts manufacture in Canada will stimulate additional activity in the foregoing raw material and support industries.

3.2 Substitution vs Downsizing

During the 1960's and 70's plastics auto parts proliferated (from a total weight of 16 lb to 160 lb per typical passenger unit). Their early growth depended entirely on functional and economic factors. In the late 1970's regulatory pressure became a further and important impetus toward greater plastics usage. The Corporate Average Fuel Economy (CAFE) regulations in force in the United States impose rising fuel efficiency requirements on the total annual production of cars manufactured in the US. Companies failing to meet these requirements not only face stiff financial penalties but would also likely be shunned by potential buyers who themselves are beginning to demand more fuel-efficient cars.

Unit weight reduction is an effective step toward better fuel economy. As a rule of thumb, one may assume that one pound of plastics used in an automobile as a substitute for steel will bring about a weight reduction of one pound. Experience has also indicated that a reduction of 400 lb in a typical Detroit passenger unit creates an improvement in average gas mileage of approximately 2 km per gallon. For cars operating in start-and-stop city traffic, the saving is likely greater still.

Car manufacturers met the initial need for lighter automobiles by downsizing each model without unduly shrinking passenger space and comfort. They found that by shortening a full-size passenger car by 25 cm, they could lower its weight by about 700 lb. The next round - about to begin in earnest - calls for smaller engines, transversely mounted. Starting in 1985, however, substitution of heavier with lighter structural and other parts must accelerate if further weight reduction is to be achieved without cramping the driver and his passengers. Such weight reduction is required to meet the mandated increase in gas mileage. Hence a significant jump in plastic auto parts is foreseen during the period 1985-1990.

The ordinary automobile design calendar dictates that parts be developed 3-4 years before their use in production. In the case of plastics parts which are to take the place of metal parts, the lead time for development can easily be longer because of the need for more thorough testing and evaluation of novel materials and designs. Hence a significant number of new plastics autoparts will be developed during 1980-82 for use during the second half of the decade.

3.3 A Larger Share for Independents

As a rule, major automobile manufacturers prefer to have new development effected by their independent suppliers. Once new techniques or products have become accepted, the auto companies then like to produce at least 50 per cent of total requirements "in-house". The majors themselves will undertake innovative development programs only if their independent suppliers are unwilling or unable to tackle new technology which the majors perceive to be indispensable.

During the current (1980) model year, sudden sales resistance to full-size cars caught Detroit off-guard. Domestic manufacturers were unable to supply sufficient compact and subcompact cars. The market share of imports rose from 14 per cent in 1978 to 33 per cent during the first quarter of 1980. Some observers predict that restoration of adequate oil imports from Iran (together with a return to calmer political currents in the oil producing nations) will take the pressure off gasoline supplies and will herald the return of buyer preference for mid- and full-size cars. Predominant opinion, however, sees progressively rising demand for improved gas mileage i.e. for smaller vehicles.

In these circumstances, the North American carmakers face an unprecedented volume of capital expenditures on new facilities for the production of smaller cars. Ford Motor Company has stated that, during the 1980's, its capital expenditures will exceed by a substantial margin the total cost of the entire US space program designed to put a man on the moon. Industry-wide requirements of $75 billion have been mentioned by responsible analysts who feel that - quite apart from the financial problems encountered by Ford, Chrysler and American Motors - the companies (including GM) will strain their creditworthiness to raise the necessary funds.

This situation favours transfer of parts development activity - with its associated need for capital - to independent producers.

3.4 The Unique Opportunity

It is difficult to define any period of time during which Canada's plastics autopart producers were in a better position than the present to increase their participation in overall North American requirements:

As shown in the preceding subsections, the following circumstances make early 1980 a favourable period for planning new growth in plastics autoparts.

- substitution of plastics for heavier raw materials is about to increase vigorously
- car manufacturers and users are prepared to accept more innovative changes than before
- heavy pressure on capital available for new parts development causes automobile manufacturers to place added reliance on parts suppliers.

It should be recognised that, once the fairly radical substitution and lightweighting changes have been effected, the rate of acceptance of new plastic autoparts will gradually decline. One may reasonably anticipate that the progress of lightweight parts development will be unusually rapid during the years up to 1985, and that it will thereafter tend to slow down to rates consistent with normal automotive design evolution.

Cautious Canadian autoparts manufacturers may rightly point to the cyclic and volatile patterns of the automotive market and to the fickle purchasing policies attributed to some of the major carmakers. That attitude, however, overlooks the legendary loyalty with which Detroit treats its large family of proven suppliers. For every "horror story" of unfairly altered requirements and cancelled orders, there are several instances of automobile companies leaning over backwards to shore up the viability and profitability of supplier companies, large and small.

The early 1980's provide the opportunity for additional Canadian autopart suppliers to join that automotive family and for established members to reinforce their position.

4. PLASTICS AUTO PARTS

Note: Readers not familiar with raw materials, processes and products used in the plastics industry may wish to consult a glossary such as that which appeared in the September 1978 issue of "Automotive Industries". Alternatively, we recommend Whittington's Dictionary of Plastics published by Society of Plastics Engineers Inc. and Technomic Press Inc. of Stamford, Connecticut 06902.

The plastics industry is relatively young; hence its nomenclature tends to be less precise than that associated with more mature industries e.g. pulp and paper.

4.1 Raw Materials

The "Canadian Plastics" resin reports list over 40 different generic resin types. Each type not only breaks down into sub-types and proprietary variations produced by different suppliers but each type is also formulated into numerous different compositions to suit particular processing or end use requirements. Thus an indeterminately large number of different raw materials are used in the production of auto parts; new ones are developed and/or formulated year by year.

The following table lists 8 categories of major resin and ranks them according to the quantities used in the average North American passenger unit in 1979; it also projects corresponding rankings and totals for 1985 and 1990. This data was prepared from the same detailed breakdown used to prepare the numerical summary in Table 1 above.

	1979		1985		1990	
	Rank	%	Rank	%	Rank	%
Polypropylene	1	23	1	28	1	25
ABS	3	14	3	12	4	9
Polyurethane Foam	2	19	2	17	2	13
Polyurethane RIM	7	3	7	5	7	6
Polyethylene	6	5	6	5	6	6
PVC	4	13	4	11	5	8
Polyester (TS)	5	8	5	10	3	12
Other		15		12		21
		100		100		100
Total Weight of Car	3,200 lb		2,800		2,500	
Total Weight of Plastics per Car	166 lb		210		262	
Per Cent Plastics	5.2		8		10.5	

RANKING AND PREDOMINANCE OF
MAJOR PLASTICS RESINS USED
IN AVERAGE NORTH AMERICAN PASSENGER UNIT
TABLE 2

The foregoing table roughly indicates the principal resin groups of interest to auto parts manufacturers.

Three of the leading seven resin groups are of particular interest to Canadian auto parts producers. World-scale plants located in Canada produce:

Polypropylene
Polyethylene
PVC

There is Canadian production of the remaining four resins specifically named in the table, but feedstocks and intermediates (e.g. Polybutadiene for ABS) are imported.

Many of the so-called "engineering resins" e.g. PTFE, Acetal, HMDSO and other silicon-bearing groups are imported in finished form. The significance of these distinctions requires explanations.

For most resins and other raw materials, the "Canadian price" i.e. the list price of raw materials used by autoparts producers in Canada is the same as the laid down price of the corresponding US materials (US price plus freight, duty and insurance). In the case of imported materials, this situation cannot easily be changed and leaves the Canadian auto part manufacturer at a significant disadvantage in competition with his counterpart in the United States.

Resin - a raw material - does not cross the Canada/US border free of duty; however, the finished auto part does cross duty-free under the provisions of APTA.

In the case of resins for which world-scale plants do exist in Canada, the domestic parts manufacturer has an opportunity to obtain relief from the price differential. Although their list price is higher than the US list price, such resins can be obtained in Canada at competitive prices if the partsmaker manages to convince his resin supplier that he needs price accommodation to obtain significant-volume orders. Canadian auto parts manufacturers tend to question the availability in Canada of competitively-priced resin; some of those who do suffer from faulty recollection or, alternatively, might benefit from more vigorous purchasing practices.

A more difficult aspect of raw material selection involves the relative price stability outlook of one resin type over another. This becomes important when planning innovative products or techniques which will result in volume sales 4-6 years later.

During the recent past, and for the foreseeable future, polymers derived from aromatic hydrocarbons are more subject to drastic price escalation. Such hydrocarbons (benzene, toluene, xylene) are used and priced as octane rating modifiers in lead-free gasoline. While other additives may be developed for this purpose, the supply of aromatic hydrocarbons is less likely to stabilise than that of the aliphatics. Among the latter, polypropylene is considered to offer the best stability prospects for both supply and price because it is a by-product of ethylene production.

The following breakdown shows the relevant division between some major resin groups:

Resins based on aromatic sources	Resins not based on aromatic sources
ABS	Polypropylene
Polyurethane (all types)	PVC
Polyester (TS and TP)	Polyethylene
Polystyrene	Acrylics
SAN	Acetal
Epoxy	EVA
Polycarbonate	
Phenolics	
Polysulphones	

Note: Polyamides (e.g. Nylon) are available in either of the two categories shown.

In this context, it might be pointed out that primary steel producers constitute a source of aromatic hydrocarbons which are formed during the destructive distillation of coal in cokemaking. The practicality of utilising these feedstocks for the benefit of Canadian plastics manufacturers might be examined.

Meanwhile, the auto parts manufacturer contemplating innovative designs in plastics has some incentive to try and utilise the three resin groups for which worldscale sources exist in Canada and which do not require aromatic feedstocks i.e. Polypropylene, polyethylene and PVC.

The major plastics resin groups are derived from fossil fuels. Such resins as cellulose acetate, CAB and ethyl cellulose have not only lost ground but many of them require plasticisers based on petrochemicals. Casein and Urea resins do not readily provide the properties required for auto parts. Use of CAB for steering wheels is one of the few current applications which do not rely on resin based entirely on petrochemicals. The latter are expected to form the backbone of plastic auto part resins for the foreseeable future. No massive new petroleum deposits are expected to be discovered nor any breakthroughs in aromatic hydrocarbon synthesis; thus the outlook is for continued scarcity and high prices for the most popular plastics resins. This in turn puts a premium on any extender or filler which can be added to such resins, especially if the filler performs additional property modifications such as

- improved mechanical properties
- better physicals (UV and heat resistance, conductivity, opacity, in some cases lower specific gravity)
- cost reduction

Reinforcing agents are usually in the form of fibres or strips designed to increase strength, toughness and resistance to failure from impact, vibration or fatigue. The list of fillers and reinforcing agents lengthens steadily. Two peculiarly Canadian developments - mica reinforcement and Large Scale Microwave polymerisation - have direct relevance to auto parts manufacture and are referred to in Section 8.1.

Availability of a broad range of resins, fillers and reinforcing agents enable the auto parts designer to tailor raw material formulations to specific tasks:

- the objective of maximum weight reduction puts a premium on conversion of large and massive parts from heavy to light raw material

- in many cases, the mechanical and physical properties required for large parts (e.g. front- and rear-end fascias) dictate the use of filled and/or reinforced plastics

- large structural plastic parts are frequently designed to replace in a single piece an assembly of metal parts consisting of many pieces. These large plastic components often form part of the car's body and must therefore present a Class A surface which is ready for painting. Colour match requirements militate in favour of such parts being finished together with the entire body in the customary infrared automotive painting tunnel. This, in turn, demands that the plastics part surface withstand high temperature and radiation.

Table 3 compares key properties of three glass-reinforced resins which find application in fairly sizeable auto parts. Since each type is fabricated by a different processing method, further reference to this table will be made in Section 4.2.

	Polypropylene Reinforced with 45% Glass Fibre (AZDEL)	Thermosetting Polyester/Glass SMC	Glass Fibre Reinforced Nylon
Specific Gravity	1.19	1.18	1.37
Notched IZOD Impact	10 ft-lb/in	10 ft-lb/in	5.5 ft-lb/in
Distortion Temperature 264 psi	310°F	450°F	390°F
Flexural Strength	20,000 psi	20,000 psi	20,000 psi
Flexural Modulus	100,000 psi	200,000 psi	200,000 psi

COMPARISON OF MECHANICAL PROPERTIES BETWEEN THREE REPRESENTATIVE GR FORMULATIONS

TABLE 3

The emphasis on large plastic parts and the increasing reliance on plastics to provide structural integrity has in recent years placed special emphasis on sheet moulding compound (SMC), bulk moulding compound (BMC) and, since 1979 especially, thick moulding compound (TMC).

Traditionally, these have consisted of various forms of glass fibre in a matrix of thermosetting polyester. Lately other thermosetting and some thermoplastic resins have been used, as will be further discussed in Section 4.2. Typical mechanical properties are compared in Table 4.

	Tensile Strength psi x 10^3	Flexural Strength psi x 10^3	Flexural Modulus psi x 10^6	Unnotched Izod Impact ft.lb/in
BMC	2,200	7,600	1.34	4.9
SMC	2,900	9,200	1.17	5.0
TMC	3,500	14,000	1.5	6.0

COMPARISON OF MECHANICAL PROPERTIES
OF PARTS PRODUCED BY
INJECTION MOULDING DIFFERENT COMPOUNDS
TABLE 4

The effect of increasing glass fibre content is demonstrated in Table 5 with the proviso that not only the percentage of reinforcing material is significant but also the physical form (length of fibre), orientation (random, uni-directional, multi-directional) and - last but not least - the adhesion between the resin and the reinforcing material. The more effective this adhesion, the more effective the reinforcing action.

Glass Content	20%	28%
Tensile Strength psi x 10^3	6.0	9.5
Flexural Strength psi x 10^3	15.0	26.0
Flexural Modulus psi x 10^6	1.5	1.6
Notched Izod Impact ft.lb/in	8.0	17.0
Unnotched Izod Impact ft.lb/in	9.0	21.0
Specific Gravity $\pm$ 0.05	1.0	1.75
Shrinkage in/in	0.0001	0.0001

PROPERTIES OF TYPICAL TMC FOR
AUTOMOTIVE USE, SHOWING
EFFECT OF GLASS CONTENT
TABLE 5

Appendix 1 provides a brief summary of the major plastics used in North American automobiles with their sources of supply in Canada.

4.2 Manufacturing Processes

The almost endless proliferation of plastics materials available to the auto parts manufacturer is virtually paralleled by a large and increasing number of different processing and fabricating methods and techniques. Again, machinery and equipment manufacturers may introduce proprietary variations to a given process and individual parts producers are apt to have a few "wrinkles" of their own.

Despite this profusion of different methods and techniques, however, four main groups account for 90 per cent of the manufacturing processes used in the production of plastics auto parts in North America. Table 6 shows the relative predominance of seven processes and gives rankings for the year 1979 as well as projections for 1985 and 1990.

PROCESS	1979 Rank	1979 %	1985 Rank	1985 %	1990 Rank	1990 %
Injection Moulding	1	47.9	1	48.3	1	48.3
Extrusion, Calendering	3	15.7	2	14.8	3	11.0
Foam Moulding Thermoforming	2	18.5	3	14.0	4	10.0
BMC/SMC/TMC	4	8.1	4	8.4	2	11.6
RIM/RRIM	5	3.3	6	3.8	6	5.2
Blow Moulding	6	2.9	7	3.0	7	4.3
Stamping	7	1.1	5	5.2	5	7.2
Other		2.5		2.5		2.4
		100.0		100.0		100.0

RANKING AND PREDOMINANCE OF PLASTICS FABRICATING PROCESSES IN NORTH AMERICAN AUTO PARTS INDUSTRY

TABLE 6

Some surprizing inferences may be drawn from this table: not only is injection moulding by far the most widely used method but it is slated to maintain that position throughout the 1980's. It is a relatively old-established process and one sees far fewer references to it in the literature than, for instance, to RIM and RRIM which contributes less than one pound for each ten pounds of injection moulded auto parts. New developments in injection moulding chiefly relate to the ability to inject and fuse ever larger shots of resin as well as to utilise various forms of reinforced resins. In the course of being softened, a screw or plunger agitated plastics mix tends to degrade any but the smallest particle size of reinforcing medium. Injection moulding of thermosetting resins (a close relative of transfer moulding) has also gained wider acceptance. The machine and die costs for injection moulding generally are significantly higher than those for RIM and RRIM; these latter techniques, however, tend to be slower and furnish parts with a coarser surface finish.

It will be noted that plastics stamping is the process expected to enjoy by far the fastest growth rate during the decade ahead; the question may be asked why such a relatively "exotic" form of processing (only 1.1 per cent of major automotive processing used this method in 1979) deserves specific mention. The answer is that even at 1.1 per cent, stamping represented over 18 million pounds of auto parts in 1979 while the corresponding 1985 volume (5.2 per cent) is estimated to advance to more than 100 million pounds and the 1990 predominance (7.2 per cent) would project usage corresponding to almost 180 million pounds. All these estimates are based on equal annual production volumes of 10 million passenger units. The particular attraction of the stamping process can be summarised:

- material requires heating only to below its glass transition point i.e. not as high a temperature as injection moulding or thermoforming. This not only saves heating time and BTU's but also contributes to faster processing cycles as the moulder need not cool a part through as wide a temperature range before the part can be safely removed from the die.

