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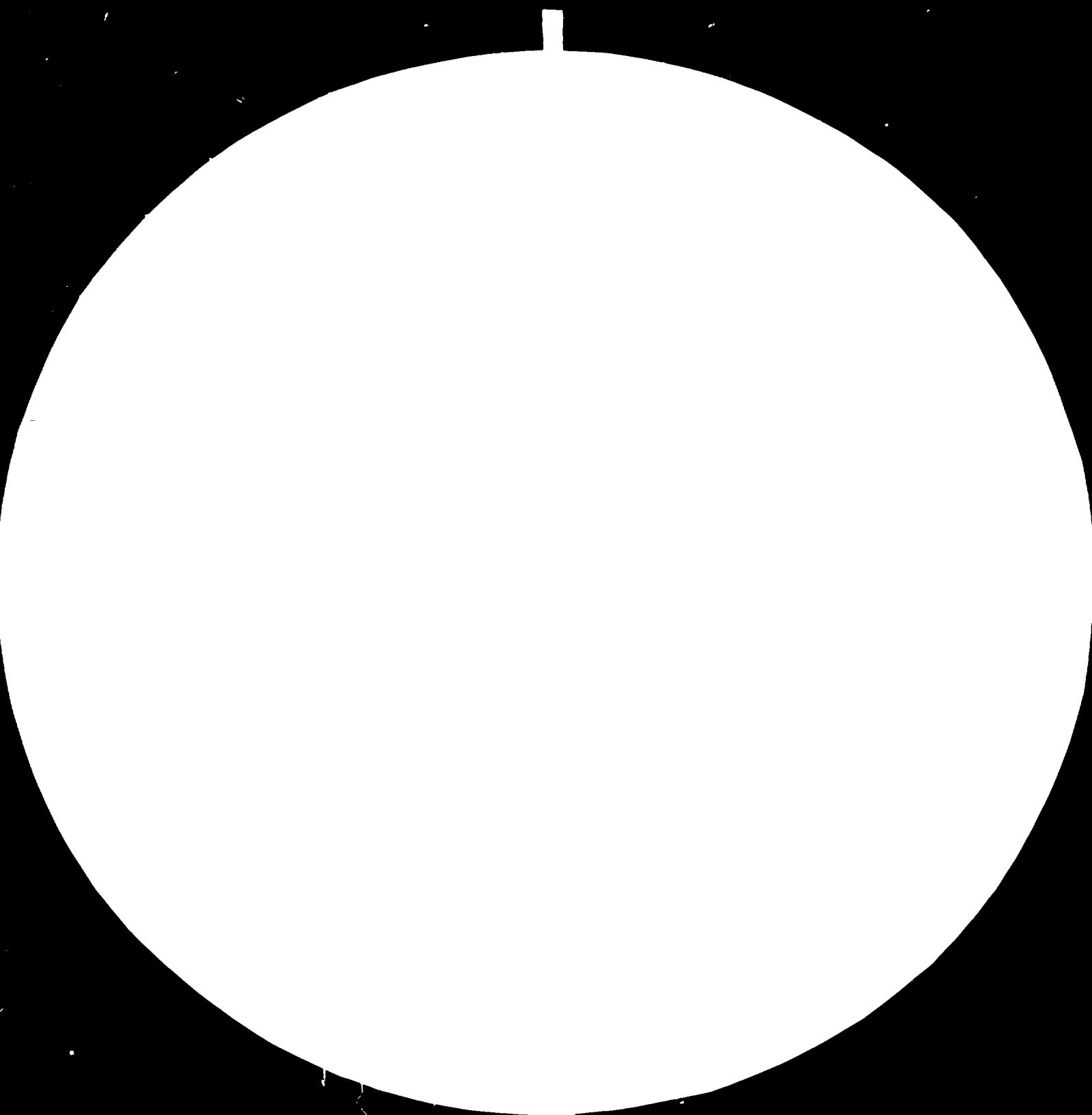

