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DIVISIÓN DE NUEVAS CREACIONES
SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
E. S. D.

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REFERENCIA: SOLICITUD DE PATENTE DE INVENCION
TITULO: PARED DE ENVASES PLASTICOS TERMOFORMADOS
RESISTENTES AL FORMAMIENTO POR EFECTOS DE
CAMBIOS EN LA PRESIÓN BAROMETRICA
SOLICITANTE: CARVAJAL S.A.
EXP. No.: 00-53.003
ASUNTO: COMPLEMENTO DE INFORMACION.

Yo, MÓNICA WOLF WASSERMAN, mayor de edad y vecina de esta ciudad, identificada con cédula de ciudadanía No.51'711.267 de Bogotá y T.P. de Abogado No. 46.034 expedida por el C. S. de la J., obrando en mi condición de apoderado de la Sociedad MULTIDIMENSIONALES S.A., a través del presente memorial y en tiempo oportuno presento las pruebas para argumentar los argumentos de la oposición presentada en contra de la patente para la nueva creación mencionada en referencia.

PETICIONES

1. Se sirva usted adjuntar al expediente el complemento de información para reforzar los argumentos de la oposición presentada.
2. En consecuencia, se continúe con el trámite de la solicitud y se conceda el privilegio de patente mencionada en la referencia..

ANEXOS

1. Guia práctica de termoformados. (6 folios)

NOTIFICACIONES

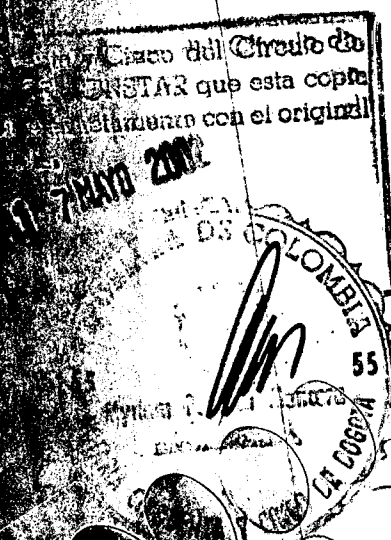
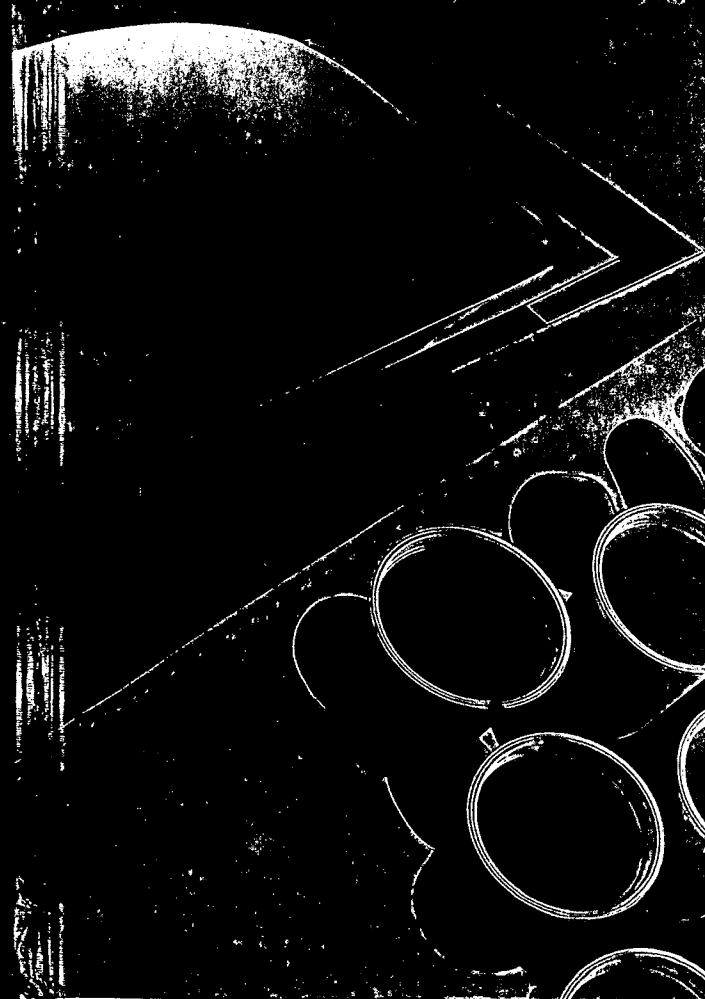
Recibiré notificaciones ante ese Despacho o en mi Oficina, ubicada en la Diagonal 83A No. 23-90 de esta ciudad.