- crystalline resins such as polypropylene are preferred; this is the resin shown in Section 4.1 to present the most favourable supply/price outlook

- conventional metalforming presses with relatively simple tooling can be used. Hydraulic presses are preferred to mechanicals. This aspect makes plastics stamping particularly attractive for producers of metal auto parts who contemplate diversifying into plastics. Stamping permits them to utilise some of their know-how on presswork and tooling although some of this familiarity will prove of only illusory value in practice.

Against these useful advantages, stamping of plastics suffers certain drawbacks in comparison with other processing methods:

- the preferred resin, polypropylene, is chemically so inert that it does not effectively "wet" or adhere to reinforcing media such as glass fibre. Only one proprietary grade of GR polypropylene is available at present (Azdel, manufactured by GRTL, a subsidiary of Pittsburg Industries Group) and this material is scarce in addition to being premium-priced. Section 8.1 describes developing Canadian technology which may overcome this hurdle and could thus become the means of securing a processing breakthrough.

- stamping, especially of reinforced materials does not as a rule generate a Class A surface

- most resins which lend themselves to stamping show deflection temperatures which do not permit finished parts to be exposed in conventional automotive paint tunnels. (Reference Table 3).

A Canadian auto parts manufacturer, Butler Polymet, Division of Butler Metal Products Company Limited of Cambridge Ontario is a recognised world leader in the technology of stamping thermoplastics auto parts. Department of Industry, Trade and Commerce supported some of the relevant early R&D work but then so baffled and bewildered the company with bureaucratic footwork that they refrained from further programs for years.

4.3 Existing Product Groups

Today's North American passenger car, truck and van carries plastics parts in almost every functional and structural component group. Different authors adopt different classifications for these groups. From the viewpoint of Canadian auto parts manufacturing, the following classification appears realistic:

4.3.1 Body Parts

Those externally visible parts which do not constitute external trim (see 4.3.7 below).

Injection moulding, RIM and SMC currently provide most of these parts. Some two-and three part assemblies have been developed for parts of large area, e.g. hood and rear deck lids, fascias and extensions. This category will experience relatively strong growth.

4.3.2 Structural Parts

Usually non-appearance items requiring strength and fatigue resistance: battery trays, front and rear retainers (the parts that connect the resilient front and rear fascia to the frame of the car) wheel rims, main (leaf) springs, drive shafts.

These components call for the highest available mechanical properties and therefore rely on resins heavily reinforced with glass or carbon fiber. Filament winding is used to obtain orientation of the reinforcing agent.

This category tends to attract "show-piece" applications of plastics which generate more editorial copy in the technical and trade literature than manufacturing volume, jobs or profits.

Compression, injection and transfer moulding are prevalent as well as GR polyester lay-up in various forms of mechanisation, depending on parts volume.

4.3.3 Mechanical Parts

A host of generally unseen and unsung items such as housings, cylinders, grommets, closures, gaskets, seals, reservoirs, connectors, separators, hooks and washers which are found in all major systems of automobiles, such as

engine	fuel and other fluid delivery
cooling system	door hardware
transmission	window hardware
brakes	

Some mechanical parts must withstand exceptionally high temperatures, pressures and other exposures. The so-called "engineering resins" shine in these applications.

Since many mechanical components are small and injection moulded, these parts frequently invite the non-specialised custom moulder into the automotive field. Too often, such moulders regard automotive work as a fill-in for seasonal or other slack periods;

they do not acquaint themselves with automotive requirements; they quote very low prices; their careers as auto parts manufacturers can be short, unprofitable and highly discouraging to other plastics fabricators who could do well in the field.

Canadian firms contemplating manufacture of mechanical parts need strong design capability together with the ability to select parts which can be competitively produced from "Canadian" resins i.e. those for which world-scale manufacturing capacity is in place in this country. Too often, mechanical parts are "upgraded" to utilise sophisticated resins which are not competitively available in Canada. (Section 4.1 above).

4.3.4 Electrical Parts

These parts divide into two main categories: those in which the electrical properties of the plastics material are of paramount importance (e.g. terminal blocks) and, secondly, those which are associated with the structure and control of the car's electrical system (e.g. fuse holders or light switches).

Both the foregoing categories are the traditional starting base of plastics parts. This is where a great variety of injection mouldings in perfectly ordinary resins find their way into an automobile. Quantities tend to be high and prices shaved to a fine competitive edge.

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Any moulder with acceptable quality control standards can become a qualified supplier here.

Electrically conducting resins are attracting special interest as well as semiconducting resins in electronic applications. The increasing use of microprocessors, LED displays and other electronic devices associated with automobile manufacture and operation will likely stimulate further special plastics applications.

Batteries and associated controls currently account for an average of 3 pounds of plastics per passenger unit (principally polyolefins). This figure may triple if certain R&D developments succeed in replacing a substantial part of the conventional lead-acid battery grid with special purpose injection mouldings. Lead acid batteries are under threat of substitution for several reasons:

- heavy weight
- power loss at low ambient temperature
- dependence on low-cost recycling procedures. Over 50 per cent of the lead used in new batteries stems from remelted metal, most of it taken from scrap batteries. Breaking and remelting of old batteries is a process which cannot as yet be carried out anywhere in the world under hygienically and environmentally

acceptable conditions. Increasing regulatory pressure and fast rising production costs militate against the continued use of conventional lead-acid batteries.

4.3.5 Functional Parts

These include housings, holders, frames and surrounds - generally out of sight and under the hood - which impose less rigid property demands than those associated with structural parts. Some functional components are fairly large (e.g. the engine fan shroud) and therefore offer useful weight-saving opportunities on being redesigned in plastics as a replacement for metal.

Typical parts include fender liners, air louvers, combination seat shells and load-floors (which convert the rear seat area of hatchback models into a luggage compartment) and the great variety of housings, panels and retainers to secure headlamps, other lights, instruments and controls.

Injection moulding, stamping and thermoforming are common processing methods for these items.

Because the parts are bulky, automakers have tended to produce them in-house. However, if early design attention is given to nesting, stackability and de-stackability, many of these parts can be combined for reasonable freight transport economy without sacrificing easy handling characteristics in the user plant's assembly line area.

4.3.6 Interior Trim

This category includes parts which are in sight and therefore subject to more rigid requirements as to surface, texture and colour than those which apply to functional parts. Interior trim includes housings for heaters, the steering column and window apertures. These tend to be blow-moulded or thermoformed, depending on their geometry. PVC used to be the preferred material but, of late, polyolefins have made inroads into this application.

Upholstery, wall and floor covering also belong here; these tend to be made by weaving, tufting or other textile-related processes and may not really qualify as autoparts. However, all the foregoing items, including polyurethane padding for seating and padding (soft front dash) are likely to undergo radical changes during the next decade. PVC and other vinyls as well as polyurethanes are likely to be supplanted by resins with less irritating and noxious products of combustion. Moreover, traces of VCM (vinyl chloride monomer, a powerful carcinogen) are alleged to have been trapped in PVC resin, and vinyls are blamed for window fogging although this phenomenon is due to the external plasticisers added to some vinyl resins in order to enhance their texture and flexibility.

4.3.7 Exterior Trim

This category covers all the "jewelry" which is applied to the exterior of a car to give it the clean and sparkling look without which Detroit feels its automobiles cannot readily be sold. (This is another marketing maxim which is being tested at present, although the current fashion is said to call for more "chrome" rather than less).

Until 3 years ago, chrome plating was deemed indispensable on the exterior of cars. Borg Warner and other resin manufacturers spent heavily to devise techniques to enable plastics to become chrome-plateable. Then the price of nickel (the major constituent in chromeplated surfaces) rose sharply, and costly environmental protection provisions were mandated for all new electroplating plants. Plating costs skyrocketed and, two years ago, major autofirms began determined programs to find a substitute for plated brightwork.

Conventional vacuum metallising, using vapour-deposited aluminum, would not stand up on the exterior of a car. Stainless steel could be vaporised but required very costly high vacua. Cathode sputtering was found to work well on both metal and plastics substrates and is now used in increasing volume for GM and Ford exterior trim.

Most of the exterior trim parts are injection moulded: front grilles, lamp surrounds, window and drip mouldings, identification plates, wheel trim rings and license plate retainers.

Because of the harsh impact wear on wheel covers, the latter have so far retained an electroplated finish although the substrates are elastomers, ABS, Noryl (polyphenylene oxide, an engineering resin) and Polypropylene.

Body sidemouldings can be polyester or polycarbonate extruded over foil. Even wheel well mouldings have been made by this technique.

Innovative processing methods and designs for exterior trim offer an independent parts supplier a ready entrée to automotive applications (both OEM and aftermarket) and are therefore of interest to Canadian manufacturers.

4.4 New Applications

The key question for this section asks:

- "What auto parts not now generally made from plastics appear to be prime candidates for conversion"?

It is essential to realise that this section addresses itself to the average unit produced in North America. Certain test cars have been built from almost 100% non-metallic or plastics components but these are purely experimental.

Although visible body components made from plastics have already been adopted on many models, there is still a predominance of metal. These components offer potentially the largest field for further conversion. They include such items as front and rear fascia, hoods and deck lids, doors, fenders and extensions. Exterior trim components also offer considerable scope for additional plastics usage. Grills, bezels and surrounds will be turned over to plastics materials completely as downsizing takes hold. Hubcaps and wheel covers offer significant additional volume for conversion.

The engineering plastics, both in specie and reinforced, are said to be making significant inroads into functional auto parts commonly made from metal. Bumpers, drive shafts, and steering control arms will remain metallic unless there is a breakthrough in reinforcing technology, and a corresponding sharp drop in the cost of sophisticated reinforcing agents (carbon and boron fibers). The foregoing components are more likely to adopt high-strength, low-alloy steel than plastics as a lightweight substitute for more conventional steels. For bumper bars and springs, the competition between high-strength steel and plastics will likely be a stand-off; for the time being, plastics appear to have the upper hand i.e. in leaf springs for the Corvette and Cadillac Seville. However, the full weight of new steel development has not yet been brought to bear on this application. Numerous holders and brackets (structural and otherwise) will gradually be turned from metal to lighter weight plastics. In general, the highest warranty cost items are likely to remain in metal for the longest time - until extensive end use testing has established the reliability of plastics.

In the interior of the automobile, plastics have already captured almost all the housings for heaters, instruments panels, air-conditioners and decks. Integral seat shells will increasingly turn from metal to plastics as will sections of the load-floor common particularly in smaller cars.

Such items as front end retainers (the structural components which serve to connect the soft front end facia to the bumper assembly) will increasingly turn to plastics.

Most of the foregoing parts are relatively large and will therefore account for a relatively high volume of plastics raw material usage. In that context, however, it must be born in mind that downsizing will affect raw material consumption. In other words, while more parts will be converted from metal to plastics, the parts will become smaller and will therefore absorb a lesser weight of raw material.

In intermediate size parts, much hope is being pinned on oil pan covers as converts from metal to plastic. Some late models i.e. the 1980 Cadillac have already made the switch. However, eventually this application is more likely to be captured by aluminum alloy or high performance steel. Weight for weight there will be relatively little difference between metal and plastics parts but metal parts are apt to develop an edge with respect to cost.

Glazing, especially such items as sun roofs, and opera windows offer additional potential to polycarbonates, these are also occasionally mentioned as candidates for conventional car windows although in these applications they lose the "unitising" aspect which makes them cost competitive with safety glass in specialty applications such as opera windows.

Lenses for lighting units, both head and tail, already consist for the most part of plastics.

Seats, armrests, head restraints and other soft and flexible parts including floor coverings are now made from plastics in the great majority of cars. Glove leather and wool fabrics will likely remain luxury items in some high-priced passenger units.

From the point of view of Canadian suppliers who endeavour to capture new product lines, small mechanical parts such as fuel system components (pump impellers), speedometer housings, transmission components, mounting brackets and fan supports may offer particularly attractive opportunities. Often these parts pose high demands in terms of structural vibrational and fatigue integrity, all of which make necessary the special formulation of resins or reinforcement agents. Dollar volumes in these items, while respectable, do not easily reach gigantic proportions and therefore they are not costed as narrowly. Small specialty parts are said to count among the most profitable auto parts. Although one hears about master cylinder reservoirs in plastics, there are still many other brake components which could be readily substituted by plastics.

Wind deflectors for truck trailers are now manufactured in Canada. Unfortunately, many of them are inefficient; not enough attention seems to have been paid to the excellent design data on this application developed and published by the National Research Council.

The drive shaft is one part which may attain commercial acceptance for carbon fibre reinforced plastics. Many other applications mentioned for this costly composite material are considered poor risks. Because these composites offer properties far ahead of conventional plastics, they are "newsworthy" and much discussed by media, speakers and teachers. This creates the impression of a degree of market acceptance which does not exist.

Truck and van doors made from SMC and TMC are finding increasing use. The tailgate of the 1980 Oldsmobile station wagon is the first such part for a North American passenger unit. It is said to save both weight and manufacturing cost.

In the foreseeable future, news in plastics conversion will likely continue to stress large heavy parts made from reinforced resins.

Sections 8 and 10 list innovations of potential interest to Canadian plastics processors and auto parts manufacturers.

5. CANADIAN CAPABILITY

This section and its relevant Appendix lists Canadian manufacturers currently and potentially engaged in plastics auto part production as well as certain other defined categories.

It is important to recognise that these lists are not comprehensive. Apart from the limits of time and budget imposed on this report, there are many other reasons why no such list can claim both accuracy and completeness. There is, for instance, no firm agreement as to the number of establishments in the Canadian plastics processing industry as a whole.

The following information is based on data in the authors' possession, supplemented by information published by the Society of the Plastics Industry of Canada, the government of Canada, trade and other publications.

The entire Canadian plastics processing industry is estimated to comprise 1,500 establishments of which more than half achieve annual sales lower than $1 million while those with sales of $3 million or more per annum account for about three quarters of the total value of industry shipments estimated at $3.5 billion in 1979. Approximately one quarter of the establishments are situated in the Province of Quebec and account for one quarter of annual industry shipments by value. Some 50 per cent of the establishments are domiciled in Ontario and these ship goods to the value of about two thirds of total annual industry output.

Because most of the US and Canadian automobile manufacturing centres are located in the vicinity of Ontario and Quebec, the concentration of plastics processors engaged in auto parts manufacturing is even greater than that which applies to the Canadian plastics processing industry as a whole. Truck and van assembly is a little more decentralised; the Volvo assembly plant in Nova Scotia is another exception. However, in the foreseeable future, significant increases in plastics auto part manufacturing and a substantial reduction in Canada's negative trade balance of such parts can only be brought about by initiatives successfully implemented in that part of Canada located in reasonable proximity to major automobile manufacturing centres.

5.1 Plastics Auto Parts Manufacturers

What has been mentioned above concerning the shortcomings of company lists applies with special emphasis to plastics auto parts manufacturers. We have seen publications by OEM automobile manufacturers in which they list their suppliers of plastics parts in Canada. One of these lists showed 58 companies. 8 of them were duplicate listings; 12 were raw material manufacturers; 6 were compounders or distributors of resins; 7 were suppliers of sundries such as labels or transparent bags for washers and small spare parts. In other words, only about half the firms were auto parts suppliers in the sense understood by this report. One receives the impression that, when automobile companies list their Canadian parts suppliers, they like to show as many names as possible.

On the other hand, we have seen listings of Canadian plastics auto parts manufacturers which failed to include the largest single establishment, namely General Motors of Canada Limited in Oshawa, Ontario, a captive operation which keeps itself surprisingly aloof from the mainstream of plastics processing activity in Canada.

Appendix 4 presents an alphabetical list of Canadian plastics auto parts manufacturers together with their principal types of products or processing capabilities. The number of employees directly and indirectly engaged on plastics processing is shown in square brackets.

A figure/letter classification indicates the relative size, corporate form and ownership of each listed firm. A detailed key to this classification is given in Appendix 3.

5.2 Candidates for Growth and Change

If Canada's plastics auto parts production is to increase substantially, one of the crucial questions to be answered is:

"Which of the existing auto parts manufacturers offer the best prospects for innovative growth and expansion? How well are their capabilities aligned with the product ranges identified in Sections 4.3 and 4.4 above?"

There are quick and easy answers to that question but they fall short of providing effective guidance toward the stated objective; one could, for instance, proceed entirely on the basis of company size and financial strength. That approach works best at the low end of the scale; a one-man injection moulding company will not significantly contribute to increased auto parts production - will probably fail to attain qualification as an auto parts supplier.

Conversely, however, a very large processor may not necessarily prove a candidate for innovative growth and expansion. Is the identification of such a candidate a subjective task? To some extent it is; yet some objective questions can be asked:

"Is the candidate company ......

- willing to work with major automobile companies and respect their methods, standards, purchasing procedures and the cyclic nature of the car business?

- keen on new developments, including the commitment of time, money and promotional effort associated with effective innovation?

- willing to work over a 3-5 year period to eventual commercialisation, and even longer to full exploitation of its developments?

- not satisfied or content with its current performance?

- willing to set up prototype manufacturing facilities on a stand-by basis and assist with product characterisation and (if necessary) certification?