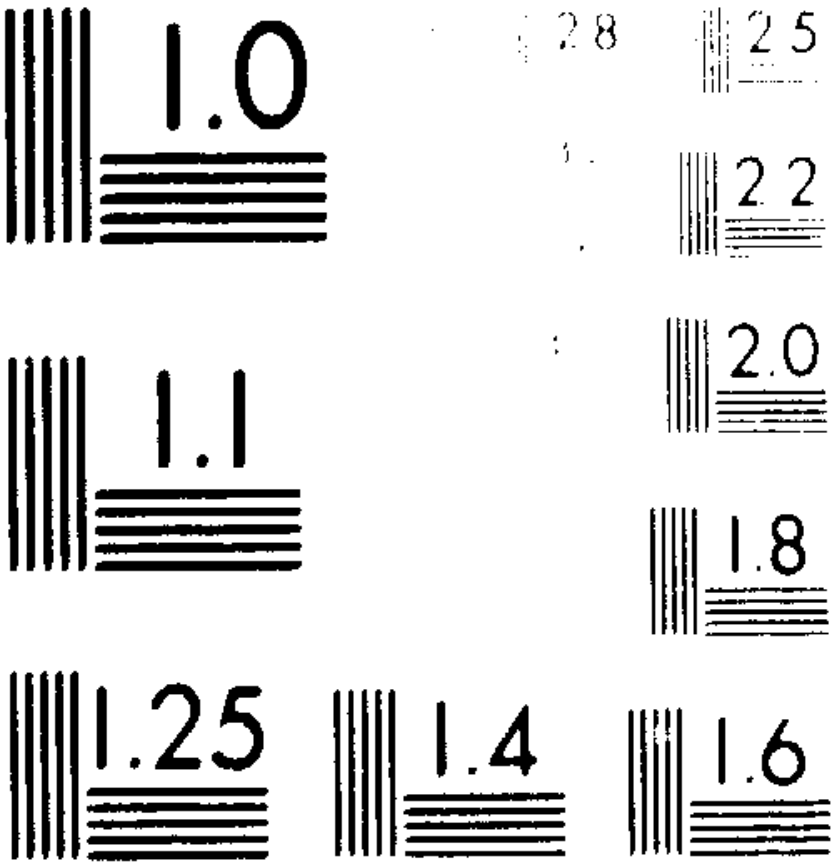
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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION

MOULD DESIGN AND MANUFACTURE FOR THE PLASTICS INDUSTRY IN JORDAN.

ID/JOR/79/803/11-01/32.1 H

Technical Report by J. E. Nightingale,
Plastics Consultant.

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Summary

The object of the mission was to advise on the extra workshop equipment and personnel training that would be needed to establish mould making facilities for the plastics industry in Jordan.

It was found that the workshop had many of the necessary basic machines, lacking mainly a versatile die-sinking machine. The bulk of the extra equipment that was needed was largely accessories to allow the essential precision machining and finishing.

The author was very impressed with the other facilities at the Royal Scientific Society (R.S.S.) and with the calibre of the personnel. The potential was so good that it was felt that in a few years, the R.S.S. could be a major source of information and training, not only for mould making, but the many other aspects of injection moulding.

A number of mouldings had been assembled in the moulding shop and these allowed immediate studies in mould design. In addition three illustrated talks covering mould design and manufacture were given to R.S.S. personnel. Three simple mould cavities were made to give some appreciation of mould making methods and to show the limitations of existing equipment.

With the commissioning of the injection moulding machine, the acquisition of extra workshop equipment and the training of three categories of personnel in mould design and manufacture, progress should be rapid towards the ability to help the plastics industry in Jordan.

INTRODUCTION

The Royal Scientific Society (R.S.S.) near Amman, has been established for a number of years as a link with industry, in the acquisition of new technologies, giving advice, guidance and training.

With the increasing interest in injection moulding, it was considered that the time had come to gain experience in the design and manufacture of moulds. It was understood that there was only one custom mould maker and one moulder, with tool making facilities, in Jordan, so that there was plenty of scope to benefit the industry.

The R.S.S. already have an established general workshop, and one of the major reasons for the author's visit was to advise on the extra equipment to allow a good mould making potential.

It was gratifying to note that they had their own injection moulding machine, as this would prove very useful in proving cavities and assessing the quality of mouldings made in them. It would give also first hand experience of materials, moulding machines, and moulding conditions, all of which can affect mould design.

PROGRAMME

After a brief planning discussion, the first two days were spent largely in detailed conducted tours of the plastics and metallurgical laboratories, the moulding shop, the machine shop and the library. This not only established a good technical understanding between the R.S.S. personnel and the author, but gave a very useful background on which to base the programme of visits to local industry, lectures, discussions, and practical work. An itinerary was quickly drawn up by Mr. F. Al Jaber, which proved to be well balanced and efficient.