De Usted, Cordialmente


MONICA WOLF WASSERMAN
C.C. 51.711.267 De Bogotá
T.P. No. 46.034 del C.S. de la J.

ILIG

Thermoforming – A Practical Guide

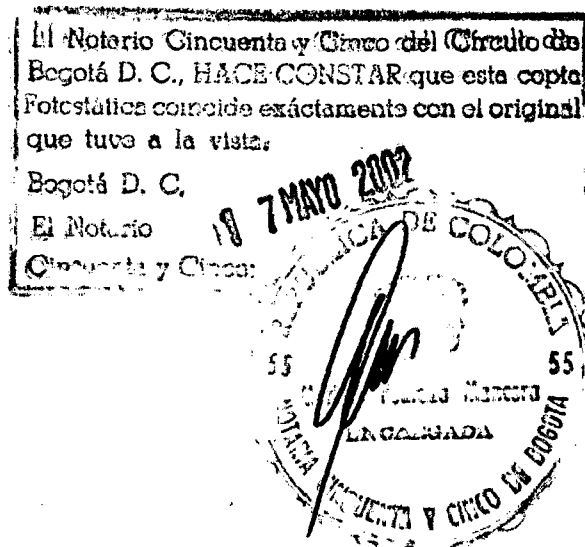


Günther Kiefer / Peter Schwarzmann

Thermoforming

A Practical Guide

Edited by Adolf Illig



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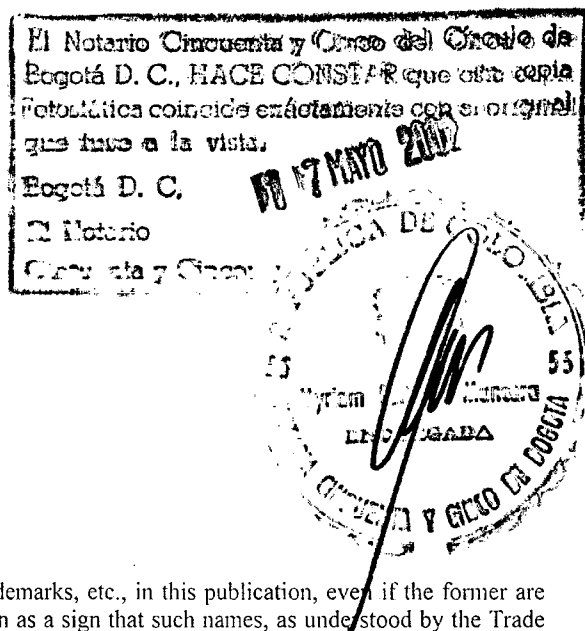
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Preface

Thermoforming product to an extent, that only a

Besides such tradition. refrigerators or car com with the pressure-formi conjunction with the mo the quality and precisor

Where the original way meanwhile established its findings regarding mate Repeatability of processi high performance plant. principles of thermoforr *Maschinenbau GmbH* principles and processes and also providing a grea engineers and technician up to now.

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Besides the thermoplasti more important machine are explained in detail ar creation is closely conne multitude of ideas and n presentation I express n and Herrn *Günther Kiefl*

My thanks for the critica for improvement and au

I thank Frau M. Späth ar

Editor and authors hope, initiation into thermofon even for older hands.

Heilbronn, August 2000

Preface

Thermoforming production processes are nowadays employed for engineering applications to an extent, that only a few decades earlier would have been deemed impossible.

Besides such traditional applications as the vacuum-forming of sheet for displays, refrigerators or car components, thermoforming has conquered an important market share with the pressure-forming method of packaging. Continually improving thermoplastics, in conjunction with the most modern machinery have not only increased output rates, but also the quality and precision of the moldings.

Where the original way of thermoforming had been more of a manual operation, it has meanwhile established itself as a manufacturing process, which rigorously relies on scientific findings regarding materials, as well as measuring- and feedback-control technology. Repeatability of processing parameters allows thermoforming to be employed in industrial high performance plant. Besides numerous ILLIG publications in trade journals, basic principles of thermoforming have been taught in training courses at the *ADOLF ILLIG Maschinenbau GmbH & Co.* for decades. However, a comprehensive presentation of principles and processes, acting as an introduction to this special subject for the student, and also providing a great number of in-depth answers to individual problems for qualified engineers and technicians already experienced in this field, has been lacking in book-form up to now.

"Thermoforming - A Practical Guide" has been compiled to fill that need.