- prepared to transfer to its OEM customer not only the technology it has developed but also more than half the total production volume for in-house manufacture by the customer - especially in the case of the most successful programs?"

These "qualifications" might be enough to frighten off many a successful plastics processor but there are more:

"Can the company satisfy the quantitative and qualitative manufacturing requirements of OEM automobile companies?"

"Can the company point to a successful record of new process and product development in the automobile or a related business?"

"Does the company offer the required hardware and software capability?"

Some of the foregoing requirements can be relaxed somewhat in the case of auto parts sold into the aftermarket rather than the OEM sector. However, from the Canadian plastics auto parts producer's view, the OEM sector represents a much larger and more accessible target. Some suppliers have likened the aftermarket to "the minor leagues" which represent useful preparation for entry into the OEM auto parts market. Certainly lead times and time horizons in general are shorter.

Each of the companies listed in Appendix 4 is itself the best judge of the size and scope of its potential new auto parts manufacturing activity. If so requested, the Department could offer its information and expertise to assist and strengthen the company's investigations, as mentioned in Section 6.

Some rough preliminary classification of the companies listed in Appendix 3 and 4 can help to match the approximate size and scope of a development project with the size, strength and product orientation of one or more Canadian plastics auto part manufacturers. However, such use of the lists is subject to the reservations stated in Section 5.1.

5.3 Non-Automotive Plastics Fabricators

The key question for this section asks:

"What Canadian plastics processors not now manufacturing auto parts could effectively move into that market?"

In this category, the most expeditious means of significantly raising Canadian auto parts manufacturing participation would involve the entry into the field of a sizeable established plastics processor who:

- displayed a mix of characteristics similar to that outlined in Section 5.2
- met the qualifications required by automobile manufacturers
- possessed know-how and manufacturing experience related to one or more of the processing techniques identified in Section 4.1 and 4.2.
- had the corporate and financial strength to execute a major program of investment in development and manufacturing of innovative auto parts.

A possible approach to answering the above question might begin by reminding oneself that large reinforced auto parts represent a promising target segment in the OEM market. A preferred processing method for such parts is TMC, a technique relatively new to Canadian manufacturers. Some relevant capability exists within Canadian General Electric Company and Protective Plastics Limited; the latter is a Canadian owned and operated fabricator of reinforced plastics with a following and reputation well beyond international borders.

Companies such as Grandview Limited (a member of the Noranda Group) and Daymond Limited (a subsidiary of Redpath Industries Ltd) have acquired a commanding stature in the plastic pipe extrusion and fixturing field as well as in injection moulding of large and thick-sectioned plastics components. Their involvement, if any, in plastics auto part manufacturing has not been commensurate with their capabilities.

The foregoing examples were chosen in ignorance of any corporate intentions or plans of the companies named. However, there is reason to believe that they would be prepared to consider any development scheme to which they could bring relevant technical and production expertise and which could be reasonably shown to meet their hurdle rates for DCF and ROI. In some instances the companies have in the past considered meaningful investments in auto parts production but did not implement the same. It could prove productive to draw to their attention the peculiar opportunities presented by the early 1980's in relation to their respective areas of expertise on one hand and the urgent development needs of OEM automobile Companies on the other (Ref. Section 6)

Even so, there will always be a number of excellent plastics processors who will shy away from any involvement with OEM and aftermarket auto parts.

5.4 Non-Plastics Auto Parts Producers

The key question asked by this section:

"What experienced Canadian auto parts manufacturers not currently producing plastics parts could utilise their marketing stature and know-how to expand into such production?"

At first sight this question appears to paraphrase the classical question asked by specialised manufacturers with respect to their computer programmers: is it easier to teach a programmer the ins and outs of a new business or to teach programming to a person already familiar with that business?

On closer inspections, however, several Canadian auto parts makers who do not produce plastics parts are subsidiaries of multi-national companies who do.

For instance, Budd Canada, Inc., one of the largest auto parts makers in Canada, does not engage in meaningful production of plastics parts in this country. Its US parent organisation, however, is reported to have developed successful innovations in raw materials (raised-impact SMC) and parts design (hoods, deck lids, truck and van doors). These items, i.e. large reinforced body panels and components, count amongst the most promising in the whole spectrum of auto parts. There is no reason to believe that existing Canadian capability would be impaired or replaced if Budd Canada Inc. were to utilise this or related technology in Canada.

International Harvester Company of Canada Limited concentrate their Canadian auto parts production on metal and rubber although their counterparts in the US are understood to have highly developed capability in reinforced polyester technology for body panels.

Long Manufacturing Division of Borg Warner (Canada) Limited are not active in the production of plastics auto parts although its affiliate is a major resin supplier and its US parent and associate companies have shown leadership in the design, development and implementation of plastics auto parts development.

Duplate Canada Limited has subsidiary companies engaged in plastics auto part manufacture but is not itself known to be actively developing lightweight automotive glazing, a topic on which major R&D activity is under way within both General Motors and Ford in the United States.

The Suspension Division of Eaton Yale Limited in Chatham has not publicly acknowledged significant interest in the work of its US associates on reinforced epoxy springs.

Other companies whose stature as metal auto parts manufacturers put them in a position to participate decisively in corresponding plastics operations include:

Aimco Division of ITT Canada Limited
Tenneco Canada Group Ltd.
Kelsey Hayes Canada Limited
Delaney Petit Operations of Lear Siegler Industries Limited
Irvin Industries Canada Limited
Bendix Automotive of Canada Ltd.

Since metal (especially steel) content of motor vehicles continues to shrink, and since the profitability of many metalforming enterprises is determined by their sales volume in terms of "weight of product" rather than "number of parts", there exists a natural incentive for metal fabricators to diversify into the production of plastics auto parts. Such conversion is becoming steadily less difficult as stamping and hydraulic shaping of plastics sheet, strip and billet becomes an accepted manufacturing technique.

6. SCOPE FOR GOVERNMENT ACTION

The key question for this section asks:

"What steps can the officers of the Department of Industry, Trade and Commerce initiate in order to encourage desirable change and growth in Canadian output of auto parts?"

6.1 "Plus ca change, plus c'est la meme chose"

The Department's auto parts division has already demonstrated its capability in enhancing Canadian participation in auto parts production. Its experience and expertise in this regard extends mainly to fabrication of metals. Strong technical and marketing expertise on metalforming exists in the Department. Because comparable experience on plastics materials, processing and fabrication is less well developed, some members of the Department may feel unduly handicapped in their dealings with manufacturers and potential manufacturers of plastics auto parts.

Whether or not such a perceived handicap exists, it should not and need not hold back constructive steps which Departmental officers can take to promote more effective auto parts production in this country. The common aspects between the development and manufacture of auto parts from metal and from plastics outnumber by a wide margin those aspects which set these two manufacturing sectors apart.

In both these fields, the manufacturer who seeks substantial and profitable growth must do more than say to his customer: "Give me a drawing and I'll quote on a part." In both fields, the Canadian supplier must demonstrate the interest, competence and plain-dealing honesty which convinces his customer that here is a firm which understands the problem and offers an approach to solving it which is at once workmanlike and innovative. In both fields, service, quality and price will determine success.

The difference between the manufacture of metal versus plastics auto parts is that the latter family of materials offers greater scope for individual initiative:

- plastics formulations are determined and effected by the fabricator to a much greater extent than are the alloys, mixtures, compositions and reinforcing agents used with metal.

- the plastics processor has more flexibility in selecting manufacturing techniques than his counterpart who produces metal stampings or castings

- the plastics processing industry is less mature than the metals processing field and therefore more subject to innovation, substitution, obsolescence and redundancy.

- compounding and specialised finishing (vacuum coating, metallising, sputtering) play a more prominent role in the plastics auto parts sector.

Despite these differences, we believe that the Departmental officers are in an excellent position to foster significant and profitable growth in plastics auto parts production, to devise and implement programs aimed at achieving that objective and to evaluate the specific suggestions made in this report.

Increased Canadian participation in the manufacture of plastic auto parts is attainable by the same methods as apply to the corresponding objective in any other auto parts; it follows classical lines of market development with only a few specialised "wrinkles" peculiar to North American car production:

1. Analyse and project user requirements
2. Define technical advances required
3. Tie these to existing capability and aim for unique products
4. Maintain close customer contact throughout
5. Secure financial and other resources
6. Implement

6.2 R&D Assistance

This aspect has received recent attention in a report prepared by Arthur D. Little Inc. for the Ministry of State for Science and Technology.

In part, that study suggests that OEM automotive companies prefer to deal with large supplier companies. That suggestion appears to overlook the numerous, well-established and not insignificant relationships which have grown up between the Canadian operations of the "Big Three" and small (20-50 employees) parts producers. Particularly on product innovation, the OEM's have proven both loyal and generous to such suppliers as Curtis Harris Industries or ABC Blow Moulding Limited or Supreme Castings Limited who have grown from small "shops" to recognised auto parts makers on the strength of innovative competence and services. Systematic search will disclose scores of similar situations which, taken in combination, could bring substantial amounts of plastics manufacturing volume into this country. Sections 8 and 10 deal further with these opportunities.

Among its recommendations, the A.D. Little report lists the need for less restrictive government assistance with R&D. In that context, it is worth noting that the cost of R&D work generally amounts to about 10 per cent of the total cost of translating an innovative concept into a saleable plastics product.

The necessary product and design engineering takes twice as much money as R&D while tooling and prototyping costs typically run three times the R&D cost with marketing and start-up expenses using up the balance.

In terms of this report's objectives, the only successful R&D work is that which leads to a significant volume of new plastic auto parts production in Canada. Even the most generous R&D assistance represents only a fraction of the support required to achieve that objective.

6.3 Market Development Assistance

Officers of the auto parts division are well acquainted with the general thrust of automotive development and with the capabilities and services which OEM customers expect from their suppliers. These officers also understand the particular types and volumes of products which the OEM's are apt to buy from and develop through outside sources.

These concepts need to be interpreted to potential producers of plastics auto parts together with changes in the direction of OEM policy.

For instance, safety standards laid down by US regulatory bodies continue to undergo changes which affect both the thrust of OEM development and the opportunities for effective innovation by outside suppliers. Until recently, the relevant regulations would mandate that a 5 mph front, rear or side-front impact would not produce damage beyond a certain specified limit. These regulations are under review to be replaced by general vehicle performance characteristics (the equivalent of a use and occupancy code in buildings) in both normal and accident situations. As part of this evolutionary change, and under pressure of the automobile lobby in Congress, legislative proposals seek to reduce the structural requirements from a 5 mph impact to one at 2.5 mph. Such a change would create opportunities for additional plastics substitution around the front and rear end assemblies of passenger automobiles. The foregoing only serves as an example of changes which should be notified to parts designers and manufacturers.

6.4 Consolidations

Previous reports and task forces have suggested that government should seek to facilitate joint ventures, mergers and other consolidations of small Canadian manufacturing units. The potential advantages of such consolidation include not only a desirable pooling of strength in finance, marketing, R&D and understanding of automotive OEM requirements; they can also contribute to higher facilities utilisation and hence lower production costs. However, these advantages usually take place only after the passage of 8-12 months of acclimatisation. Moreover, successful consolidations usually occur spontaneously between corporate units which have achieved a record of successful cooperation. The scope for "artificially induced" consolidation must be regarded as limited despite the fact that officers of the Department are likely in the best position to recognise the compatibility which may exist between potential partners.

7. BARRIERS TO CHANGE & GROWTH

7.1 Structural Barriers

Recognising the unquestioned excellence and value of previous studies, one occasionally gathers from them the impression that Canada should emulate the United States' approach to industrial output, that Canada can be regarded as a nascent US which should hurry up and grow to become like its southern neighbour - at least in terms of its manufacturing industries.

While that argument can be constructively pursued in some directions, it ignores important aspects related to Canadian market size, geographic spread, seasonal and climatic variations. Some observers regard all these as drawbacks which the Canadian manufacturer must overcome to compete with his US counterpart on even terms. Again there is truth in that argument although it overlooks some inherent advantages; in the early 1980's the development and production of plastics auto parts demands flexibility of the kind which smaller Canadian companies can marshal more quickly than their oversized competitors.

The structure of the Canadian plastics industry as a whole presents a barrier to concerted action by a body such as the Society of the Plastics Industry of Canada (SPI). That association counts among its members organisations with different, if not opposed, objectives. Resin manufacturers seek different goals from plastics fabricators and manufacturers of machinery, equipment and tooling differ from both the foregoing categories.

Hence the Department of Industry, Trade and Commerce can play a particularly important role in helping the plastics industry to overcome some of the structural barriers referred to.

7.2 Strategic Barriers

Proximity to his customer is a valuable attribute of the successful auto parts maker; that means proximity not only to the purchasing function (typically in the Detroit area) but also the customer's development facilities and assembly plants.

Only in a few instances do Canadian suppliers reap the advantage of local contact with OEM automotive customers: e.g. at the cold weather testing and development facility of General Motors at Kapuskasing, Ontario. Experience has shown that even the most competent suppliers located in Western Canada or the Maritimes must overcome additional difficulties in their dealings with major auto companies. However, even the manufacturer located in Central Canada needs seasoned and respected representation in Michigan, as further outlined in Section 8.3.

Another form of strategic barrier can perhaps be described as failure to fit a company's marketing targets to its size, strength and area of technical competence. Big, long-running contracts are the wish-dream of most manufacturing executives. That is why such contracts are usually "cut to the bone" as to price; that is why OEM's run them "in-house" and know the relevant costs to a nicety. There are good reasons why Canadian manufacturers may be better served by concentrating their development thrust on areas which:

- OEM's do not want to enter
- are too small to interest OEM's, and
- too complex for the OEM's

7.3 Financial Barriers

Even in times when Interest Rates stand at less forbidding levels than in the early spring of 1980, investment in automotive facilities and R&D is hard to justify on a long-term basis:

- automotive volume is highly vulnerable to cyclic swings
- transportation is only the third-largest single market segment for plastics products; despite rosy forecasts read elsewhere, the anticipated long-term growth trend is also the third largest

- the plastics fabricating industry is relatively immature

- since investment capital seeks the safest and highest return available, financial analysis does not favour long-term investment in auto parts facilities.

Some analysts, however, tend to ignore that - compared to manufacturing in general - plastics production requires a lower asset and equity base. This aspect is especially important in Canada, where the pool of venture capital is relatively small. It points out the importance of carefully selected and applied financial assistance to existing and potential manufacturers of plastics auto parts.

7.4 Psychological Barriers

These are the most varied and the most numerous; only those which are believed to exert strong influence on the plastics auto parts producer are mentioned here.

Too many Canadian manufacturers cling to the Edisonian view of invention: they feel that innovation requires a great leap forward in technology or science, a change which supplants all existing practice in the same way as electric power did away with gas light. Edison himself knew better; his advances were usually made one small step at a time. He said many times that his inventions consisted as to 5 per cent of inspiration and 95 per cent perspiration.

Over-cautious Canadian entrepreneurs should not disqualify themselves on the basis of lack of genius.

Nor should they be held back by the widespread belief that automotive OEM's know all the answers or that US suppliers are more accustomed to or acquainted with automotive requirements than their Canadian counterparts. In the current turbulence of automotive light weighting and downsizing, no one knows many - let alone all - of the right answers. The automotive OEM's have acknowledged their need for vendor assistance in this regard; the reasons for this situation are set out elsewhere in this report.

The need to focus on innovative development in areas other than USA is dealt with in Section 10.3.

One difficulty facing the officers of the Auto Parts Division is easy for an outsider to spot but hard to cure: frequently the officers must wonder what happens to the sound advice and frequent suggestions which they give to executives in Canadian manufacturing companies. At times, it must seem as if "no one out there is listening". Perhaps the advertising industry knows the answer to this problem, namely, that a message has to be repeated over and over again before it sinks in.

An intangible and frequently mentioned barrier is that of nationality. Even with the existence of an Automotive Parts Trade Agreement, the US customer tends to favour a US supplier over a Canadian. The OEM's not only deny this sentiment but point to the existing volume of parts which they purchase here. Manufacturing and transportation costs likely play a larger role in this respect than nationalism.

From time to time, voices are heard to condemn government assistance to industry as a direct subsidy which calls for the imposition of dumping duties or other tariff or non-tariff protection. It is not believed that such demands have a meaningful effect on auto parts exports to the United States. Nor should they be used as a reason for reducing federal help to the industry.

8. STRATEGY FOR INNOVATION

8.1 Homegrown Technology

It is agreed that innovation is one of the important keys to capturing additional manufacturing volume for Canada. Unfortunately, this country has a poor record in exploiting its innovative skills. The telephone, the ball point pen, the naval torpedo and other items conceived and first tried in Canada were then "lost" to other countries where they stimulated the development of large industries. Canadian innovators seem to deflect much of their time, talent and financial substance to the creation of a world-wide patent structure to protect their inventions. In the fast-moving world of plastics auto parts that tendency may be particularly inappropriate.