LECTURES

In order to be in a position of appreciating points made during visits to local industries, an illustrated talk was given on the second day on "Mould Beginnings". This detailed the many factors that must be considered even before a mould is designed, if the best chance of success is to be achieved. A copy of the paper on which the talk was based, and the O.H.V. slides used, were left with the R.S.S.

The second lecture was given on "Prototyping and Prototype Moulds", since initially much experience in both component and mould design must be gained at a minimum of time and cost. This talk was based on two papers presented by the author to symposia in England, and again copies were left with the R.S.S.

The third talk was on moulding faults - their recognition, causes, and remedies. This was considered relevant, not only to help the R.S.S. with the running of their injection moulding machine; but also to allow assessments of potentially poor mould design and manufacture, that could be the cause of one or more of most of the moulding faults.

VISITS

In order to assess potential markets for mould making, visits were paid to four moulders, and one pressure die-caster. In addition, a visit was paid to a mould maker, who appeared to be very cooperative, and could be useful therefore in exchanging practical experience for special services by the R.S.S.

During discussions with Dr. D. Clarke and the R.S.S., the Agricultural Film Co. expressed interest in obtaining injection mouldings, and this formed the basis of a seventh visit. Details of all the visits are given in the Appendices.

PRACTICAL WORK & DISCUSSIONS

It was very fortunate that a variety of injection mouldings were present to the R.S.S. when their injection moulding machine was delivered. These had been numbered and were correctly housed on shelves in a glass-fronted cupboard by the injection machine.

A number of these were taken into the metallurgical laboratory,

.../

examined, and analysis made of the relevant component and mould designs. In addition, there were discussions on the choice of moulding materials, their effects on mould design, and the way in which the cavities filled. Measurements were made on the size of gates using a vernier magnifier, while stress concentrations and weld lines in the clear mouldings were examined between crossed "Polaroids" that were in the plastics laboratory.

After sketching the designs of some of the moulds for the "analysed" moulding, R.S.S. staff were asked to attempt mould designs for other mouldings, on any individual basis. Each design was then discussed with the group as a whole. They were receptive to what was, to them, new thinking, and discussions among themselves showed the potential of a good team.

Details of the analysis of the mouldings examined are given in the Appendices. Other mouldings could be "analysed" as time and relevance allow.

In order to get the "feel" of mould making, two cavities were made by pressure hobbing in lead, while the workshop machined a small tensile bar mould in mild steel. The finish of the latter was poor due to the limitations of the equipment, but the principle was demonstrated, as well as the limitation of the existing machines. It was explained how these similar, small, quick and cheap inserts could be fitted into the side-gated bolster when it is made and set up on their injection machine. Other moulds producing physical testing specimens can be made in the future, and will be an added benefit to the plastics laboratory, in helping them with the characterization of polymers. The production of these moulds will give useful experience without involving outside customers; and when successful they can be used to demonstrate to potential customers for moulds, the capabilities of the R.S.S.

It is quite possible, too, that the department could make other short run mouldings for other R.S.S. projects, e.g. fittings for solar energy panels, and de-salination plants. These could save significant amounts of money and time. It is also possible that short run moulds and mouldings could be made for Amman University, with whom there appeared to be good relationships.

A demonstration of mould surface polishing was given using abrasive papers already in the metallurgical laboratory, together with the finest grade that the author had brought from the U.K. When the recommended polishing equipment and suggested tool-steels have been received, it is recommended that the exercise is repeated to establish not only the metal finished, but also the resulting surfaces on mouldings made against those metal finishes.

Recommended Roles for the R.S.S in the Future regarding plastics Mould Design and Making; and Injection Moulding.

Moulds:

1) To carry out specialized mould making operations e.g. spark erosion, Electro-deposition, pressure hobbing, and metal casting; as a service to the local mould making industry. (Long term).

2) To advise local tool-makers on the above. (Short & Long term).

3) To offer (a) a component design service (Short & Long term).
(b) a mould design service (Long term).
(c) prototyping facilities, to include both machined models and prototype moulds.

4) To offer mould making facilities.
(a) Modifications to existing moulds, and manufacture of simple moulds. (Short term).
(b) Full mould making facilities (Long term).

5) To offer training in mould Design and manufacture, on the approximate basis of 1/3 Theory - 2/3 practical, including drawing and machining. (Long term).

Injection Moulding:

1) Extend the existing facilities for characterising injection moulding materials. e.g mould test specimens and measure spiral flow. (Short & Long term).