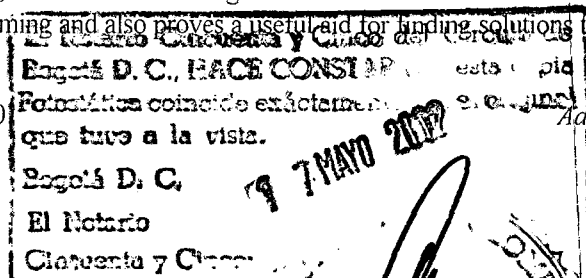
Besides the thermoplastics employed as thermoforming material, all processing stages, the more important machine models, as well as principles applied to mold- and tool-making are explained in detail and demonstrated with practical examples in this book. The book's creation is closely connected with ILLIG's 50 year old Company history. Accordingly, a multitude of ideas and much experience has been incorporated, for whose comprehensive presentation I express my particular gratitude to the authors, Herrn *Peter Schwarzmann* and Herrn *Günther Kiefer*.

My thanks for the critical examination of the manuscript, as well as numerous suggestions for improvement and augmentation go to Herrn Professor *Günther Harsch*.

I thank Frau M. Späth and Mr. E. J. Tremmel for the professional translation into English.

Editor and authors hope, that "Thermoforming - A Practical Guide" facilitates the novice's initiation into thermoforming and also proves a useful aid for finding solutions to problems even for older hands.

Heilbronn, August 2000



Adolf Illig

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The influence played by the plug contour

The plug contour (Fig. 4.47) can be determined with the following *known values*:

Let the following apply for *distance a* between plug and tool:

$$a = 1.5 \cdot \text{material thickness } s + (1 \text{ mm to } 3 \text{ mm})$$

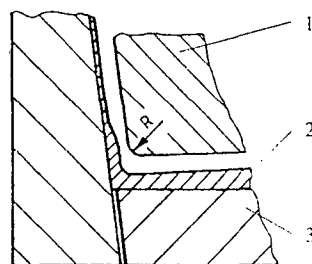
The *outside diameter* D_s of the prestretching plug is a function of the *downholder's inside diameter* D_v and results in $D_s = D_v - (2 \text{ mm to } 4 \text{ mm})$

The *base radii* R are subject to the thermoforming material used. A *small* base-radius R_1 is chosen for materials of low kinetic friction, such as PS, HIPS, PET, PVC and a *large* base-radius R_2 for materials of high kinetic friction, like PP:

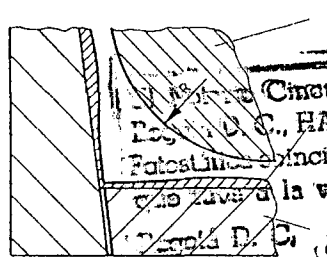
$$R_1 = (5 \text{ mm to } 6 \text{ mm})$$

$$R_2 = (10 \text{ mm to } 20 \text{ mm}) \text{ and higher.}$$

Please note: The smaller the plug's base radius R , the thicker the base will be and vice versa. The base area gets thinner, when plug radius R is increased. When a plug of small base-radius R is used, the thinnest spot on a molding is at the base of the sidewall (Fig. 4.48 a) and in the bottom corner of the molding (Fig. 4.48 b), or in the clamping flange area, when a plug of large base-radius R is employed.



a)



b)

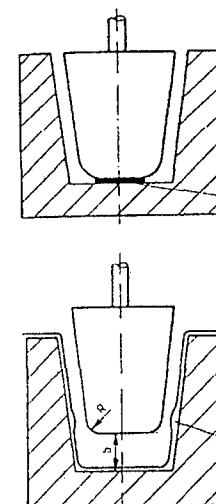
Fig. 4.48 Wall thickness distribution in the base area
a) plug radius too small, b) plug radius too large
1 plug, 2 molding, 3 tool

Influence of the plug stroke

In its home position, with the tool closed, the plug must not touch the clamped material, before it starts its movement. When the plug reaches its end-position (lowest point), gap a to the base (Fig. 4.47) should approximately correspond to the following value

$$a = 1.5 \cdot \text{material thickness } s + (1 \text{ mm to } 2 \text{ mm})$$

On no account must the plug enter to such an extent, that it clamps the material to the bottom. One possibility for determining this gap with modelling clay is shown in Fig. 4.49. If the intrusion depth is reduced too much, in order to achieve a thinner bottom, uneven wall thicknesses may result (Fig. 4.50).