National Research Council of Canada sponsors R&D which is, in part, highly relevant to potential new developments for plastics auto parts. The following two random examples from our recent experience may help to demonstrate:

Wind Deflectors

The sharp escalation of fuel prices has focused attention on the fact that wind resistance accounts for approximately one half the power requirement of a highway tractor trailer unit proceeding at a steady highway speed of 100 km/h. Wind deflectors can greatly reduce that resistance but many of the deflectors currently mounted on trucking equipment are not as effective as they should be.

As early as 1976, the Low Speed Aerodynamics Laboratory of the National Aeronautical Establishment of NRC began to quantify the potential fuel savings from properly designed wind deflectors, publishing a series of reports which appeared to become the "Bible" of the industry - in the US and in Europe. Hardly anyone in Canada paid heed to them or even knew they existed.

Large Scale Microwave Plasma

This new technology is just emerging from the laboratories of Ecole Polytechnique in Montreal. It enables microwave plasma to be simply scaled up and to act as a catalyst for the synthesis of polymers with truly remarkable properties.

The relevance to development of new plastics auto parts is varied and includes:

- surface conditioning of glass and other fibres, mica, nepheline syenite and other fillers to effect significant increases in the property improvement normally induced by fillers. This topic relates directly to the manufacture of large reinforced parts - i.e. one of the most topical auto part product groups.

- increased strength, toughness and continuity of surface coatings (both on metallic and plastics substrates) to enable more lightweight parts to be used on the exterior of cars and trucks.

- induration of organic glazing materials
- replacement of GR polyester by more economical polyolefin formulations

It is hoped that the prototype evaluation and development of this new technique will be undertaken in Canada and that it will be monitored as well as guided by Canadian manufacturers to ensure domestic exploitation.

Among shorter term goals, programs should be put in place for the evaluation and application of several other techniques with special reference to plastics auto parts:

- modification of polyolefin resins to make them more readily responsive to dielectric heating; this will make feasible the economic fabrication of thick-walled auto parts
- techniques for embodying amorphous metal strip in thermoplastics and thermosetting matrix resins.
- techniques for welding and cementing plastics assemblies
- evaluation of new laminates consisting of a solid or foamed polyolefin core covered by thin sheet steel. The concept is borrowed from aircraft construction practice

(where the skin metal is typically aluminum) and it achieves a Class A surface capable of painting and curing by conventional means. The composite part claims stiffness and specific gravity comparable to that of aluminum at a cost significantly lower than that of aluminum.

8.2 Innovative Leadership

Many Canadian manufacturers deliberately avoid originality. They believe that they can't afford it. Their approach to innovation may typically consist of keeping close watch on what is being done in the United States. They wait for any new product to be proven in service, and then they work as fast as they can to be among the first to manufacture it in Canada. The procedure is relatively safe; it is also unlikely to contribute heavily to increasing the volume of manufactured goods in this country.

In the plastics industry, fabricators have tended to rely on resin manufacturers (generally subsidiaries of major oil companies or multinational chemicals producers) for information on new material formulations, processes, equipment and products. In part this practice stemmed from earlier days in the industry when the resin manufacturer would supply fully compounded (often colour-matched) material to the fabricator. When a new process or product required specially formulated raw material, little could be done by the fabricator until such special material became available.

That situation no longer holds true to the same extent; not only can the fabricator turn to any number of custom compounders for new compositions but, increasingly, the major resin manufacturers confine their activities to the production of basic resins; they leave the necessary compounding to other firms; occasionally a resin producer may have corporate ties to a compounder.

Nevertheless, the resin manufacturer is still regarded as a major source of new process and product information as well as a source of professional advice and evaluation of early development samples.

This pattern has not served Canadian processors badly but it can hardly be expected to secure a basis for substantial additions to the volume of domestically manufactured plastics auto parts.

The following sections will therefore outline ways in which producers of plastics auto parts can lift their sights to more effective leadership in process and product innovation.

8.3 Application Engineering

Before the manufacturer begins the long and costly process of product development, he must try to assure himself of the anticipated life and profitability of the development target - be it a single product or a group. Forecasting techniques are available and should be utilized but it is also indispensable to make effective contact with the prospective customer.

In the case of plastics auto parts, such effective contact can only be secured and maintained through a competent agent who resides in Michigan and who not only understands his major OEM customers but also enjoys their recognition and respect as well as that of his Canadian principal.

A choice of such agents is available. The Auto Parts Division has in the past helped Canadian firms to identify potential agents, and this activity should be maintained and specifically developed with respect to plastics components.

It could not be the function of either the Canadian government or the Society of the Plastics Industry to furnish the services of a "super-agent" who could function on behalf of all those plastics fabricators who could not or would not retain a full-time agent of their own. However, an individual agent or firm can successfully represent several principals in non-competitive product lines.

In the early stages of cooperation, the aim should be to achieve small, useful and needed product improvements. In this way cooperation and communication in the triangle of manufacturer:agent:OEM will be allowed to settle down effectively. On the quality of that cooperation will depend much of the success of the entire development.

8.4 Longer Term Plans

Because significant new product development in the OEM automobile market aims at full commercialisation several years after initial introduction, the selection of products and processes for development becomes an important consideration. The more flexible the selection can be maintained the better. Yet some specific targets can be identified.

Example: Electric Vehicles

Their success hinges on better methods of storing electric power - more effective batteries. The chief problem with batteries is that they lose power rapidly on acceleration. Existing batteries can economically attain a single-charge driving distance of 250 km for a vehicle governed to operate at 35 km/h maximum. However, if the governed speed limit is raised to 80 km/h (50 mph) the single-charge distance is reduced to 75 km. In these circumstances, weight reduction becomes even more critical than it has already become in response to government-mandated fuel efficency now strongly confirmed by customer demand in the marketplace. Already the automobile designer is adopting an outlook similar to that of the aircraft designer in relation to strength to weight ratios. The advent of the electric vehicle will intensify that tendency.

Forecasts published by the major automotive OEM's, their trade associations, independent industry analysts and the Environmental Protection Agency of the US government call for the production of approximately 1 million electric vehicles during the five-year period 1985-1990. AT&T estimates that some 40 per cent of its fleet of 100,000 vans now operating in the United States could with advantage be electrically powered. That this is no empty public relations gesture may be deduced from statements made by the President of General Motors that his corporation will sell electric passenger cars and small pick-up trucks to the public no later than 1985 and that it expects to produce 200,000-300,000 per annum of such vehicles "sometime after 1985".

In terms of overall car sales by GM, these are small figures; however, electric vehicles will stimulate a new round of lightweighting and materials substitution which may well present good opportunites for Canadian producers of plastics auto parts who are prepared to work to such time and market horizons in the hope of establishing themselves as OEM suppliers.

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9. POTENTIAL CASUALTIES

Previous sections of this report outline the opportunities expected to open up for Canadian processors of plastics as a result of further lightweighting of passenger automobiles, trucks and vans; especially since materials substitution in favour of plastics resins and composites will likely accelerate during the 1980's.

These developments will cut into the volume of some Canadian manufacturing sectors - notably those related to the production and fabrication of cold-rolled steel and other carbon steels as well as those related to electroplating.

Such substitutions occur gradually and are subject to local and temporary fluctuations. Hence any relevant forecasts represent little more than subjective - albeit carefully weighed - judgments. For that reason, some explanation of the major aspects is in order.

9.1 Development Lag in Steel

Table 1 in Section 3.1 projects that the combined total weight of iron and steel in the average North American passenger vehicle will decline from 2,880 pounds in 1979 to 2,020 pounds in 1990, a reduction of 860 pounds per unit or approximately 30 per cent. These being rough estimates, it is fair to assume that the reduction in the weight of iron and steel used in the manufacture of trucks and vans will also approximate 30 per cent. The corresponding reduction for zinc is 50 per cent.

The input/output studies conducted by Statistics Canada for the year 1979 have not yet been published. Preliminary data suggest that shipments (from all sources) of iron and steel to the automotive sector in 1979 represented a value in the vicinity of $800 million, equivalent to approximately two thirds of the shipments of iron and steel to the transportation industries sector as a whole.

These overall figures fail to show that the alloy types of cast iron, steel and zinc used in automobiles will also undergo modifications during the decade under review.

- plain carbon steels will increasingly give way to high-strength-low-alloy (HSLA) compositions.

- alloy cast irons will take the place of more conventional cast irons

- zinc die-castings will be designed with wall sections so much thinner than at present that radical changes in temperature and coolant circulation control may be required on die-casting machines.

Hence the dislocation caused by raw material changes may be greater than is suggested by the overall changes in raw material usage.

One of the reasons for the slow rate of acceptance of HSLA in automobiles was the tendency of flat-rolled alloys to exhibit stretcher strains on being deformed. This defect can, in part at least, be mitigated by appropriate tool design but North American tool and diemakers have been slow to tackle this problem. In face of the buoyant markets of 1979, they did not think they needed to make any changes. The slump of 1980 is proving them wrong.

As mentioned in Section 3, it is anticipated that stronger and lighter-weight alloys (especially HSLA) will emerge as strong competitors for plastics in the inter-material substitutions designed to upgrade fuel efficency of North American cars. Zinc fabricators have developed thin-walled diecastings to produce fender extensions which weigh only 1.5 per cent more than mineral-filled nylon and are cost competitive with plastics parts.

9.2 The Heavies

Apart from overall materials substitution, a more specific question can be formulated:

> "What Canadian companies are likely to lose existing product lines as a result of such lines being converted to components made from plastics rather than conventional materials e.g. ferrous or non-ferrous metals?"

The short answer is: all those who feel that they do not have to update their products. Curiously enough, there still are many Canadian auto parts suppliers who think that <u>their</u> particular product lines will be spared from fundamental change. Their reasoning follows one or more of the following lines:

- parts such as frames, pillars, steering control arms and suspension items are so safety-critical that they will not be supplanted by lightweight non-steel components.

- Detroit is so strapped for capital that it can't afford to change its manufacturing methods e.g.:

  - doors will always have to be made from metal so that they can be "bent" into shape on the assembly line.

  - radiator supports will always have to be multi-piece steel weldments

  - only small cars can be designed as unitised shells; the majority of North American cars will always be of the body-on-frame type.

- "our" part is only re-designed every six years, so we have five years to go before <u>any</u> change.

These arguments bespeak the conservative outlook of too many Canadian auto part manufacturers in the face of material change of any kind. These managers deny the need for long-term planning, strategic or otherwise; they joined in the cheers for Henry Ford II when, in late 1978, he approved the construction of V-8 engine plants and renewed his 5-year old saying that "big cars mean big profits and little cars mean little profits, and fortunately the average American car buyer won't use little cars". They cling to these views even after learning that some of the new V-8 engine plants will have to be written off before a single saleable engine has ever been produced in them.

The following alphabetically arranged schedule indicates those auto parts in which existing parts are projected to undergo significant change during the 1980's. Manufacturers who produce these parts and who fail to anticipate changes should therefore prepare for the possibility of losing automotive volume:

Battery trays
Body parts
Brake covers
Brake pedals
Brake cylinders
  (master and wheel)
Bumper bars
Bumper brackets
Bumper guards
Bumpers
Closures
Clutch covers
Clutch pedals
Dashboards
Drive shafts
Duct assemblies
Fanblades
Fuel Tanks

- Grilles
- Handles
- Hubcaps
- Lamp lenses
- Pillar posts
- Radiator supports
- Rims
- Rocker panels
- Scuff and sill plates
- Trim
- Truck and trailer body parts
- Truck tanks
- Vacuum Reservoirs
- Water pumps
- Wheels
- Window regulator parts

9.3 Wrought Aluminum

Aluminum is one of the raw materials often mentioned as a competitor of plastics for the purpose of weight reduction in automobiles, trucks and vans. Its consumption in the average North American passenger unit is projected to rise from 128 lb in 1979 to 200 lb in 1990. The majority of aluminum alloys in present and projected use are in the form of castings associated with engine parts (e.g. the cylinder block) where thermal conductivity and low specific heat play an important part in addition to favourable strength to weight ratios and relative freedom from corrosion. By and large, these parts do not compete with plastics. However, wrought aluminum in the form of sheets, extrusions and roll-formed sections are candidate materials for some of the same auto components as plastics. Until the development of stampable plastics formulations - especially the reinforced compositions - aluminum enjoyed an advantage over plastics in that it could more easily adapt to being fabricated on the same types of forming equipment as flat-rolled steel. That relative advantage is gradually receding. Proponents of aluminum point to easier recyclability as a further plus enjoyed by aluminum over plastics.

However, the addition of significant quantities of wrought aluminum to North American cars would so overburden existing capacity for rolling, extruding and forging the metal that even greater price instability would result than has already occurred in this metal. As a result, the major auto manufacturers are re-examining their forward design plans. Curiously enough, plastics are less price elastic because plastics resins represent only 2% of the quantity of crude oil and natural gas processed in Canada. (Appendix 5)

Moreover, the quantity of energy required to produce a unit weight of aluminum is twice as great as that consumed in the production of glass-filled polypropylene.

Wrought aluminum will no doubt find some application in the programs designed to reduce automobile weight. However, those manufacturers whose plans rely solely on aluminum as a general long-range substitute for carbon steel face potentially heavy disappointment. Two years ago, Chrysler Corporation completed a part-by-part study of replacing steel with aluminum. Only very few of these subsitutions proved economically promising.

9.4 Costly Delays

The most serious potential for loss of business faced by Canadian plastics auto parts manufacturers lies in the tendency to adopt a wait-and-see attitude.

As pointed out in this report (particularly in Section 3.4) plastics auto part development is entering a period of uncommonly broad change. This is reflected in the automakers' willingness to accept innovation more readily than they normally would, and to entrust to independents an unusual proportion of the relevant development and manufacturing activity. During the early 1980's, therefore, established parts manufacturers have the opportunity to strengthen their marketing stature in Detroit while newcomers in plastics auto parts production can establish themselves with greater ease than they otherwise could. By 1985, the rate of innovation will likely slow appreciably, and so will the receptivity of the car manufacturers to new ideas and new sources of supply for parts.

Time will certainly be required to identify profitable linkages between Canadian plastics auto part manufacturing capability and the market's need for the products of that capability. The necessary preliminary work should therefore begin without delay. Section 10 outlines possible approaches to prompt action. Cutbacks in US auto production schedules often provide additional openings for innovative changes - another reason why 1980 is an especially interesting year for planning changes in auto parts design.

10. SCOPE FOR ACTION

This section summarises suggestions which may help to stimulate Canadian auto parts manufacturing. Sub-Sections 10.1 to 10.3 deal with orientation and background; Sub-Section 10.4 lists specific program items which could be undertaken.

10.1 Risk-Taking versus Risk-Weighing

By virtue of the Auto Parts Trade Agreement, Canadian plastics processors have the opportunity to compete for continent-wide sales volume; they also find themselves in head-on competition with their counterparts in the United States. Canada's entrepreneurs are accustomed to operate in a smaller plastics industry; a smaller pool of venture capital is available to them with which to finance innovative products. Hence Canadian suppliers have a natural tendency toward caution. They like to husband their development funds until a "sure-fire" opportunity presents itself.

Unfortunately, some existing government programs designed to assist Canadian entrepreneurs are apt to reinforce the cautious and conservative attitude of the Canadian plastics processor. The tortuous and drawn-out process of applying for EDP assistance really puts the applicant into the position of having to warrant that he knows all the risks plus methods of eliminating them.

That approach is unlikely to succeed in the dynamic plastics auto parts sector where new products and processes appear more quickly than in the more mature metal fabricating field.

The Auto Parts Division, in concert with its protege, the Canadian plastics processor, will have to go out on a limb further than may be customary for them: they will have to select an auto parts product group which is slated for growth and to which the processor can bring specialised know-how, experience and design skills; they will have to embark together on the long-term task of proving the manufacturer's competence in the automobile parts environment; to do that, they will have to have faith in the long-term viability of the automobile industry as a whole; specifically they must accept, on little more than faith, that their major automotive customer will not only survive as a corporation but will also recognise the manufacturer's status as a loyal and effective innovator who has earned the right to execute parts contracts on a long-term basis.

Few expert risk-weighers will choose to operate under these conditions - yet those Canadian auto parts supplier who have accepted them can point to several decades of good profits and mutually rewarding relationships with their OEM automotive customers.

10.2 Automotive Requirements

Sections 5 and 6 indicate the general qualifications and characteristics of Canadian companies which can be expected to succeed as plastics auto parts producers. Section 8 identifies several technical innovations which merit government assistance and some of the relevant marketing requirements.

As part of an effective support program directed at plastics processors, the Department will have to acquaint the companies with automotive OEM practices in innovation, parts development and purchasing.

Many plastics processors are not familiar with the lengthy and more or less predictable time delays faced by any new automotive item. They need to understand the gradual progress from concept to prototype to first use to extended use. They need to appreciate warranty costs and the possibility that unconventional materials or processing methods will call for even lengthier than normal evaluation testing.

If these requirements appear excessive, and if they make the auto parts manufacturing industry look undesirable as a target for future development, it may be worthwhile to consider briefly both the success achieved and the methods adopted by Japanese industry in this regard.

10.3 The Japanese Example

History and geography combine to concentrate the attention of Canadian plastics processors on developments in the US. Since the lion's share of our auto parts market is located there, the concentrated attention to American needs and practices is natural and proper.