2) Offer a service of proving mould and or insert cavities. (Short & Long term).

3) To offer training in the principles of Injection Moulding; including the mechanism of the process; the variables involved (machines, materials, and moulds): faults,causes and remedies; trouble-shooting; and costings.

General

Organise conferences in Arabic (or largely Arabic) on various aspects of plastics applications and fabrication. For example : -

Nov '81 - Applications for plastics .

Nov '82 - Plastics in Agriculture .

Nov '83 - Developments in Injection moulding.

Nov '84 - Developments in mould Design and making .

ACKNOWLEDGEMENTS

The author would like to acknowledge the assistance given to him, thereby making maximum use of the time available.

To:

1) U.N.D.P. in Amman for making the administrative arrangements - meeting at the airport, hotel booking, and financial facilities.

2) The Royal Scientific Society for their hospitality, both inside and outside the R.S.S.

3) Dr. A. Jaradat for the general administrations for the visit.

4) Mr. S. Darabseh for the general administrations in the laboratories, and hospitality outside the R.S.S.

5) Mr. F. Al Jaber for drawing up an itinerary for the whole of the visit, conducting the tour of the R.S.S., overall consortship, and hospitality outside the R.S.S.

6) Messrs. N. Haddad, F. Takouri, M. Amer, F. H. Mallah, J. A Elyan, and I. Shweahat for their help in the practical work, arranging lecture facilities, contributing to discussions, and general kindness and hospitality.

MACHINES AND EQUIPMENT IN THE R.S.S. WORKSHOP THAT ARE RELEVANT TO MOULD MAKING.

(No.) = R.S.S. list No.

Hydraulic press - 65 ton capacity	(2)
"Alzmetal" heavy duty drill - capacity (M.S.) 42mm	(7)
"Weiler" lathe - 280mm swing - 800mm centres	(8)
"Rumag" universal mill - table 1000 x 250 N.T.40 hor. travel - 530: cross 220; vert. 490	(9)
"Elb" surface grinder. Magnetic chuck 900 x 300 hor. travel - 600; cross 350; vert;450	(18)
"Martin" lathe - 420 swing - 2000 centres	(19)
"Klopp" shaping machine 550 stroke; cross 500; vert; 370	(21)
"Deckel" G.K. 21 engraver (1.5 - 10:1 reduction)	(22)
Surface plate cast iron 1000 x 1000	(30)
" " granite 1000 x 800	(89)
Electric welder - 350 amp	(38)
Tool and cutter grinder	(39)
Cylindrical grinder Max - 50 internal; 175 radial	(43)
"Oerlikon" T.I.G. welder	(47)
Electro-plating equipment - tanks about 150 x 150 x 150	(57)
Spot welder	(83)
Slip gauges 2mm - 100mm	
Hole gauges up to 3mmϕ and above 11mmϕ	

On order:- "Deckel" F.P. 3 Universal mill
Table 800mm x 375 hoz. travel 380 x 300

RECOMMENDED EXTRA WORKSHOP EQUIPMENT

((H.-----) = No. in Hommel catalogue held by R.S.S.)

One die-sinking machine (details to be sent to R.S.S.).
Mould polishing equipment (see attached list).
One rotary table 320 mm diam. (H.29501).
One compound sine table 275 x 200 (H.28515).
One magnetic vice (H.27690)
Two pairs chuck blocks 76 x 60 x 32 (H.28230).
One magnetic chuck 600 x 300 (H.28214 or 28216).
One demagnetiser ("Eclipse" DA960 or equivalent).
One precision vice 80 capacity (H.27605).
One set angle slip gauges
Hole gauges to cover 3-11 mm diam. (Mesa "Imicro" BAE & BAF).
Two magnifiers with graticles (H.39625).
One set of 40 mm stencile - vertical
normal mirror letters and numbers DIN 1451 Type III for Deckel engraver
One each - Taper reamers 3 x 10)
5 x 15)(H.13420)
10 x 25))
One each - Taper pin reamers 2,3,4,5,6 & 8 mm diam. (H.13432).
10 each Taper pins, to fit holes made by the above reamers.

In one to two years time:-

One E.D.M. machine and accessories
(Details of suggested Agemaspark and Chamilles machines left with the R.S.S.).

MOULD CLEANING EQUIPMENT REQUIRED

From:- Engis Ltd., Park Wood Trading Estate, Maidstone, Kent, England. Telex (96231) G.