Influence of the tool on

In Table 2.4, materials plastics to be formed. felt prestretching plug will turn out too thick prestretcher is being u thin. This will also hap its end-position. Table with plastics, mainly p

Table 2.1 Prestretch

55	forming material
HIPS	
Styrolux, K-Resin	
PP	
PP "crystal clear"	
PVC	
PVC "crystal clear"	
PET (PETG, APET)	
PET "crystal clear"	

1) tiny hollow glass-sp

Following known values:
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such as PS, HIPS, PET,
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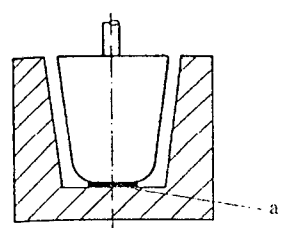
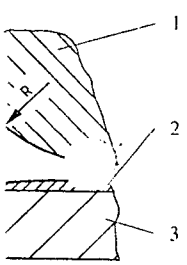


Fig. 4.49
determining the correct gap between plug and
tool bottom with the aid of plasticine
(plug gap *a* = thickness of compressed plasticine)

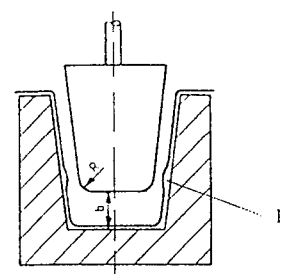


Fig. 4.50
thickness increase *I* in the sidewall, when radius
R is small and plug-gap *b* is too large

Influence of the tool material

In Table 2.4, materials for prestretching plugs are recommended, that will suit the plastics to be formed. *Incompatible* material combinations should be avoided. If a felt prestretching plug is being used for thermoforming PP material, a cup's bottom will turn out too thick, because the felt is too rough. Where a PTFE (e.g. Teflon) prestretcher is being used for thermoforming HIPS, the cup's bottom will be too thin. This will also happen, when forming-air commences, once the plug has reached its end-position. Table 4.1 gives advice on suitable prestretcher materials for use with plastics, mainly processed in roll-fed machines.

Table 4.1 Prestretcher materials used in roll-fed machines

Forming material	Plug assist materials		
	POM	Felt hardened	Syntactic foam ¹⁾
HIPS		x	
Styrolux, K-Resin	x		x
PP	x		x
PP "crystal clear"	x		
PVC			
PVC "crystal clear"			
PET (PETG, APET)	x		x
PET "crystal clear"	x		

¹⁾ tiny hollow glass-spheres, encapsulated in epoxy resin.

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Thermoforming on RDM Machines

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These documents have been drawn up for the purpose of training courses. They serve the reader as an introduction to the topic of thermoforming on RDM machines during the training courses and can be used thereafter as reference material. However, as it is only possible to provide an overview, these training-course documents cannot be a substitute for the actual operating instructions. No legal claims can be derived from the specifications contained herein. These documents have been drawn up with great care. It cannot be excluded, though, that the odd error might have found its way into them. The specifications included can be amended without prior notice. If you have any queries about these documents or any suggestions, we would be glad to hear them.

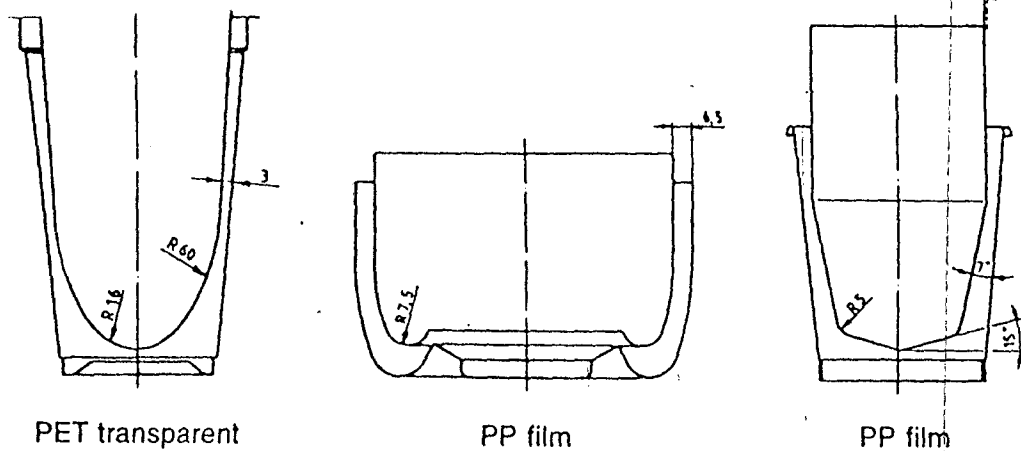


Fig. 6.15 Examples of plug assist contours (continuation)

6.1.9 Guides

For the guides an equally small tolerance is necessary as for the individual bores. In the upper and lower parts of the tool the bores for the guide journals and bushes are bored and ground in one clamping device with the bores of the blanks. To reach the high precision of the tolerance of 0.002 mm, the tool parts are machined in a temperature controlled room at 20 °C. In order to also ensure the temperature in the tool block as well, it is already stored in the room mentioned for 24 hours prior to machining.