However, in terms of productivity, quality assurance and, above all, technical innovation, Japanese plastics processors have performed better than their US counterparts for almost a decade.

Some of the ingredients of their success may prove helpful to Canadian innovators, although others are tied to basic cultural differences such as the Japanese lifetime employment system, their fierce loyalty to the workplace and their devotion to national economic aims.

In the late 1960's, Japanese auto makers decided to abandon their low-price image in favour of low-defect and high-reliability products. They cooperated closely with their Ministry of International Trade and Industry (MITI) to survey and develop new processes and products - one of them the stratified charge engine. They evaluated new technology developed in the Unites States, United Kingdom, Germany, Italy, France and USSR. MITI apportioned development programs to various firms on the understanding that proven results would be shared on an industry basis. Scientists and Engineers from one auto company were used as critics and referees of the innovations developed by a competitor company. MITI became a valued ally of the industry.

Within five years, automobiles from Japan had supplanted those from Germany as the leading imports in North America. The Honda Civic became the first production model car to meet the fuel economy and exhaust emission requirements of the State of California (the strictest in North America), and it has continued to stay 3 to 5 years ahead of both mandated requirements and competing models. The Japanese market planning, product planning and distribution studies were as thorough as their technological efforts, and no one can rightly accuse the Japanese that they merely copied what they had seen and learned from others.

During the past three years, however, another development has taken place which merits the interest of Canadian plastics processors: increasing quantities of OEM auto parts have been imported into Japan from the United States. Mitsubishi Motors, Honda, Nissan and Toyota are said to be establishing purchasing offices on the West Coast. Some 25 per cent of 1980 exports (estimated to total $250 million) are reported to represent plastics parts.

10.4 Specific Tasks

This section provides a point-form outline of suggestions for action based on the information given in this report.

10.4.1 Program Changes

Existing Canadian government support programs for the benefit of plastics auto parts producers require changes, including the following:

- support must cover not only R&D but also the design engineering, tooling, prototyping and start-up costs, as well as the market planning and testing functions. 100 per cent funding of R&D is not recommended as the other and equally significant costs greatly exceed those of R&D

- cut down further the formalities required to apply for (and subsequently report on) programs

- permit (and simplify procedures for) program changes.

10.4.2 Innovation

- enter into on-going dialogue with OEM auto parts purchasers and development facilities, their Supplier Research Programs and Vendor Development operation as a source of advance information on new developments in plastics auto parts.

- produce and keep updated a plastics auto parts summary which analyzes and projects user requirements, defines innovative and technical advances to be attained, spells out the manufacturing and other capabilities needed by a Canadian producer who wants to participate in the development and sets up provision for customer liason, financial and other resources necessary for implementation

- put the abovementioned manufacturing summary (together with periodic updating material) into the hands of 4 or 5 dozen plastics processors selected from the attached lists

- compile and distribute summaries on relevant R&D and design work done by NRC, DBR, ORF and other federal and provincial agencies together with information on how industry can cooperate with these institutions on new developments

- based on the foregoing information and on the response received from plastics processors, co-ordinate 6 to 8 separate innovative programs, rate them as to potential for increased Canadian manufacturing participation and offer each seriatim to processors.

10.4.3 Design, Pilot and Prototype Engineering

- impress on all parties that this function typically requires 5 times as much effort and money as R&D from which it must be distinguished from the start

- consider adoption of R&D results achieved by others unable or unwilling to proceed to pilot plant development (Licensing and joint ventures as an alternative)

- make available a list of Canadian toolmakers and their recognised plastics specialisation, especially with Kirksite and other prototype tooling

- compare cost-effectiveness of alternative approaches to new products

- determine and report on shifts in plastics raw material availability and cost effectiveness with particular reference to composite materials

- watch for potential linkages between product development needs and Canadian capability

- ensure that preparation for design and pilot plant work in each program begins long before the R&D phase has been completed, so that manufacturing feasibility remains an important objective of R&D.

10.4.4 Marketing

- maintain updated forecasts of automobile and plastics parts production

- monitor and project consumer preferences and regulatory requirements as a basis for defining further substitution and lightweighting of passenger cars, trucks and vans.

- contact Canadian plastics fabricators who have in the past chosen to stay away from auto parts production; point out that conditions for independent suppliers are now more favourable.

- maintain a continuing program of acquainting Canadian plastics processors with the requirements of OEM auto parts accounts:

    - vendor qualification
    - time frames
    - quality assurance
    - application engineering (agents)
    - prototyping
    - shared "in-house" volume

- rate the major classifications of plastics auto parts with respect to their likelihood of being sourced from;

    - independent processors in general
    - Canadian processors

- investigate the feasibility of encouraging joint ventures and mergers to strengthen Canadian auto parts manufacturing capability; a surprisingly high proportion of competent plastics processors favour such cooperation

- evaluate the possibility of meaningful exports of plastics auto parts to Japan

10.4.5 General

- consider utilising Canada's established and highly regarded vacuum metallizing capability as a starting point for acquiring additional manufacturing volume for exterior and interior automotive trim parts.

- encourage R&D aimed at finding economic use for the waste plastics fraction recovered from car shredders; unless such use is found, shredding of wrecked autos will become uneconomical as their recoverable metal content shrinks and their (presently discarded) plastics content increases

- cooperate with the "Plastics in Automotive Council" recently organized by the Society of the Plastics Industry of Canada. This group of resin producers and processors shares the aim of increasing Canadian participation in the market for plastics auto parts. It was learned from the Council's Chairman that preparatory work was now under way, focused on SPI's annual meeting "Canplast 80" to be held in Vancouver later this spring.

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APPENDIX I

Major Plastics Raw Material Used in North American Automobiles

ABS (Acrylonitrile Butadiene Styrene)

a solid thermoplastic resin chosen for its rigidity, dimensional stability and resistance to weathering. It can be injection moulded to a Class A surface without any post-moulding operations. Special grades can be electroplated. Fiber reinforcement further enhances mechanical properties.

Used for grilles, instrument panels, housings and extensions.

Polyesters

a large and complex family of resins which can be formulated as thermosetting compositions (often reinforced with glass fibres) when they are familiar as the structural materials for "fibreglass" boat hulls. These are unsaturated polyesters. They form the basis for sheet moulding compound (SMC), bulk moulding compound (BMC) and thick moulding compound (TMC). These lend themselves to more or less mechanised fabrication under heat and pressure in hydraulic presses.

These compounds have long been used in the interior of automobiles for housings, frame parts and handles. They are now being tried for hoods, deck lids and door sections where they require in-mould or post-mould surface finishing. Front ends of some late model cars are SMC.

Flexible thermoplastics are familiar in such forms as "Mylar" film used for automotive trim either clear or pigmented or vacuum metallized.

Polyethylene

A waxy, translucent thermoplastic resin familiar from the plastic garbage bags used in the home (where the green or other dark colour results from dyes or pigments). Fabricated by extrusion, calendering or injection moulding. Highly resistant to strong acids and bases. Excellent electrical properties make it a preferred cable covering.

Polypropylene

A sister resin to polyethylene which cannot be distinguished from it by the layman. This thermoplastic is relatively crystalline and rigid. Translucent battery cases (lighter than the old hard rubber cases) are familiar uses in automobiles. So are the translucent containers for windshield wiper fluid and engine coolant overflow. Polypropylene is used in plastics gasoline tanks which require a special internal lining because hydrocarbon vapour can slowly diffuse through a polypropylene wall although neither water nor strong chemicals can penetrate it.

Polyurethane

A resin formed by the mixing and reaction of an isocyanate and a polyhydric alcohol, often prepared on the fabricator's premises. An almost unlimited variety of formulations exists but they can be roughly subdivided into the thermoplastic variety which is generally injection moulded, and thermosetting compositions used as foam (familiar in car upholstery and other soft trim) or in RIM.

PVC (polyvinyl chloride)

one of the oldest thermoplastics in common use. A commodity resin familiar in "vinyl" upholstery. Although non-flammable, it emits choking and noxious fumes when exposed to flame or heat. For this reason, the PVC family of resins may be phased out of automotive use. Rigid Vinyls are used in structural applications such as brackets and retainers.

	CAPACITY	PRODUCTION	IMPORTS	EXPORTS	CONSUMPTION
ABS					
Monsanto	32				
Borg-Warner	25	40	9	2	47
	57				
Polyester					
Ashland, CGE, Dow	35				
Reichhold, USM, Fiberglas					
Polypropylene					
Hercules	68				
Shell	68	36	51	7	80
	136				
PVC					
B.F. Goodrich	163				
Diamond Shamrock (DSAG)	100				
Esso Chemical	43	125	43	6	162
	306				

CANADIAN CAPACITY, SUPPLY, CONSUMPTION AND EXPORTS
OF PRINCIPAL AUTOMOTIVE RESINS AND
THEIR SOURCES
(all figures represent thousands of metric tons)

APPENDIX 2

REPRESENTATIVE PROCESSING METHODS FOR AUTOMOTIVE PLASTICS

Injection Moulding

The process consists of conveying a powder or a pelletized quantity of material from a hopper into a heated chamber where it is melted, and then injected through channels into a closed mould. Although primarily designed for thermoplastics materials, machine modification enables thermoset resins to be injection moulded.

Extrusion

Extrusion is a continuous process whereby rod, tubing, sheet, monofilament and profile shapes of continuous cross section are produced by forcing a heated plastic material through a die or orifice.

Pultrusion

Pultrusion resembles extrusion and is used for producing solid or hollow profiles and shapes from a thermoset resin. Strands of roving are coated in a resin bath and pulled through a shaped orifice and then cured.

Blow molding

Hollow articles are formed by forcing a heat softened tubular shape (a so-called parison) to the contours of a mould. The process uses air to force the material against the mould and is an adaptation of methods used in glass container manufacture.

Compression Moulding

Compression Moulding is a technique in which the moulding compound or sheet is placed in the open mould cavity, the mould is closed and heat and pressure are applied as the ram of the press is lowered. While primarily for thermosets, this process has recently been used with thermoplastic sheet.

Transfer Moulding

Transfer Moulding is a method of moulding thermoset materials in which heat-softened plastic is forced into a closed mould and cured in place.

Rotational Moulding

In the rotational process, powdered plastic is introduced into a hollow mould that is rotated and heated. The material melts and lines the inside of the mould. The mould is then cooled and the product removed.

Thermoforming

In thermoforming, a thermoplastic sheet is heated to make it pliable and then forced by means of pressure or vacuum to assume the shape of the mould it is forced against.

R.I.M.

Reaction Injection Moulding uses separate reactive liquid pre-polymers. They are pumped under pressure into a mould cavity. Mixing and heating and polymerization occurs within the mould.

Reinforcing materials can be incorporated and the process is known as RRIM (Reinforced Reaction Injection Moulding).

Reinforced Plastics

Reinforced Plastics can be either thermoplastic or thermosetting. The reinforcing commonly consists of glass fibers or woven glass cloth but can be any material which enhances the properties of the polymer. Other reinforcing materials are graphite, mica, ceramics, small glass beads. The reinforcing materials are incorporated into a matrix of the polymer.

		1 Canadian Owned	2 Foreign Owned U.S.	3 Foreign Owned Europe	4 Auto Makers	5 Multi-Nationals
a	more than 250 employees volume in excess of $10 million*	14	4		1	4
b	101 - 250 employees volume $4-10 million*	21	4	2		1
c	25 - 100 employees volume $1-4 million*	47	5	2		
d	fewer than 25 employees volume up to $1 million*	22				
	TOTALS	104	13	4	1	5

KEY TO REFERENCE CODE OF COMPANIES LISTED IN APPENDIX 4

APPENDIX 3

*The ranges of annual sales volume are calculated, assuming an output of $40,000 in sales per person employed. For labour-intensive operations, this assumption may prove too high while it would be too low for capital intensive producers.

Example: The index 2b in Appendix 4 denotes a company owned or controlled in the U.S., employing between 101 and 250 and achieving annual sales between $4 and 10 million.

APPENDIX 4

CANADIAN BASED COMPANIES CURRENTLY MANUFACTURING PLASTIC AUTO PARTS

Name	Employees & Category	Products, Manufacturing, Mode and Capabilities
ABC Plastic Moulding 20 Brydon Drive Rexdale, Ont. M9W 4N1 416-743-6731 M. Schmidt, Gen.Man.	[200] 1b	Blow moulding - 15 machines. Automotive, Custom & Industrial. Established, 1974.
Able Plastics Ltd. 170 Glidden Rd. Brampton, Ont. L6W 3L2 416-453-9100 S. Vallecoccia, Ops. Mgr.	[95] 1b	Flexible urethane foam & related plastics, furniture bedding, automotive, packaging & industrial use. Established, 1976.
AD-Print Markings Ltd. 1915 Stainsbury Ave., Vancouver, B.C. V5N 2M6 604-872-7622 R.E. Dunhard, G.M.	[30] 1c	R. V. striping, automotive striping, fleet markings, pressure sensitive decals & nameplates. Screen print up to 52 x 80 in. Press sizes 12 x 18 in, 20 x 27 in, 25 x 38 in, 44 x 66 in, 52 x 80 in. Established, 1960.
Alert Products Ltd. 305 Bering Avenue Toronto, Ont. M8Z 3AS 416-239-3244 C. C. Cook, Pres.	[15] 1d	Eight injection moulders, 40-250 ton. Designed and built own tools, complete mould shop. Two colour injection moulding.
Allen Industries Div. Dayco Canada Ltd. P.O. Box 3188, Stn.C Hamilton, Ont. L8H 7K6 416-547-2371 V.G. Showich, Vice-President & Gen. Man.	[700] 2a	Interior trim, seat cushions & backs, door panels, seat pads & belts, resinated cotton pads, dash liners.
Anco Products Ltd. 146 St. Regis Cr. Downsview, Ont. M3J 1Y8 416-630-8953 D.J. Reid, Pres.	[25] 1d	Windshield wiper arms, blades, wiper hose, washers & parts.
Armstrong Fibrelgass Ltd. Chipman, Queens County New Brunswick E0E 1C0 506-339-5841 Gary Armstrong, Manager	[3] 1d	Truck parts, cabs, etc. in fiberglass.

Annis-Way Signs Ltd. 596 West St. S. Box 603, Orillia, Ont. L3V 6K5 705-325-2277 L. H. Annis, Pres.	[10] 1d	Custom signs & displays, transp. seating, interior components for jet aircraft. 36 x 36 vacuum press former, 10 x 6 ft. PVL vacuum former. Established, 1948.
Apco Industries Ltd. 10 Industrial St. Toronto, Ont. M4G 1Z1 416-421-6161. J.A. Grierson, Pres.	[40] 1c	Plastisols for trucks and dip rails, body sealer, mastic undercoating.
Atlantic Bridge Co.Ltd. Plastics Division P.O. Box 299 Mahone Bay, N.S. B0J 2E0 902-624-8325 W.B.MacDonald, Sales M	[80] 1c	Fiberglas Cabs, front end loaders, Fiberglas truck parts, hoods, fenders, air ducts, roofs.
Auto Supply Mfg. Co. 420 Aqueduct St. Montreal, P.Q. H3C 1Z6 514-932-8101 L.S. Farrell, Pres.	[10] 1d	Lamps, lamp parts, lenses, pig tails, sockets, hood ornaments.
Beckwith Bemis Ltd. 1145 Belanger St. Sherbrooke, P.Q. J1K 2B1 819-567-5281 G.A. Westman, Pres..	[50] 3c	Mfg. coated plastics & shoe stiffening materials, adhesive coatings for label & shoe trade, vinyls for shoe uppers, car tops, industrial upholstery, luggage soft sided, shoe bindings, shoecounters & box toes, transport upholstery, etc. Three production machines of own design. Established, 1947.
Bennett Ltd. 2700 Bourgogne St. Chambly, P.Q. J3L 4B6 514-658-1771 Patrick Farrar, V.P.	[300] 2a	Asphalt & resin boards for trim, dash liners, gaskets & misc. moulded parts, moulded plastic plarts.
Binder Tool & Mold Ltd. 2930 College St. Windsor, Ont. N9C 1S5 519-254-3883 F. Binder, Pres.	[50] to 60 1c	Custom injection moulding of automotive, appliance, games, toys, models, office furniture. 13-70 ton Battenfield. 1200 ton Impco. Est. 1969.
Bombardier Ltd. Plastic Products Div. (formerly LaSalle Plastiques Inc.) 425-10th Ave. P.O. Box 1070 Richmond, P.Q. J0B 2H0 819-826-3757 Y. Nadeau, Gen.Man.	[100] 1b	Injection and thermoplastic resins for automotive and industrial products speciality nylon, acetal, polycarbonate & structural foam. Ultrasonic welding, painting and finishing. Injection moulding processes from 50 tons to 2700 tons, shot size 1 oz. to 270 ozs. 15 presses, 1 structural foam of 40 lb. cap. Established 1969.