	Approx.Price (U.K.)
One "Diprofil" standard kit No.4	£533.00
"Hyprez" diamond compound code 25 - FS 35 2 x 5 gram hyplicator	£ 30.00
One "Hyprez" accessories kit	£ 48.00
One case for above	£ 18.00
Type C stone holder	£ 12.00
One "Gesswein" stone introductory kit type M.F.	£ 14.00
One "Gesswein" stone introductory kit type D.F.	£ 23.00
One dozen "Gesswein" stones M.F. type Code No.602	£ 15.00
One dozen "Gesswein" stones D.F. type Code No.2602	£ 21.00

Literature left at the R.S.S.

Originals:

6 Numbers of I.C.I Engineering Plastics.
Copy of I.C.I's "Principles of Injection Moulding" G103.
Copy of I.C.I's "Index of literature" (Plastics).
Reprint of the chapter on Mould Design and Manufacture for a Development series "Injection Moulding".
Demag Injection Moulding Pocketbook.

Photocopied:

Plastic and Rubber Institute (P.R I) Symposia papers

- "Mould Beginings" Also subject of a talk
- "Prototyping and short run moulds" Also subject of a talk
- "Setting up a Tool-room"
- "Low Cost Moulds-Miscellaneous Materials and Methods".
- "Gates and Runners".

Literature on: Electro Discharge Machines.
Graphite for Electrodes (for above).
Mould Polishing Machines and compounds.
Inco Heat Exchange Tubes.

Various O.H.V. slides.
Classified list of moulding powders.
Uddeholm mould steels for plastics.
(Moulding sheets 10 off).

Recommended Books

"Injection Mould Design" - R.G.W. Pye 2nd Edition
George Godwin Ltd., 1-3 Pemberton Row, Red Lion Court,
Fleet Street, London E.C.4.
(2 copies - one for reference in the library, the second in the metallurgical or plastics laboratory).

"Injection Mould Design Fundimentals", - A.E. Granvill & E. N. Denton.
Machinery Publishing Co. Ltd., New England House,
New England Street, Brighton, Sussex BN1 4EB.
(2 copies - as above).

Machinery's Handbook - Latest edition
Machinery Publishing Co. Ltd., - address above. OR
Industrial Press Inc., 200 Madison Avenue, New York, N.Y.10016.
(2 copies - as above).

Recommended Magazine

"Plastics and Rubber Weekly"
by subscription to:-

Maclaren Publishers Ltd.,
P.O. Box 109, Davis House,
69-77 High Street,
Croydon, Surrey CR9 1QH
England.

Training Courses

Osterreiche Kunststoffewerk G.m.b.H.
Kleine Stadtgung, 9. Wien, Austria.

Contact:- Herr Heinrich Schmidtberger

Central Institute for Plastics Engineering and Tools,
The Grundy Industrial Estate,
Madras, India,

Other Recommended Additions

Mould Assembly

One mould base to fit the Netstal injection machine.
Suggested dimensions:-

Overhang clamp plates (for bolting on) - 40 x 40 cms.
Cavity plates - 30 x 40 cms.
Thicknesses 86 and 46 mms
These will constitute the Die Mould Equipment catalogue designation:-

D.M.E. 3040-CP-46-86 Nr.2
+ Overhang clamp plates 40 x 40 or "Hasco" equivalents.

Also Ejector pins 10 each 2,3,4,5,6, & 8Ø x 150 and 200 mm long
Guide pins 12 at 20 and 30Ø and mating bushes - 4 sprue bushes 5Ø at small end

Address:- D.M.E. Europe
2800 - Mechelen, Belgium Telex 22248

Metal Stocks for Mould Making

Mould steel plates 400 x 300 x 25,50,75 and 100 mm thick

Alcan Aluminium alloy B.79.S. plates 400 x 300 x 25,50,75 and 100 mm.

Additional Photographic Equipment

This is to extend existing equipment to allow the preparation of 2" x 2" slides for lectures and symposia. Accessories to fit either the Leica or Minolta cameras:- extension rings, bellows, slide copier, lens reversal ring, portable tripod.

VISIT TO JORDAN PLASTICS CO., AMMAN 3/6/80

Present:-	Mr. Abu Etta	Jordan Plastics
	Mr. F. Al Jaber)	R.S.S.
	Mr. M. Amer)	
	Mr. J. Nightingale	U.N.I.D.O.