6.1.10 Cooling

The tool cooling on RDM tools has two functions:

- a) cooling and
- b) control of expansion.

In order to ensure the reproducibility of the forming process in continuous operation, the forming tools must be run at a constant temperature. The cooling, whether direct or indirect (Fig. 8.6), is effected with water. With indirect cooling the best possible heat conduction should be aimed at. This has to be achieved via a large contact surface between mould segment and cooling jacket and by means of good thermal conductivity. Heat conduction is improved, if the two contact surfaces are machined as precisely as possible.

The two tool halves, the upper and lower parts, can be separately cooled. In the case of multi-up tools cooling is always provided. The cooling water connections are also effected in the same way as the compressed-air connections, with the exception of the ejector cooling, directly via bores in the tool installation bridges. On many RDM-K tools, screwing tight the two tool parts simultaneously makes the connections.

The tool temperature should be 20 °C maximum and 16 °C minimum.

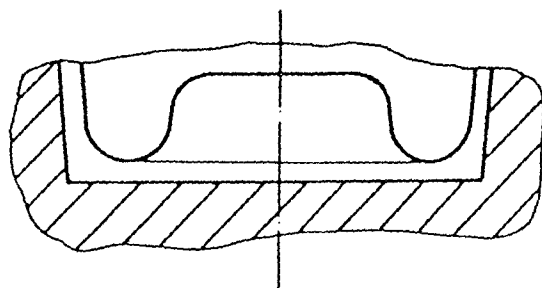


Fig. 6.14

The radius R can be taken from table 6.4. The values are correct for materials with a small adhesion tendency; for soft materials with a slight melting resistance, e.g. PP, the values for R are multiplied by between 1.5 and 3.

d = diameter of the finished product	s = initial thickness of the semi- finished pro- duct	< 1	2	3
10		1	1	1
20		1	2	2.5
30		1.5	2.5	3
40		2	3	4
50		2.5	4	4
60		3	4	5
70		3.5	5	5
80		4	5	5
90		4.5	5	5
100		5	5	5

Table 6.4 Radii for plug assists for film with a relatively low sliding friction, e.g. PS-HI, PET with antiblock finish, PVC-U

For examples of plug assist contours see Fig. 6.15

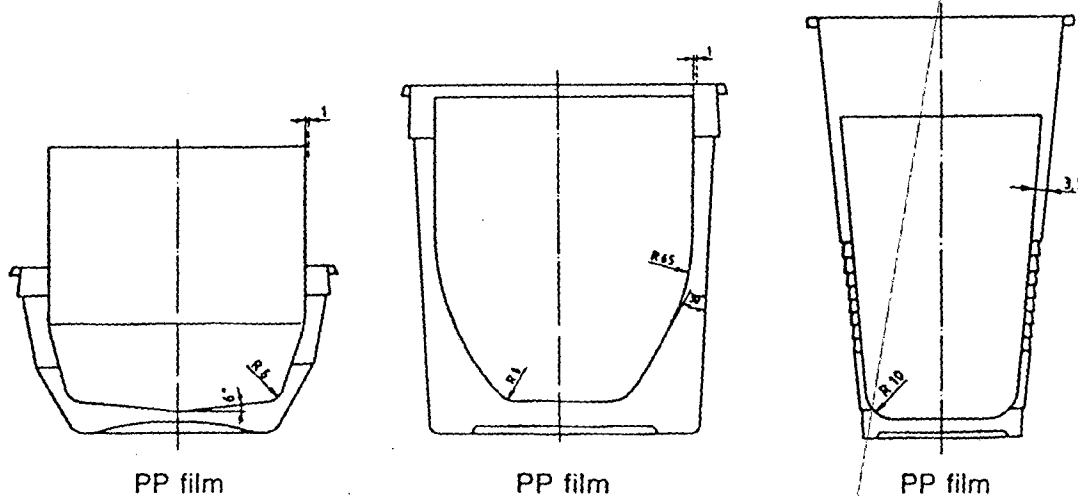


Fig. 6.15 Examples of plug assist contours

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If a plug assist base has a relatively large flat surface (from approx. 40 mm surface diameter upwards), the base can be hollowed out (Fig. 6.14). In this way the film in the base area is not quenched and can consequently be stretched better. Caution ! Excessively small hollowing depths will quench the films despite this.