Bombardier Ltd. Specialized Seating Div.(formerly Ville-Marie Ltd.) 440 Laurentides-Ave. Beauport, P.Q. 91C-3P2 A. Archambault,G.M.	[55] 1b	Manufacture polyurethane moulded foam for recreational seats, industrial seats, upholstered furniture, office chairs and other transportation seats, cars,buses, trains, etc. 5 Machines-Hennecke, North American Urethane. Est. 1960.
Bow Plastics Ltd. 5700 Cote de Liesse Montreal, P.Q. H4T 1B1 514-735-5671 S.Bern, Pres.	[150] 1b	Manufactures line of housewares, baby needs, pails, tote boxes, laundry supplies, kitchen supplies, toilet seats,trash cans, horticulture, automotive & marine supplies,etc. pipe & pipe fittings. All phases of injection, extrusion & blow moulding with fully equipped engineering & designing departments, machine shop and mouldmaking shop. From 10 gms. to 220 oz. Est. 1939.
Buckingham Plastics & Co. 375 Danforth Rd. Scarborough,Ont. MIL 3X9 416-691-2721 P. Rothstein, Gen. Man.	[85] 1c	Compression custom moulders, electrical, automotive, appliance industries. Mfg. Maplex line of Melmac dinnerware, 8 transfer, 27 compression. Est. 1970
Butler Polymet Division P.O. Box 3066 Cambridge,Ont.N3H 4S1 (519)653-8660 Douglas G. Mason, Pres.	[125] 3b	Stamping and forming of glass-reinforced thermo-plastics, high density and ultra-high density polyolefins; 11 stamping presses; extruder. Division of Butler Metal Products Co. Limited Est. 1939.
Canadian General Electric Co. Ltd. 755 Division St.N. Cobourg,Ont. K9A 3T1 416-372-5411 R. J. Zarboni,Man Resin&Moulded Plastics	[275] 5a	Custom moulder, complete moulding & finishing facilities for all thermoset & thermoplastic materials. In plant design engineering. Manufacture Fiberglas reinforced epoxy duct systems. 30 injection machines, 79 compression machines, 8 filament winders. Est. 1924 (plastic section)
Cadillac Plastics Division Dayco (Canada) Ltd. 91 Kelfield Street Rexdale, Ontario M9W 5A4 416-249-8311 R. Cirone, Gen. Mgr.	(52) 2c	Plastic basic shapes, rod, tubes, film, sheet.
Chemacryl Plastics Ltd. 73 Richmond St. W. Suite 500 Toronto, Ontario M5H 2A2 416-869-0013 W.C. Hall, Pres.	(62) 2c	Extruded sheet (double skin) and moulding compounds.

Canadian Collord Products Ltd. P.O. Box 2264, Walkerville P.O., Windsor, Ont. N8Y-4R8 519-256-4937 U.J.Fields, Chm. & Pres.	[20] 1d	Vinyl Plastisol coatings to metal wiring clips, battery hold downs, window glass stops, etc. Custom made vinyl plastisols. Pour mouldings for window glass stops. Est. 1939.
Canadian Fabricated Products Ltd. 1172 Erie St. Stratford, Ont. N5A 6T3 519-273-1080 A. Rennie, V.P. & G.M.	[650] 1a	Automotive soft trim, covers for head rests, arm rests, seat backs, door panels.
Canadian General Tower 52 Middleton St. Cambridge, Ont. N1R 5T6 519-623-1630 R.S. Turnbull, V.P. & G.M.	[500] 1a	Vinyl coated, urethane coated fabrics for seats, tops, etc.
Chatham Fabrics Ltd. P.O. Box 310 Thamesville, Ont. N0P 2K0 519-692-3870 J.W. Hoskins, Pres.	[65] 1c	Seating and interior door trim, door panels, headliners.
The George Cluthe Mfg. Co. Ltd., P.O. Box 35, Waterloo, Ont. N2J 3Z7 519-743-2695 George Cluthe, Pres.	[200] 1b	Injection moulding, thermoflectors, nylon, acrylic, vinyl, polyethylene.
Creators (Canada) Ltd. 150 Signet Dr.,Weston, Ont. M9L 1T9 416-749-4440 F.W. Jung Vice-Pres. & Gen.Man.	[150] 1b	Mfg. simulated chrome & wood decorative mouldings, exterior & interior trim for autos, appliances, furniture, etc. Gen. extrusion & a speciality line of duct hose (Flexvin) 18 extruders, 48 spec. purpose machines, 10 hose machines. Est. 1963.
Crila Plastic Industries Ltd., 195 Healey Rd. Caledon, Ont. L0P 1A0 416-857-4350 C. Hatzekelis, Pres.	 1b	Mfg. automotive trim, mouldings, pinstripes, dooredge, top moulding for vinyl roofs, opera window mouldings, etc.
Curtis Harris Industries Ltd., 300 White St. Cobourg, Ont. K9A 4R5 K9A 4R5 416-372-3302 E.O. Curtis, Pres.	[44] 1c	Truck cabs.

Custom Fiberglass Eng. 7123 Fir Tree Drive, No. 1&2 Mississauga, Ont. L5S 1G4 416-677-5470 S. Dalnokia, Mgr.	[6] 1d	Hoods, scoops, bumpers, etc.; hand lay-up fibre glass
Custom Plastics Int. Ltd. 887 D'Arcy St., Coburg, Ont. K9A 4K2 416-372-2281 R.F. Harrison, Pres.	[90] 1c	Custom moulders, engineering & design facilities, 12 injection moulding machines from 3 oz. to 30 oz. Est. 1965. Hot stamping, drilling, lapping & assembly work.
Decedar Brothers Ltd. 858 Forhan Street Wallaceburg, Ont. N8A 3S7 519-627-3394 George Trottier, Pres.	1c	9 oz. 200 ton to 150 oz. 1,000 ton; sonic inserting, decorating specialists for aluminum, zinc, brass, chrome plated zinc & plastics. Complete facilities for dip painting, hot stamping, rolled woodgrain silk screening, degreasing, structural foam moulding up to 8 lbs.
Davidson Rubber Co. Ltd. 128 Peter Street, P.O. Box 300, Port Hope, Ont. L1A 3W4 416-855-6317 A. McConvey, Plant Mng.	[420]	Custom moulding of automotive interior & exterior, plastic trim & seating products. Specializing in polyurethane, plastisol, PVC & ABS; injection moulding, rotational moulding & vac forming. Est. 1966.
Daymond Limited 2441 Royal Windsor Dr., Mississauga, Ont. L5J 4C7 416-823-4423 J.A. Swan, Pres.	1a	Mfg. vinyl siding, agricultural drainage pipe, sewer drain pipe, drain waste vent pipe; fittings. Extrusion; injection moulding.
Depco Metal Products Ltd. 25 Belvia Rd. Toronto, Ont. M8W 3R2 416-251-3353 M.J. McLardie, Gen. Man.	[68] 1c	3 extruders 2 1/2 - 3 1/2". Butyrate window mouldings and anti-rattle spacers; rolled sections & stampings. Potential for body side mouldings.
Design Dynamics Ltd., 407 Iroquois Shore Rd. Oakville, Ont. L6J 4Z6 416-842-2622 G. Blechman, Pres.	[125] 1b	Mfg. & dist. automotive accessories, including covers, cushions & related soft goods; non-automotive lines include garment, shoe, travel bags, corrugated storage products, tubular furniture, bean bag chairs, utility covers. Est. 1945.
Detroit Gasket Division Weller Corp. Ltd. 366 Centre Street Petrolia, Ont. N0N 1R0 519-882-1660 R.G. Sharp, Gen. Man.	[50] 2c	Body trim foundation panels, seaming line, binding, tool bags.
D.B.M. Reflex Enterprises Inc. Division of DMB Industries Ltd. 5657 Dessiant Street Montreal, P.Q. H4S 1M8 514-331-7280 I. Caroli, Vice-Pres.	(18) 1c	Reflex pins, optics pins, electroforms, moulds and plastic reflector production.

Dominion Auto Acc. Ltd. 420 Keele St., Toronto, Ont. M6P 2L2 416-763-3501 P. C. Buck, Pres.	[90]	1c	Injection moulders, blow moulders of automotive & marine products. Est. 1936.
Dominion Chain Co. 617 Douro St. Stratford, Ont.N5A 6V5 519-273-0840 K.G. Vacing, Market Man.	[400]	2a	1 Hoists, tail gate chains, tie down for tires.
Donlee Plastics Div. of Donlee Mfg. Ind. Ltd. 1935 Wilson Ave. Weston, Ont. M9M 1A9 416-741-9210 M.W. Bloom, Gen. Man.	[65]	1c	Precision blow moulding, spray painting, finishing, decorating, assembly & child's safety car seat, foam moulding, plastisol, rotational moulding, polyurethane foam.
Duroflex Plastics Ltd. 135 Ormont Dr. Weston, Ont. M9L 1N6 416-669-2729 C. Doucett, Plant Mgr.	[6]	1d	Custom profile extruding, furniture trim, automotive trim, window glazing & window tracks, welting, mylar & tedlar laminating 3 extruders. Est. 1969.
Electrohome Ltd. Industrial Prod. Div. 809 Wellington St.N., Kitchener, Ont. N2G 4J6 519-744-7111 R. Flanagan, G.M., Ind. Prod. Div.	[50]	1c	Custom moulders, rigid structural & special self skinning flexible urethane products, kitchen & vanity doors, mirror & picture frames, computor terminal & electronic housings, automotive decorative commercial applications.
Emco Plastics Ltd. 80 Stafford Dr. Brampton, Ont.L6W 1L4 416-457-5300 Paavo Penna, Gen. Man.	[145]	2b	Injection moulded thermoplastic parts.
Emrick Plastics Ltd. 444 Hanna St. E. Windsor, Ont.N8X 2N4 519-258-3211 E. Jakob, Pres.	[90]	1c	Custom injection moulders, painting hot stamping, vacuum metalizing serving primarily the automotive industry & some appliance & construction. 17 moulding machines, vertical insert moulding included. Est. 1972.
Eltra of Canada Ltd. 1352-60 Dufferin St. Toronto, Ontario M6H 4C6 416-531-2401 D.W. Perkins, Pres.	(300)	2a	Storage batteries.

E.V.A. Fiberglass Products Pleasant Corner Road W. Vankleek Hill, Ontario 613-678-6613 Chris Williams, Pres.	(2) 1d	Fiberglass body parts.
Emu Plastics Ltd. 98 Crockford Blvd. Scarborough, Ont. MIR 3C3 416-759-8198 J. Antoszak, Pres.	[45] 1c	Custom injection moulders of electronic components, automotive parts, houseware appliance parts, consumer products. Engineering & technical services available in new product development. Hot stamping, heat sealing, spray painting, blister sealing & ultrasonic welding, 14 inline screw presses from 30 ton 1.5 oz. to 150 ton. Est. 1964.
Fabriform Plastics Ltd. Custom Plastics Division 3745 Commercial Drive Vancouver, B.C. V5N 4G1 604-879-2991 J.H. Wright, Pres.	(13) 1d	Thermoforming, vacuum forming in plastics.
Fiberglas Canada Ltd. 3080 Yonge Street Toronto, Ontario M4N 3N1 416-482-2836 F.W. Henkelman, Pres.	(500) 2a	Reinforced plastics, textiles, resins, reinforcements, yarns, etc.
Fibertech Ltd. 3001-37th Avenue Vernon, B.C. V1T 2X9 604-454-7251	(12) 1d	Fiberglass parts for trucks.
Fibrestrie Inc. 2480 Roy Sherbrooke, P.Q. J1K 1C1 819-563-0688 Marcel Guindon, Prop.	(23) 1d	FRP mouldings, truck cabs.
Fiberez of Canada Ltd. P.O. Box 1057 Saunders Dr. Cornwall, Ont. K6H 5V2 619-933-3525 D.E. Hall, Gen. Man.	[30] 1c	Fibreglas laminated parts, fiberglas moulded truck body components.
Fleck Mfg. Co. 91 Lincoln St. Tillsonburg, Ont.N4G 4H5 519-842-3641 F. Berlet, Pres.	[350] 1a	Insert mould electrical cord sets & componets, compression moulding bakelite, silicon rubber, hypalon, PVC, injection moulding. 70 injection moulding machines up to 7oz. 4 compression moulding machines. Est. 1956.
Fort Gary Industries Ltd. 460 McPhillips St. Winnipeg, Man. R2X 2G8 204-586-8261 D. L. Suche, President	[160] 1b	Steel fabricated components lined with natural rubber, various elastomers urethanes, PVC, epoxy. Standard & special truck bodies & tractors. Est. 1919.

J. H. Fowler Limited 2 Currah Road St. Thomas, Ont. N5P 3P9 519-631-7562 J. H. Fowler, Pres.	[17]	1d	Custom injection moulder with complete facilities for designing & building plastic moulds. 4 machines, reciprocating screw injection, Engels & Batterfields 35, 85, 110 & 275 ton. Est. 1952.
Furlong Plastics 1293 Caledonia Rd. Toronto, Ont. M6A 2X7 416-789-1131 T. Itin, Pres.	[75]	1c	Complete engineering for custom extruding in rigid & flexible PVC, polycarbonate, ABS, acetate & butgrate. 6 extruders 2 1/2 - 3 1/2", 6 injection moulding machines, 2-16 oz. Est. 1959. Window spacers.
Ganrick Corp. Ltd. 655 Morton Dr. Windsor, Ont.N9J 2L3 519-734-7842 J. W. Ganjo, Pres.	[4]	1d	Plastic injection moulding for marine, automotive & industrial. 19 oz. & 121 oz. Battenfield. Est. 1971.
Gemma Plastics Corp. 230 Fairall St. Ajax, Ont. L1S 1R6 416-683-5348 F. Gemma, Pres.	[18]	1d	Custom moulder for consumer, industrial, automotive & toiletries. 8 machines, 50 ton to 600 ton. Est. 1976.
General Motors of Canada Ltd. William St. Oshawa, Ont.L1G 1K7 416-644-5000 I.A.Barrie,Mfg.Supt.	[420]	4a	Injection moulding & finishing of automotive component. 10-75 ton Reed Prentice. 3-150-250 ton Husky, 5-440 ton Buehler, 25-350-2700 ton Natco. 4-770-2500 ton Krauss-Maffer. 6-650-2700 ton Farrel, 2-1500 ton HPM. 7-700-3000 ton Cincinnati. Est. 13 years.
General Tire & Rubber Co. Ind. Products Div. Box 1002, John Street Welland, Ont. L3B 5R9 C.L. Gretsinger, Gen. Sales Mgr.	[550]	1a	Moulded & extruded plastic & rubber parts, closed cell, sponge parts.
Hoover Ball & Bearing Co. Ltd. 100 Towline Rd. Tillsonburg,Ont.N4G 2R7 519-842-5971 N.G. Grabb,V.P & G.M.	[150]	2b	Urethane foam seats for volkswagen.
Horizon Plastics Ltd Northam Ind. Park Cobourg,Ont. K9A 4L1 416-372-2291 C. Elliott, Pres.	[28]	1c	Injection moulding of structural foam in material handling, business machine housings, leisure products, building products, automotive, swimming pool walls, etc. 4-86 x 86 in. Shot cap. 50 lb. multiple nozzle. Est. 1972.
Hull Thomson Ltd. 3315 Devon Drive Windsor,Ont. N8X 4L5 519-254-3753 D. J. Panton, G. M.	[25)	1d	Poll forming, automotive trim.

Hunter Drums Ltd. 1121 Pioneer Rd. Burlington, Ont. L7M 1K5 416-335-5201 J. J. Paton, Sales Mgr.	[10] 1d	Laminated vinyl to cold rolled galvanized aluminum in sheets only. Vinyl in woodgrains or solid colours. End uses - appliance housings, automotive, shipbuilding & custom sheet laminator. 1 - 8ft. shear 3/8 max. Est. 1967.
I.T.L. International Tools Ltd 3805 Malden Rd., Box 68 Sandwich Postal Stat. Windsor, Ont. N9C 3Y8 R.E. Deane, Pres.	[350] 1a	Injection moulds, compression moulds, die casts.
Inmont Presstite Ltd. 30 Armstrong Ave. Halton Hills, Ont. 416-877-6991 L7G 4R9 A.J. Eckert, Vice Pres.	[34] 2c	Vinyl adhesives, joint sealers, underbody compounds, extrusion, polyurethane foam, weatherseals.
Jacobs & Thompson Ltd. 89 Kenhar Dr. Weston, Ont. M9L 2R3 416-749-0600 D.J. Giroux, Vice-Pres. & Gen. Man.	[100] 1c	Gaskets, polyurethane tapes.
LaSalle Plastics Inc. P.O.Box 1070 Richmond, P.Q. J0B 2H0 819-826-3757 R. Robert, Sales M.	[150] 1b	Injection moulding 500-2,700 ton plus tooling.
Lion Rubber Plastics Ltd 0140 Clement St. LaSalle, P.Q. H8R IT2 514-366-2170 Wm. Anderson, Vice P. & Sales	[110] 1b	Plastic injection & extrusion.
M&K Plastic Products 311 Bowes Rd. Concord, Ont. L4K 1B1 416-669-9725 M. Fuchs, President	[50] 1c	Thermoplastic & composites injection moulding of standard & advanced engineering materials for electronics, furniture, automotive & industrial markets, decorative structural or functional parts, specialists in unique high pressure structural foam moulding, complete assembly services, ultrasonic moulding, hot stamping & painting, in house toolroom, product marketing & tooling development assistance. 75-1000 ton presses, 6 oz. to 175 oz. shot capacity. Thermoplastic & high pressure structural foam. Est. 1975
Magna International Inc. 355 Wildcat Rd. Downsview, Ontario M3J 2S3 416-661-1485 Neill Elliott, Gen. Sales Mgr.	(200) 1b	RIM plastic parts.