This firm is the largest injection moulder in Jordan, with a number of other plastics fabrication processes.

Their injection machines include 1000, 900 and 750 ton lock I.M.I.'s, and a number of 400 ton machines including Hunsy's.

They have a number of bottle blowing machines with capacities up to 10 litre and possibly up to 25 l.

They had a lay-flat film plant, but they considered that, with other film producers in Jordan, they could make better use of the extruder by producing plastics netting, similar to "Netlon", but by a German process. This would cost them about 90,000 D.M. for the extruder head and die, but they would be charged no licence fee or royalties.

On one of their large presses they had a mould for making crates. The cavity was made so that the sides moved radially outwards on mould opening. The initial movement allowed the punch to withdraw from the moulding, and further opening released the moulding from the opened sides. We were told of a good example of knowledge of conditions of service. A crate moulding was submitted to a firm in Iraq in March when the temperature was 25°C and passed their compression creep test. Initial production was delivered in the July when the temperature had risen to 48°C and the mouldings failed. It was found that each 1°C rise in temperature caused a drop of 10 Kg. loading in the creep test. To overcome the failure the ribs had to be increased with a consequential increase in weight from 1.4 to 1.7 Kg.

All their moulds are imported.

VISIT TO PETRA PLASTICS AMMAN 3/6/80

Present:- Mr. Ismaiel Hejazi — Petra Plastics
Mr. F. Al Jaber) — R.S.S.
Mr. M. Amer)
Mr. J. Nightingale — U.N.I.D.O.

This is a small firm with only three injection moulding machines. All their moulds are purchased second-hand in Europe and it is unlikely that they would be interested in any new moulds made in Jordan.

VISIT TO ELIAS HAMMAM CO. AMMAN 4/6/80

Present:- Mr. Elias Hammam
Mr. F. Al Jaber) — R.S.S.
Mr. N. Haddad)
Mr. J. Nightingale — U.N.I.D.O.

This was the only custom tool-maker visited and although his equipment was very limited, he made up for it with practical experience and ingenuity. He was quite happy to show us how he made his moulds and visits by R.S.S. personnel from time to time would give them useful practical information. The R.S.S. could "repay" him for his time and co-operation by occasional services such as mould proving or mould polishing.

VISIT TO THE BATTERY CO. AMMAN 4/6/80

Present:- Mr. Higazi - Director General)) The Battery Co.
Mr. Mohamad Kurdi - Works Manager)
Mr. F. Al Jaber) R.S.S.
Mr. N. Haddad)
Mr. J. Nightingale - U.N.I.D.O.

This firm has a large and fairly well equiped workshop which included a large horizontal boring machine, an E.D.M. machine, and a 1:1 Deckel copier. They had also facilities for chromium plating.

It was hoped that some of these facilities could be used to help the R.S.S. in the short term, but it was underctood that they were not well disposed towards the R.S.S.

VISIT TO JORDAN ORMANIN CO., ZARKA 4/6/80

Present:- Mr. Mahmoud M. Sakf El-Helt - Co. Manager
Mr. F. Al Jaber } R.S.S.
Mr. N. Haddad }
Mr. J. Nightingale - U.N.I.D.O.

This firm makes melamine plates, bowls, cups and saucers by compression moulding. Most of the products were decorated with "Ormanin" foils, which are special papers that are printed with a design and then impregnated with a U.F. or M.F. resin. The pellets or powder is placed in a mould and when the moulding is fully formed but only partially cured, the press is opened, the foil carefully positioned on the plain moulding and the press closed to bond the foil to the surface and complete the cure.

Their equipment consisted of four 250 ton, single daylight and three 350 ton double daylight presses - all Daniels (U.K.).

VISIT TO THE OVERALL JORDAN CO. LTD., AMMAN 4/6/80

Present:- Mr. F. Al Jaber } R.S.S.
Mr. N. Haddad }
Mr. J. Nightingale - U.N.I.D.O.

This firm was visited because they undertake pressure die-casting of aluminium, the moulds for which are similar to injection moulds.

At the time of the visit the press was not running and they said that they had only two moulds, one of which was a car door handle. They did not appear interested in having further moulds made.

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VISIT FROM THE AGRICULTURAL FILM CO., AMMAN AT R.S.S.
16/6/80

Present:- Mr. Suleiman Dawood - Agric. Film Co.
Messrs. S. Darabseh, F. Al Jaber & N. Haddad - R.S.S.
Mr. J. Nightingale - U.N.I.D.O.