- no startup problems with PS and PVC films
- unsuitable for transparent materials due to intensive markings on the product
- unsuitable for PP due to adhesion to the film
- easy connection to the plug assist rod
- of those proposed here felt is the most expensive material

Syntactic foam

(e.g. Syntac 350 from Emerson & Cumming/USA)

(epoxy resin filled with hollow glass balls with a diameter of 0.015 mm from Grace/USA)

- This material is universally usable, with slight restrictions for transparent products
- When cutting, dust is incurred
- Syntac is also obtainable as a castable compound under the designation 351.

properties		POM	Syntac 350	hardened felt ^①
heat resistance	°C	80 ... 100	176	80 ... 90
tensile strength	N/mm ²	70	45	6,5
thermal conductivity	W/K · m	0,35	0,12	
expansion	1/k · 10 ⁻⁵	120 · 10 ⁻⁶	21 · 10 ⁻⁶	
density	g/cm ³	1,42	0,6	0,6
ball-thrust hardness	N/mm ²	160		

^① Felt block art. no. 4542, hardness H3 0.60 hardened with recipe 647

Table 6.3 Plug assist material properties

6.1.8.3 Determination of the plug assist contour

General procedure:

- a) The initial contour results from the contour of the negative mould whereby all round both laterally and in the base a spacing "a" from this is provisionally assumed. Fig. 6.13:

$$a = 1,5 \cdot s_1 + x$$

s_1 = initial thickness of the film in mm

x = 1 to 3 = $f(s_1)$; 1 for films < 1 mm

d = diameter of the product in mm

If the product is not round, the width is put in here

- b) Interfering edges, on RDM machines the downholder inside diameter, must be taken into consideration (interfering edge spacing between plug assist and downholder greater than 1.5 mm).
- c) At the beginning the base radius or the base contour is taken from table 6.4. The base radius is enlarged in the following cases:

6.1.8 Plug assist

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Plug assists are used to achieve as uniform a wall-thickness distribution of the product as possible.

Plug assists must be used, if:

$$H/D \geq 0.4 \quad (\text{or } \geq 0.35 \text{ *})$$

H = drawing depth

D = product diameter or width of the product in the case of rectangular parts

- * For forming parts with slight side wall inclines ($< 10^\circ$) and small base radii ($< 6 \text{ mm}$) plug assists are used for small drawing ratios from approx. 0.35 upwards.

The contour of a plug assist is dependent on the following factors:

- contour of the negative mould
- plastic film to be formed, i.e. material type, material finish and thermoforming behaviour
- forming temperature
- plug assist material
- surface roughness of plug assist
- forming process sequence.

6.1.8.1 Requirements on the material

- A plug assist material is not allowed to quench the hot plastic when it comes into contact with it.
- It must have favourable sliding and friction behaviour with the hot plastic.
- The plug assist material must be sufficient for its mechanical load (such as pressure, bending, abrasion),
- and must also comply thermally with its usage.
- The material should be easy to process.
- Last but not least, the price, material and production costs must also be taken into consideration.

In appendix A 15 the plug assist materials suitable for plastic films are recommended. Avoid any adverse material combinations. For example, if a plug assist made of felt is used for thermoforming PP, the bottom of a cup will become thick because felt has too high a friction value. If a plug assist made of PTFE (e.g. Teflon) is used for thermoforming PS-HI, the bottom of a cup will become too thin because PTFE has too low a friction value. Table 6.2 provides information on suitable plug assist materials for the main plastics used on automatic roll-fed thermoformers.

4.8 Thermoforming with combined forming- and punching tools

4.8.1 Forming-/punching tool with shearing cut

Fig. 4.46 shows a combined forming- and punching-tool with shearing cut. *Sequence* of the forming- and punching process:

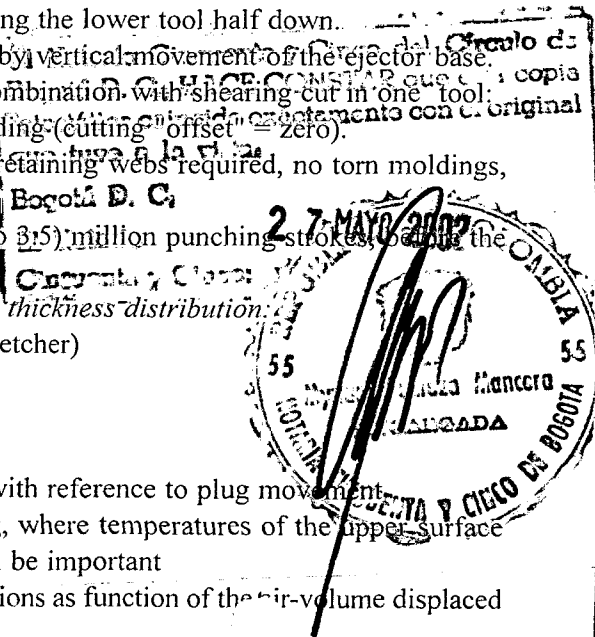
- Transport the heated material into the open tool.
- Close tool (the tool half with the tool insert is moveable, the other tool-half is fixed). During closing, a cut is started on the material by die plate and cutting die and the edge of the molding gripped by the downholder.
- Enter plug into the lower tool-half; this preforms the clamped material by mechanical prestretching. Forming air is introduced during plug movement and the article is being formed at a pressure ranging from 500 kPa to 700 kPa (5 bar to 7 bar).
- Cooling until the molding's temperature at its thickest part (usually the edge-zone) drops below its glass transition temperature, so that the article can be demolded without reversion.
- Turn off the forming air.
- Punching by *punching movement*; the completed article is cut out by an approximately 0.8 mm upward stroke of the lower tool half.
- The forming tool is opened by moving the lower tool half down.
- Ejection of the punched-out article, by vertical movement of the ejector base.

Advantages of the forming / punching combination with shearing cut in one tool:

- Perfect cut, concentric with the molding (cutting offset = zero).
- Clean, smooth cutting edge, i.e. no retaining webs required, no torn moldings, no punch dust or flash.
- Long service life of the tools: (1.5 to 3.5) million punching strokes, before the die-plate has to be reground.

Influencing factors on the molding's wall thickness distribution:

- Plug geometry (plug serves as prestretcher)
- Plug stroke
- Plug material
- Plug temperature
- Timed forming-air commencement with reference to plug movement
- Material temperature during forming, where temperatures of the upper surface as well as those of the underside can be important
- Sum-total of the exhaust-air cross-sections as function of the air-volume displaced during forming time.



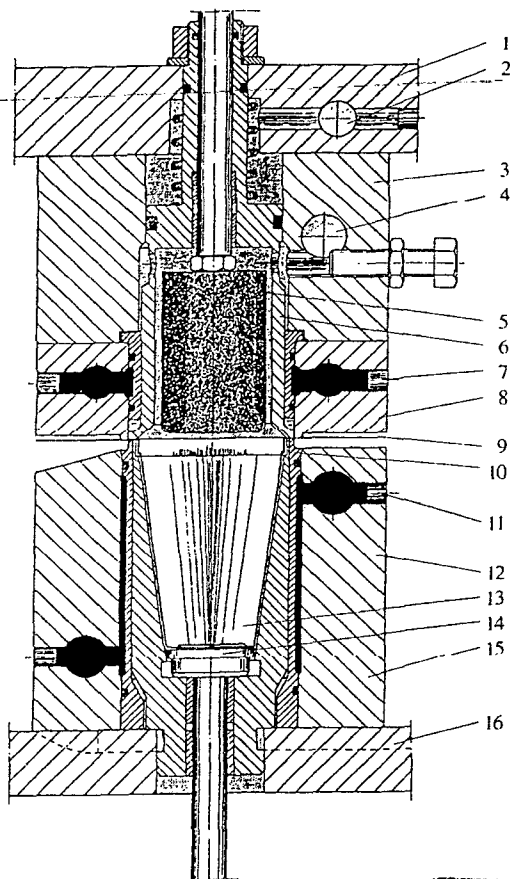


Fig. 4.46

Forming- and punching tool with shearing cut

- 1 head plate
- 2 compressed air for downholder
- 3 intermediate plate upper part of tool (cooling jacket)
- 4 Forming air (compressed air for forming process)
- 5 prestretcher
- 6 downholder
- 7 cooling water for die plate
- 8 die plate (bottom die)
- 9 material
- 10 cutting punch (top punch)
- 11 cooling water for lower tool half
- 12 tool insert
- 13 molding
- 14 ejector base
- 15 cooling block, lower tool half (cooling jacket)
- 16 base-plate

In the following, influencing factors are shown with the example of a round molding (Fig. 4.47).