Major Plastics 1293 Caledonia Rd. Toronto, Ontario M6A 2X7 416-789-1131 R. McCallum	(30)	1c	Injection and extrusion moulding. 7 extruders 3x2½ and 4x3½. Window spacers.
Maple Leaf Plastics Ltd. 375 Danforth Rd. Scarborough, Ont. M1L 3X9 416-698-2545 J.B. Goldhar, Pres.	[150]	1b	Plastic ash trays, bushings, parts, seat belt rewinders, brushes, dist. caps.
Marine Plastics (1968) Ltd. 1417 Hunter Street N. Vancouver, B.C. V7J 1H3 604-988-3431 P. Devries, Pres.	(25)	1c	FRP products, truck parts.
Maritime Fiberglass Fabricators Ltd. P.O. Box 430 Minto, Queen's County New Brunswick E0E 1J0 506-327-6505 Maurice Vandenborre, Mgr.	(20)	1d	Fiberglass moulded products, plastics, reinforced fiberglass.
Markos Yachts Ltd. 3-1210 Pipeline Road Coquitlam, B.C. V3B 4S1 604-464-7533 A. Markos, Pres.	(12)	1d	Fiberglass truck parts.

Mastico Ind. Ltd. P.O. Box 400 73 Goshen St. Tillsonburg, Ont. N4G 4H8 519-842-8403 M. Cook, Gen.Man.	[60] 1c	Sound deadener body linings.
Midland Industries Ltd. 320 Elizabeth St. Midland, Ont. L4R 4L6 705-526-7801 L.E. Love, President & G.M.	[150] 1b	Injection, compression & transfer moulding of custom industrial components with facilities to spray paint, hot stamp, sonic weld & assemble the finished product. 21 injection moulding machines, 7 compression & transfer machines, decorating & finishing eqpt. Q.C. lab eqpt computor monitoring & process cont. eqpt. Est. 1953.
Mitchell Plastics Ltd. 11 Hoffman St. Kitchener, Ont. N2M 3M5 519-744-4197 M.Ariss, Pres.& Gen.M.	[100] 1c	Custom injection, compression & transfer moulding for appliance, electrical, plumbing, furniture, automotive, agricultural, sporting goods & general manufacture. 21 injection machines to 500 ton-75 oz.cap. 13 compression (semi & auto) to 250 ton cap. Est. 1915.
Moldcraft Plastics Ltd. P.O. Box 1116 Guelph, Ont. N1H 6N3 519-821-2340 F.S. Zotter, Pres.	[55] 1c	Ignition coil caps, ignition components, compression moulding, custom moulding.
Mond Industries Ltd. 225 Evans Ave. Toronto, Ont. M8Z 1J5 416-259-8405 P.H. Green, Pres.	[60] 1c	Fiberglas truck bodies.
Morbern Industries Ltd. 80 Boundary Rd. Cornwall, Ont.K6H 5V3 613-932-8811 D. Bloomfield, Pres. & G.M.	[90] 1c	Manufacture expanded & non expanded, vinyl coated fabrics & polyurethane coated fabrics for the upholstery, handbag, luggage, garment footwear & automobile industry.
Mactac Canada Ltd. 100 Kennedy Rd. S. Brampton, Ont. L6W 3E8 416-459-3100 C.F. Beatty, V.P.	[400] 1a	Self adhesive PVC trim.
National Pro Industries Inc. 400 Marie Victoria, Boucherville, P.Q., J4B 1WZ 514-665-4824 M. Scholler, President	[20] 1d	Injection moulding, mould making proprietary items lines in the sporting goods, leisure time products & automotive products. Up to 350 ton injection machines, reprocessing with 1,000 lbs/hr. Rotojet machines with automatic unthreading device. Skin packaging. Est. 1969.

National Rubber Comp.Ltd. 394 Symington Ave. Toronto, Ont. M6N 2W3 416-763-4381 Jules Gross, Vice Pres.	[300] 1a	Rubber splash guards, die cut.
N.E.T.P. Limited 8481 Earl Thomas Avenue Niagara Falls, Ontario L2E 6X8 416-357-1744 Lorenz Hauf, Vice-Pres.	(50) 3c	Vacuum formed plastic trim parts.
Newark Tool & Mach. (1977) Ltd. 81 Millwick Drive Weston, Ontario M9L 2R4 416-745-5000 Julius Poizner, Pres.	(70) 1c	Injection moulding of thermoplastics.
Norseman Plastics Ltd. 39 Westmore Dr. Rexdale, Ont. M9V 3Y6 416-745-6980 H.M. Walton, Pres.	[90] 2a	Precision custom moulding, decorating, painting & assembly including sonic, solvent & spin welding. Proprietary lines include material handling & bulk shipping containers, bread trays & milk cases. 16 moulding machines. 50-1500 ton, hot stamping machines including roll on machine, paint booths, assembly eqpt including sonic welders & spin welders. Est. 1969.
North American Plastics Co. Ltd. Base Line Rd. Wallaceburg, Ont. N8A 4L5 519-627-6061 D. Pare, Plant Manager	[350] 2a	Interior & exterior plastic auto parts, injection moulding, chrome plating on plastic parts, vacuum metallizing, wood graining on plastics, complete facility for plastic parts decoration. Fully automatic conveyorized paint booths. 20 machines 200-2700 ton cap. Est. 1964.
Northridge Plastics Ltd. Box 579, North Ridge, Ont. N8M 2Y4 519-839-4120 Mr. M. Hosack , Gen.Mgr.	[30] 1c	Plastic injection parts.
Olsonite Co. Ltd. 3324 Marentette Ave. Windsor, Ont. N9A 6M8 519-966-2100 F.S. Bryant, Sales Mgr.	[230] 2b	Steering wheels for passenger & heavy duty trucks, automotive custom moulding.
Paramount Industries Div. Donlee Mfg. Ind. Ltd. 137 Wendell Ave. Weston, Ont. M9N 3K9 416-248-0261 R. Cook, Sales Man.	[150] 1b	Automotive trim, zinc die castings, zinc & steel electroplating, ancillary metal forming operations, sun visors, pads & padding.

Pacific Auto-Plas Ind. Ltd. Box 649 Kelowna, B.C. V1Y 7P4 604-765-7791 H.D. Culling	(35) 1c	Truck parts in plastic, FRP.
Pentagon Mold&Die Co.Ltd. 206 Oakdale Rd. Downsview, Ont.M3N 2S5 416-741-2806 J. Deak, President	[14] 1d	Plastic flower planters, plastic funnels, automotive parts, bumper jack parts, seat belt parts & parts for security system. 4 machines 110-375 ton. 2 metalmecania, 2 selfmade. Est. 1970.
Perfection Automotive Products (Windsor) Ltd. 3766 Peter St. Windsor,Ont. N9C 1K2 519-256-2353 J.M. Ash, Pres.	[75] 1c	Truck mirrors, speedometer cables, vent & heater control cable, automotive accessories, painting electrostatic & dry powder.
Permalite Ind. Div. Susan Shoe Ind. Ltd. 1980 Brampton St. Hamilton, Ont. L8H 3S5 416-561-8630 D.R. Cockle, Gen.Man.	[700] 1a	Production of unit soles & automotive components, specialty moulding, insert moulding, mould & compound development, custom compounding, injection moulded frames, specialized in thermoplastic rubber, nitrile rubber-PVC blends, EVA, PP ionomer resins.
Plastal Inc. (formerly Plastic Mfg.Ltd) 460-476 Edouard St. Granby P.Q. J2G 323 514-378-8439 G. C. Keefer, President	[30] 1c	Manufacture highly engineered industrial, marine, aviation & transportation products from thermoformed & reinforced composite plastics. Est. 1952.
Plastic Components Ltd. 44 Thomas St. Mississauga, Ont. L5M 1Y7 416-826-8500 R.K. Chan, President	[25] 1d	Automobile parts, electrical components, steel mould design & construction, special two colour moulding. Complete mould making shops. 14 machines 30-200 ton. Est. 1965
Plastic Moulders Ltd. 24 Buckingham St. Toronto, Ont. M8Y 2W1 416-252-2241 G.H. Bottomley, Pres.	[35] to [40] 1c	Custom injection moulding, specializing in sporting goods, display boxes, protective head gear, hardware & automotive parts. Capability for design & engineering of products. Prototype tooling & mould making facilities. 12 Reed & Newburg Machines from 50 ton 3 oz to 300 ton 30 oz. Est. 1967.
Plastiglide Ltd. 150 Norfinch Dr. Downsview, Ont. M3N 1X9 416-638-4020 Bruce Gilbert, V.P. & G.M.	[60] 2c	Plastic bushings & bearings, nylon pulleys, washers & spacers
Plastoflex Industries (owned by Ontario Plastics Ltd) P.O.Box 280, Rockwood,1Ont. N0B 2K0 519-856-9518 J. Marcoux, Pres.	[35] 1c	Industrial, automotive, agricultural & speciality hoses & tubes. 6 extruders. Est. 1972.

Peerless Plastics 2800 Kew Drive Windsor, Ont. N8T 3C6 313-424-8200 John Morillo, President	[52] 1c	Injection moulding, 10 machines. 125-1,200 ton. Have own machine shop, Plastech Tool & Mould, 2705 Ken Drive, Windsor, Ont.
Plastmade Industries Ltd. 3055 Lenworth Drive Mississauga, Ont. L4X 2E6 416-625-3061 J. Pinkitz, Pres.	[40] 1c	Specializing in injection moulding of thermoset & thermoplastic materials. Precision moulding of small to medium sized parts. 11 machines. Est. 1970.
Plastomer Div. (owned by Consumers Glass Co.Ltd. 151 John St. Barrie, Ont. L4M 4V3 F.W.Ward, V.P. & G.M.	[150] 1b	Injection and compression moulding custom & proprietory. Battery cases & covers, O.E.M. automotive parts, crates & hampers for agricultural & industrial markets. Capacity 30 tons to 1,000 tons. 1 oz to 150 oz. Est. 1956.
Plaza Fiberglas Mfg. 4440 Chesswood Dr. Downsview, Ont. M3J 2B9 416-638-5110 A. Citron, Pres.	[150] 1b	Make truck bodies & auto parts.
Polypenco Canada Ltd. P.O. Box 280 100 Frederick St. Halton Hills (Acton), Ont. L7J 2M4 519-853-0280 M. Worthington, Manager	[12] 2a	Nylon & industrial plastic parts, bushings, nylon castings, nylon gears.
Precision Spring of Canada Ltd. 95 Victoria Avenue Amherstberg, Ontario N9V 3L1 519-733-4474 G.B. Peterson	(32) 2c	Custom injection moulding. 12 machines 100 - 1000 tons.
Progressive Molded Products Ltd. 111 Martin Ross Ave. Downsview, Ont. M3J 2M1 416-661-9800 M.A. Garron, Pres.	[95] 1c	Product & mould designer, custom plastic injection moulding, product & mould designing & mould making through Progressive Tools Ltd. Manufacture a proprietory line of products through the "Aventura" Div. 20 plastic injection moulding machines ranging from 5 oz 100 ton to 118 oz 900 ton. Est. 1967.
Production Plastics Inc. 21 Ryan Place Brantford, Ont., N3T 5V6 519-756-4540 W.E. Bonk, Pres.	[35] 1c	Custom injection moulding & decorating

Protective Plastics Ltd. 50 Passmore Ave. P.O. Box 156 Milliken, Ont. L0H 1K0 416-291-0581 P. Szasz, Pres.	[300]	1a	Reinforced plastics, press moulding fabrication, truck panels & hand lay up parts. 16 presses, 3 preform, 4 filament winders, truck panels lines, 1-2000 ton 12 ft x 48 ft sheet press. Est. 1952.
P.V. Trim Ltd. 2350 Cawthra Rd. Mississauga, Ont. L5A 2X1 416-270-3112 M. McLardie, Gen. Mgr.	[200]	1b	Automotive O.E.M. extruded parts, decorative functional simulated chrome laminates, interior & exterior bumper strips 4-2 1/2, 3-1 1/4 in, 1-1 3/4, 6-3 1/2 in eqpt. Est. 1971
Quality Plastics 353 Inroquois Shore Rd. Oakville, Ontario L6H 1M3 416-845-9032 R.J. Edwards, Pres.	(30)	2c	Injection moulding to 70 ozs. capacity in rigid PVC and other engineering materials. Extrusion of pipe, tubing and other profiles.
Reliance Products Ltd. 1830 Dublin Ave. Winnipeg, Manitoba R3H 0H3 204-633-4403 S. Berney, Pres.	(250)	1a	Blow moulding, injection moulding and chemical packaging.
Rehau Plastics of Canada Ltd. 9195 Charles DeLatour St. Montreal, P.Q. H4N 1M3 514-384-3330 D.R. Mueller, S.M.	[150]	3b	Extrusion of profiles tubing & pipes up to 12 in. I.D. made of PVC, PE, PV, PP for industries such as construction, furniture, automotives & electrical industry. 20 extruders. Est. 1952.
Richardson Mfg. Ltd. Box 159, Station F Winnipeg, Man R2L 2A5 204-669-4410 D.J. Richardson, Pres.	[50]	1c	Manufacture auto accessories & crop sprayers. Vacuum forming & cutting presses. Est. 1951.
H.E. Roberts Mfg. Co. Ltd. P.O. Box 1170 705 St.Clair St. Ext. Chatham,Ont. N7M 5L8 519-352-7227 H.E. Roberts, Pres.	[9]	1d	Interior trim, truck, bus, auto seats, door panel, headlining.
Rockwell International of Canada Ltd. Box 9500, Downsview,Ont. M3M 3B9 416-669-2350 A.J. Harkness, V.P.	[200]	5b	Custom injection moulding, compression moulding, S.M.C. hot stamping, painting of automotive components, communications, appliance lighting plastics. 200 ton to 3,000 ton moulding presses.
Rubbermaid (Canada) Ltd. 2562 Stanfield Rd. Mississauga, Ont.L4Y 1S5 416-279-1010 M.R. Mallory, Pres.& Gen. Man.	[400]	2a	Automotive car mats,rubber & vinyl. 17 injection moulding machines. Est. 1950

Salga Assoc. Ltd. & Co. 50 Belfield Rd. Rexdale, Ont. M9W 1G1 L. Luczay, Gen. Man.	[160]	1c	14 machines, 2"-4" up to 12 lb. Blow moulding.
Scepter Mfg. Co. Ltd. 11 Bermondsey Rd. Toronto, Ont. M4B 1Z3 416-751-3820 T.Torokvei,Pres.	[400]	1a	DVC pressure pipe & fittings, PVC conduit & fittings, beverage & dairy cases, consumer products. Swim fins, jerry cans, skate guards, industrial parts. Industrial thermoplastic & fiberglas fabricators, 20 extruders, 60 moulders, filament winding. FRP machine. 5 press moulders. Established 1948.
Schlegel Co.Canada Ltd. 514 South Service Rd. Oakville, Ont. L6J 5A2 416-845-6657 D.E. Paton, Pres. & Gen Mgr.	[88]	2c	Man woven textile weatherstripping for auto, building & construction products. Est. 1933.
Sheller Globe of Canada Ltd. (Can.Steering Wheel Div) 253 Queen St. E. Brampton, Ont. L6W 2B8 416-459-1940 R.N. Rivers, Gen. Man.	[200]	2b	Automotive steering wheels. Est. 1962
Sicma Canada Ltd. 194 rue Benjamin-Hudon Ville Saint Laurent,P.Q. H4N 1H8 514-331-5671	[10]	1d	Plastic moulding, F.R.P. parts, seat belt assemble.
Sid Saini Products Ltd. P.O. Box 1042 Victoria Street Cobourg, Ontario K9A 4W5 416-372-8791 Sid Saini, Pres.	(20)	1d	Injection moulding, to 500 tons. Arm rests.
Sigma Tool & Machine Ltd. 251 Nantucket Blvd. Scarborough,Ont.MIP 2P2 416-755-7721 H. Leistner, Pres.		1d	Custom injection moulder, automotive, appliance, packaging, toy goods, furniture, promotional. Est. 1955.
Shaw Flexible Tubes Ltd. 25 Bethridge Rd. Rexdale, Ontario M9W 1M7 416-743-7111 L.E. Shaw, Pres.	(100)	1c	Extruded polyethylene, PVC and nylon tubing, reinforced high pressure hose, pneumatic tubing, etc.