Mr. Dawood apologised for being 2 days late in keeping his appointment. He brought with him the two fittings he would like for L.D.P.E. pipework and in addition an expanding plug to close the open end of a pipe.

The first fitting was a tube to form a "T" connection in a "main" pipe. Upon questioning he agreed that it was unsatisfactory, since it leaked. He requested that he wrote to the R.S.S., giving the range of tube sizes that the fitting would be used, with their wall thicknesses. We also asked him to give his yearly requirements of this, the drip-feed nozzle, and the plug.

WORK PLAN FOR THE STAFF AID WORKSHOP

(To be undertaken as and when facilities and time are available)

1) To make steel plates 30 x 30 to 50 x 50, not less than 10mm thick, with various surface finishes. e.g. coarse grind, fine grind, rough E.D.M. finish, fine E.D.M. finish, polished to 400 grit, 600 grit, and best mirror finish.
A small number or letter should be engraved (as with all multi-cavity moulds) in the corner of each plate for identification; and all the plates mounted in a chase. Mouldings should be made in as many polymers as possible, in black and natural.
All will form useful references when discussing surface finishes with customers and could form the basis of a specification.

2) On receipt of detailed drawings (from J.E.I.) make a side-gated bolster to fit the Metstal injection moulding machine. Make a note of man-hours of work for future reference.

3) Design and make cavities to fit the side-gated(s-g) bolster to mould physical test specimens e.g. tensile, impact and heat test bars. Note man-hours for each cavity.

4) Design and make cavities to fit s-g bolster for the moulding of "sales-aids" e.g. paper knife, ruler, etc. for publicity purposes.

MOULD DESIGN ANALYSIS

R.S.S. Moulding No.	Pertainent feature of the Moulding
17	Polystyrene petri - dish cover. Tunnel gated on vertical walls. Thicker base of base unit allows flow across base first. Hence good moulding. With lid material flows around the skirt first and gives weld line opposite gate, a potential gas trap, and shows a short moulding characteristic of ripple over large area of top. (View by polarised light - shows maximum stresses in gate area).
16	Clear polystyrene cup with solid handle, pin gated in centre bottom of cup. Slight (witness) marks show that part of the cavity had two blocks let in to form handle easily (made before EDM!!). Sides show very slight "short" moulding (shows up better by polarised light).
L.175	Acrylic tap top - sprue gated, sprue 75 mm long, 35 mm would be adequate and would double taper angle. Cavity made by two splits to open on mould opening.
L.328	Acetal gear. 53 mm OD gated on face ca 15 mm from centre. Four pairs of rectangular holes are formed on circular pins that are fixed in fixed half of tool. Sleeve ejectors are placed around the four core pins that form holes on the other side of the gear.
V.498	Catalogue spine - possibly A.B.S. or impact polystyrene (free flow) single tunnel gate in centre (need for good flow) on convex side machining marks run full length, therefore punch and cavity mated accurately and ribs are then "sparked" into punch. Ejector pins each spine - radiused tops therefore pins trapped or located.
1	Polystyrene beaker triangular pattern on inside - this gives better grip on the punch. Shallow dome centre inside opposite gate to give more efficient flow into cavity. Ejection by stripper ring and mushroom ejector on beaker bottom.

13	Polystyrene beaker with base. This could be a 5 - "plate" mould. Since it is a pin feed (normally 3 plate) splits (extra plate) and main cavity (+ 1 plate). "0.2L" mark on punch (easiest to engrave and helps to keep beaker on punch). Ejection by central pin 23 mm diam. Wall thickness 0.79 - 0.81 mm. Slight eccentrucity (due to punch location?) gave slight weld line visible by polarised light only, therefore acceptable to end user.
V.419	Polypropylene tweezers (forceps) (Integral hinges). Single tunnel gate on one "hinge plate" to give good orientation at hinges. Ejection is by blades.
V.308	Multi (96) connector, possibly polyester (pair tunnel gates each end to give complete filling of thin lattice). 7 at 1 mm diam. ejector pins.
L.248	Blue polystyrene - most of the cavity "sparked" apart from plain panel. Tunnel gate in one corner. Punch given a fine finish and then ribs "sparked" in. Ejection by a) 4 pins b) Pins on spigots c) Sleeves around core pins.
Tensile Bar	Polystyrene. "Fan" gate on bar axis. 8 mm diam. ejector pins in centres of "dumb-bell" ends to avoid any marks along gauge length.
X.61	Telephone mouth-piece. Probably A.B.S. - pin gate on the inside closest to centre (no marks on outside). Thread unscrewed by a sleeve with 6 slots that advances at same screw pitch as internal thread, when cavity (moving half) has opened.