Smith & Stone Ltd. 2 Glen Road Georgetown, Ontario L7G 2P4 416-457-6000 F.J. Doyle, Pres.	(370) 2a	Custom moulding in thermoplastic and thermoset. 7 thermoplastic injection presses 6 ozs. to 25 ozs. 10 semi-automatic injection presses 50-380 tons. Semi-automatic transfer presses 50-250 tons. 3 thermoset injection presses 28-200 tons. 2 automatic compression presses 20-250 tons.
Somerville Belkin Industries Ltd. Automotive Products Division 20 Betrand Ave. Scarborough,Ont.MlL 2P4 416-751-4800 R.A. Tripp,Gen.Man.	[150] 1a	Custom compression moulding of SMC & BMC products for automotive business machines & other O.E.M. users. Compression presses to 2,000 tons capacity. Formulate & manufacture SMC & BMC moulding materials. Power wash and paint baking facility. Die cutting with flat bed Sheriden presses.
Spaulding Fibre of Canada Ltd. 130 The West Mall Etobicoke,Ont.M9C 1B9 416-622-3524 M.P. Romar V.P. Sales	[50] 2c	Rotation moulding.
Stauffer Chemical Co. of Can. Ltd. 207 New Toronto St. Toronto,Ont. M8V 2G2 416-255-0121 R.E. Nobles, Sales Man.	[350] 2a	Vinyl coated fabrics, vinyl sheeting.
Standard Plastics Ltd. 920 Alness St., Unit 23 Downsview, Ontario M3J 2H7 416-661-2525 R. Matsu, Pres.	(35) 1c	Specialize in engineering plastics and mould all types of materials. Own mould building capability. 9 machines, 1 oz. to 12 ozs., Farrels, Kawaguchi, Metalmecs, Negri Bossi.

Staroba Plastic & Metal Prod. Ltd. 299 Adelaide St. W. Toronto, Ont. M5V 1P7 416-364-8333 O.R. Staroba, Pres.	[20] 1d	Custom injection moulding, film reels, cores, appliance components, automotive parts, mould making, ultrasonic welding, hot stamping, decorating & assembly. 12 injection moulding machines, capacity to 500 tons. 7 toolroom machine. Est. 1969.
Supreme Casting & Tooling 14 Racine Rd. Rexdale,Ont. M9W 2Z3 416-743-6731 Mike Schmidt, Pres.	[50] 1c	Plastic moulds.
Symplastics Ltd. 21 Tideman Rd. Orangeville, Ont. L9W 3K3 416-941-5300 R.W. Deans, Pres.	[20] 1d	Extruder & processors of HDPE sheet for the stationery, sign, transportation & automotive industries. Facilities for die cutting, creasing, print treating & silk screening. 10 machines. Est. 1973.
Tamco Ltd. 3950 Malden Rd. P.O. Box 7190, Windsor,Ont. N9C 3Z1 519-966-0723 Leonard Neal, Pres.& G.M.	[100] 1c	Gearshift levers, steering column jackets,steering column shafts.
Tarxien Co. Ltd. 505 Finlay Ave. Ajax, Ont. L1S 2E2 416-683-1681 A.A. Medad, President	[140] 1b	Custom injection moulding of automotive & industrial precision parts, toys. housewares. 20 machines, 100-750 ton. Est. 1965.
Thermoset Plastics Ltd. 40 Dussek St. Belleville, Ont. K8N 5E2 613-968-3469 E. Witt, President	[120] 1b	Custom moulding, transfer, compression & injection, electronic precision parts, lenses, knobs, handles, proprietary line c automotive ignition parts, distributor ca; & rotors. 30 transfer & compression presse from 25-150 tons. 7 injection presses, 1 1/2 oz to 8 oz shot. Est. 1944.

Tilco Plastics (1976) Ltd. [80] 1c
P.O.Box 268
475 Park Hill Rd.
Peterborough, Ont. K9J 6Y8
705-742-4209
P.D. Baker, Vice-Pres & Sales Mgr.

Injection moulding.

Toronto Plastics Ltd. [225] 1b
2045 Midland Avenue
Scarborough, Ontario
M1P 3E2
L. Leadbeater, President

Custom injection moulders & extruders of quality engineered industrial plastic products. Complete technical service including product design, mould & die desi as well as mould & die manufacture. 30 moulding machines, 40-476 tons. Est. 195

Tridon Ltd. [300] 1a
201 North Service Rd.
Burlington, Ont. L7R 4A2
416-632-8900
D. Sedgwick, Pres.

Manufacture windshield wipers, insert fittings, gear clamps & electronic signal flashers. Est. 1924

Trim Fab Ltd. (118) 1b
2805 Slough Street
Mississauga, Ontario
L4T 1G2
416-675-2708
Roger Verrall, Pres.

Body side mouldings.

Trim Trends Canada Ltd. (190) 2b
Victoria Street
Dundalk, Ontario
N0C 1B0
519-923-2017
Walter L. Jones, Vice-Pres.

Decorative trim, mouldings.

Tru-Moulded Products (Toronto) Ltd. [40] 1c
104 Skyway Ave.
Rexdale, Ont. M9W 4Y9
416-675-3888
M.F. De Meo, Pres.

Custom injection moulded thermoplastic parts, components & products for all industries. Design assistance in materia moulds, production & quality control fro research & development to high volume production. Complete engineering & mould building facilities. Mechanical, chemical ultrasonic assembly. 10 injection mould machines. 3 oz to 24 oz 65 ton to 450 to Est. 1968.

TRW Canada Ltd. 5a
230 Louth St.
St. Catherines, Ont.
LZR 7B5

See United Carr

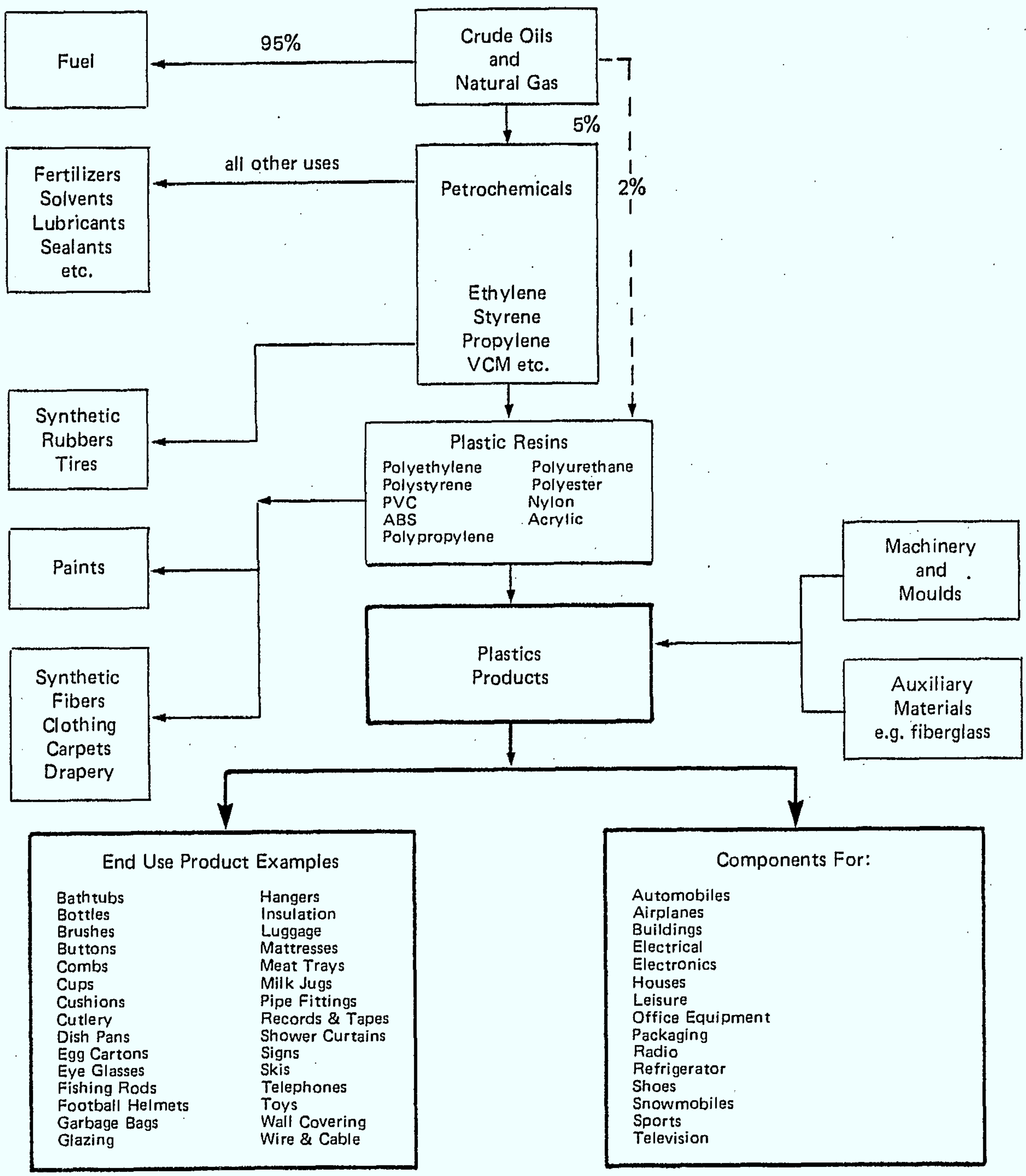
Uniroyal Ltd. General Products Div. 51 Breithaupt St. Kitchener, Ont. N2G 4J4 519-744-7171 L.G. Khoubesserian, Gen. Mgr.	[900]	5a	Manufacture automotive padded instrument panels, vinyl coated fabrics, wool felt, knitted textiles, rigid & flexible urethane mouldings. Est. 1907.
United Carr Division of TRW Canada Ltd. P.O. Box 500, 455 Arvin Ave. Stoney Creek, Ont. L8G 4A2 R.M. Healey, V.P. & Gen. Mgr.		5a	Compression moulding; Injection moulding
Viceroy Mfg.Co.Ltd. 1655 Dupont St. Toronto, Ont. M6P 3T1 416-762-1111 J. Beatty, Pres.	[320]	1a	Battery containers & covers. Injection moulding.
Ville Marie Rembourrage Ltee 440 Ave. de Laurentide Beauport W., P.Q.91C 3P4 418-667-1533 J.J. Dumas, Gen.Man.	[95]	1c	Polyurethane foam, arm rests, bus, truck seats.
Vinaflex Canada Ltd. 398 Nash Rd. N. Hamilton, Ont. L8H 7P5 416-560-0772 P. Hubner, Pres.	[80]	3c	Mould components for footwear industry, shoe sales, skate boots, manufacture compounds, thermoplastic rubbers & PVC. Mould automotive components 12-2 station Desma, 1-6 station Desma, 3-2 station Lorenzin, 4 1/2" compounding extruder. Est. 1972.
Wallaceburg Plastics (Div. of Thamesville Rigid Struct. Foam & Plastics Ltd.) 110 Arnold St. Wallaceburg,Ont. N8A 3P4 519-627-1696 J. Badder, Pres.	[30]	1c	Custom injection moulding & custom structural foam injection & moulding, tooling & engineering available. 5 machines. Est. 1975.
Webster (W.L.) Mfg. Ltd. 10150 Riverside Dr. E. Windsor,Ont. N8P 1A1 519-735-2151 H.J.G. Jackson,P & G.M.	[30]	1c	Seats, automotive trim (interior).

Western Fibre Craft Ltd. 1629 Brookside Blvd. Winnipeg, Man. R3E 1TO 204-633-1885 W. Pawlyk, President	[6] 1d	Mfg. van tops & pick up caps. Est. 1973.
Willpak Industries Ltd. 2030 Speers Rd. Oakville, Ont. L6L 2X8 416-827-0224 G.W. Willson, Pres.	[20] 1d	Vinyl processors, vacuum formers, custom formers, fabricate vinyl car roofs & vinyl packaging. Vacuum formed line of car-van consoles & window lowers. P.O.P. displays, B blister. 10 machines. Est. 1976.
Windsor Chrome Plating Co. Ltd. 2700 Ouellette Ave. Windsor, Ont. N8X 1L7 519-996-0441 Peter Boscariol, Pres.	[100] 1c	Chrome plating including bumpers & bumper guards.
Windsor Plastic Products Ltd. 6680 Hawthorne Dr. Windsor, Ont. N8T 1J9 519-944-5445 L.M. McBride, Pres.	[90] 1c	Injection mould, assembly & custom finish thermoplastic parts. Automotive parts, supplier of decorative trim components, interior & exterior. 8 injection moulding presses, 200 ton-700 ton. Complete finishing plant & lab facilities. Est. 1975.
Woodbridge Foam Corporation 175 Rexdale Blvd. Rexdale, Ont. M9W 1P8 T.R. Beamish, Pres.	[15] 1c	
Woolley G.S. 1978 Ltd. 399 Kennedy Road Scarborough, Ontario M1K 2A1 416-264-2581 M. Garron, Pres.	(125) 1b	Custom injection moulding, 45 machines from 30 ton, 1 oz. up to 350 ton, 25 ozs. Insert moulding, chrome plating, painting, hot stamping, ultra-sonic welding and assembly. Mould design and manufacture.

Zenith Plastic Plating Div. (Tozer, Kemsley & Milbourn(Canada) Ltd. 429 Attwell Dr. Rexdale, Ont. M9W 4M3 416-247-5311 D. Howard,Gen. Man.	[40] lc	Copper-bright nickel-chrome plating of ABS & Noryl plastic, automotive parts, decorative parts, hardware, plumbing, industry. Est. 1965.

APPENDIX 5

The Plastic Industry



Plastics Processing Section in heavy lines

The Society of the Plastics Industry of Canada
Suite 104, 1262 Don Mills Road
Don Mills, Ontario M3B 2W7

APPENDIX 6

QUALIFICATION OF PLASTICS AUTO PART SUPPLIERS

Major automotive firms require that their plastics parts suppliers undergo a qualification process not unlike that relating to other parts suppliers. As a rule, enquiries for plastics parts will only be given to "qualified" vendors, i.e. those who have satisfied certain conditions.

The normal procedure is for a team from the auto firm to pay a personal visit to the prospective supplier's plant in order to assess his equipment, personnel, know-how, quality assurance and his financial strength. Once satisfied with these, the purchaser will often require the vendor's undertaking to maintain stand-by inventories of each auto part to be supplied. In Central Canada, a standard provision requires the vendor's commitment to maintain at all times inventories of all "live" parts sufficient to keep the manufacturer's assembly lines running for 3 days plus "3 days'" material in transit between seller and buyer plus a further "3 days" of stand-by material. These provisions for stand-by capacity are flexible depending on the size, weight and bulkiness of the parts in question.

One aspect receiving special attention is the vendor's ability to warrant security and maintenance of tools, dies and fixtures. In some instances, buyer's tooling will be loaned to a moulder for specific runs, subject to return in good condition. In other cases, a vendor may have to supply tooling which is either directly paid for by the buyer or absorbed in the parts price.

APPENDIX 7

EXOTIC REINFORCED PLASTICS FOR USE IN "LIGHTWEIGHT" CARS

To create a quasi blueprint for reducing passenger car weight, major North American automobile companies designed, built, displayed and widely advertised one-off models such as the Ford Lightweight Vehicle and the Chrysler Poly-Car. These cost $3-4 million per copy.

Significantly, European manufacturers built similar units ten years earlier.

Steel has been extensively displaced in these experimental cars in such sensitive units as steering control arms, drive shafts, suspensions and other structural items. In general these were made of carbon fibre reinforced epoxy materials costing $20 - 100 per lb.

Apart from their high cost, these materials will not likely attain general commercial application during the next 3 - 5 years for a number of reasons including:

- low productive capacity; current capacity is 500,000 lb/yr and this is mainly used in applications more critical than auto parts, e.g. aerospace components
- during 1981, supply may ease somewhat with 500,000 lb/yr of new capacity being brought on stream by Hercules and 750,000 lb/yr by Union Carbide Corp.

- even if the cost of carbon fibre reinforced plastics were to come down from $20.00/lb to $5.00/lb, this reinforcing material is less cost-effective than glass fibre reinforcement.

- because they are very light, carbon fibres tend to levitate in air which creates hygiene and health problems in the workplace. Further, carbon fibres conduct electricity and can thus cause costly shorts and other motor damage in a plant.

Reference to carbon fibre reinforcement should always be qualified as to whether PAN or Pitch fibres are involved (the former much more expensive than the latter) and whether the reinforcement is oriented or not; length and disposition of fibres (milled, roving, orientation) also significantly affect both product cost and performance.

CARBON FIBRE REINFORCEMENT

Pitch fibre versus Polyacrylonitrile (PAN) used in Reinforced Laminates

	Pitch	PAN
Tensile Strength	150,000 psi	180-200,000 psi
Flexible Modulus	35-40x10^6 psi	22-50x10^6 psi

In general, forecasting on new developments tends to be overcautious and carbon fibre may find a significant place in plastics auto part reinforcement more rapidly than anticipated. If so, its early applications will likely be in "hybrid" parts i.e. those where the fibre reinforcement consists of mixtures of glass and carbon fibre.

Competitors on the reinforcement horizon include:

"glassy" or amorphous steel ribbon
(tensile strength 400,000 psi;)
(tensile modulus 24 x 10^6 psi)

polycrystalline silica
(e.g. FP fibre being developed by Dupont)
(tensile strength 200,000 psi)
(tensile modulus 5.5 x 10^6 psi)

aramid fibre
(e.g. Kevlar used in tire reinforcement)

new form of glass fibre

DUE DATE

	201-6503		Printed in USA