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MOULD DESIGN CHECK LIST

1) Check restraints - (a) Component design
   - (i) Sharp corners
   - (ii) Thin sections

   (b) Moulding material
   - (i) Shrinkage
   - (ii) Flowability
   - (iii) Enthalpy

   (c) Moulding machine
   - (i) Platen space
   - (ii) Min./Max.mould height
   - (iii) Lock
   - (iv) Shot weight
   - (v) Register ring diameter
   - (vi) Nozzle radius
   - (vii) Fixing system
   - (viii) Lifting arrangements
   - (ix) Penetration of nozzle thro' platen

2) Type and position of gate(s).

3) Consider how the cavity will fill - (a) Possible weld lines.
   (b) Possible air traps.

4) Check at an early stage - (a) Possible types and locations for "cooling".
   (b) Possible types and locations for ejection.

5) Consider the cross-section of mould-start with the sprue.

6) Consider the plan view of the mould.

7) Consider the mould in 3 dimensions.

8) Position eye-bolts (for lifting mould), if possible above c.of g.

ALCAN **Plate Products**

Issue No 1
November 1976

Alloy data sheet

"DURAL 79"

Alcan GB-

(B79S)

German Standard D1N 1725
Alloy 3.4345 (AlZnMgCuO,5) F46

B79S is an aluminium alloy containing approximately 4.3% zinc, 2.6% magnesium, 0.7% copper and 0.1% chromium. One of the strongest light alloys supplied in the fully heat-treated (TF) condition, it was originally developed for use in highly stressed heavy section components in the aerospace industry. It is extensively used for moulds in the rubber and plastics industry, tools, jigs and machine tables.

Availability

B79S can be supplied as hot rolled plate to the following normal standards:

Thickness	8.0mm to 150mm
Length	6000mm max
Width	2000mm max

The above availabilities show only the range of sizes of one particular dimension and combination of certain sizes may be difficult to produce. Accordingly, Alcan Booth Sheet Limited should be contacted at an early stage of any project.

Applications

Blow moulds, shoe moulds, rubber moulds, foam moulds, vacuum deep-drawing moulds, jigs, tool heating plates, machine tables and other highly stressed components.

Characteristics and Properties overleaf

Alloy data sheet

B79S

Characteristics

High thermal conductivity — Four times higher than steel, reduces cycle time and power usage.

Machinability — High metal removal rates mean machine and labour time substantially reduced compared with steel. Machine tools last longer, fewer machines required. Excellent surface finish, easy to hand pattern or chemically mill.

Ease of handling — One third the weight of steel means easier handling in storage and tool changes, storage racks can be lighter and taller.

Strength/ weight ratio — Offers a considerable advantage over steel/Kirksite tools.

Shape control — Special controlled stretching technique during production ensures maximum stress relief and minimum distortion during and after machining.

Freedom from porosity — Free from pores and inclusions, thus making polishing easy.

Corrosion resistance — Resistant to all commonly used plastics, and therefore does not require surface coating and/or chrome plating to afford protection.

Dimensional control — Produced to the same high standards as aircraft plate.

Weldability — Using TIG and MIG methods, repair welding is possible.

Mechanical Properties

Typical mechanical property levels for B79S-TF are as follows:

Thickness	0.2% Proof Stress		Tensile Strength		% Elongation on 50mm	Brinell Hardness
	N/mm^2	$Tonf/in^2$	N/mm^2	$Tonf/in^2$		
50mm	450	29.1	520	33.7	9	145
100mm	420	27.2	490	31.7	8	135
150mm	390	25.3	465	30.1	6.5	128

NOTE: For most practical purposes, compression strengths are equal to tensile strengths.

General Physical Properties

Thermal conductivity at 25°C	0.30 cgs units (121 W/M°C)
Coefficient of thermal expansion	23.5×10^{-6} in/in°C (between 20° and 100°C)
Specific gravity	2.74 gm/cc
Young's Modulus	71500 N/mm^2
Ultimate shear stress	310 N/mm^2
Resistivity (at 20°C)	5.4 michrohm/cm

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