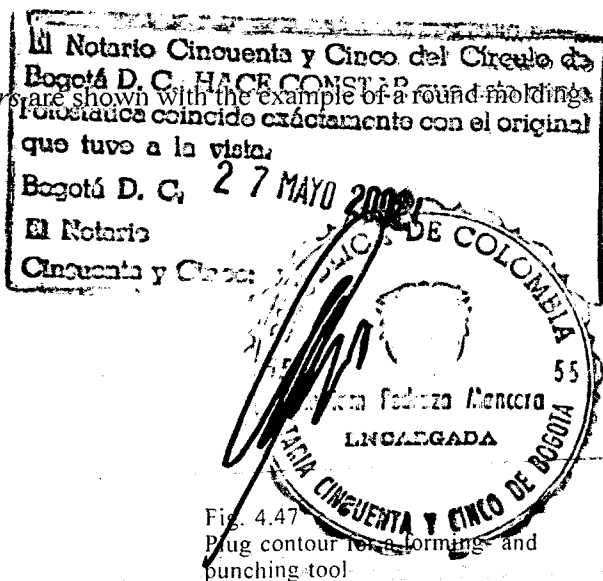
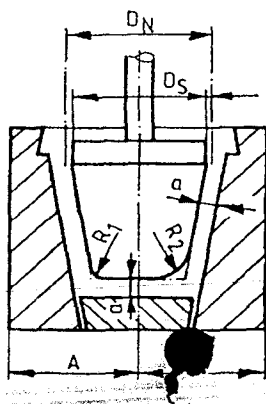


Fig. 4.47

Plug contour for a forming- and punching tool

For multi-layered material with an outer skin of PE, where the PE-side comes into contact with the plug assist, PTFE-plugs should be used.

Material-properties of individual prestretching plugs

Polyoxymethylene POM, e.g. Delrin (DuPont), Ultraform (BASF), Hostaform (Hoechst):

- cost-effective prestretching plug material
- processed without problems
- best material for crystal clear articles
- unsuitable for PVC
- low long-term exposure to high temperature; maximum 110 °C to 120 °C
- surface smooths out, turns brownish and forms cracks
- in most cases, the surface has to be re-roughened after every 30 to 100 hours of operation, with the exception of polished plugs for crystal-clear items
- where PS-materials are concerned, start-up difficulties arise from chill marks if prestretching plugs are cold.

Hardened felt (hardened with Formulation 647, from Filzfabrik Fulda, obtainable in sheets of up to 80 mm thick. Non-hardened felt plates, at thicknesses in excess of 80 mm, can be "surface-hardened" with Clou low viscosity primer):

- no start-up problems with PS- and PVC-materials
- unsuitable for transparent materials, because of severe markings on molding
- unsuitable for PP because of sticking to the material
- simple connection to the prestretcher rod
- amongst the suggested ones, felt is the most expensive material.

Syntactic foam (e.g. Syntac 350, product of Emerson & Cumming/USA):

- universally employable, with minor exceptions regarding crystal clear articles
- creates dust on cutting
- also available in casting modification as Syntac 351; casting itself is a very elaborate operation, however.

Influence exerted by the forming sequence, or the timed commencement of forming air and plug movement

The clamped material is being preformed by the plug through mechanical preforming, as soon as the tool is closed. If the plug movement is started early, i.e. shortly, before the material is clamped (Fig. 4.51), it may well be possible to process a small amount of waste- alongside new material. But we advise against this, for reasons of accurate repeatability and good wall thickness distribution. If the material had been formed relatively hot, too soon a plug movement may result in chill-marks and irregular wall thicknesses in the edge zone of the completed article (Fig. 4.51). If the article-forming air is turned on too early, it will separate the hot

material from the plug too soon. The plug is thus incapable of fulfilling its task, despite continuing its movement. The base becomes too thin. If forming air is turned on too late, the plug pushes too much material into the base: this will then be too thick and the article's walls too thin.

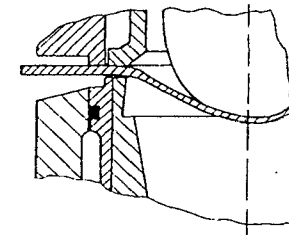


Fig. 4.51
Non-repeatable wall thickness distribution in the edge-zone, when plug movement commences, before tool is shut

Influence of the material's forming temperature on wall thickness distribution

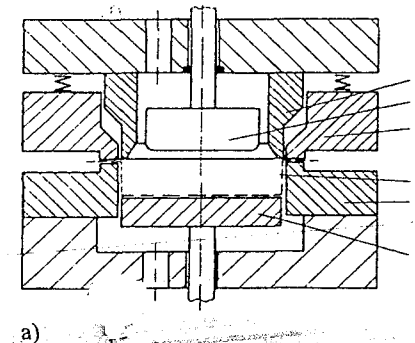
The aim is, to achieve a still justifiable definition sharpness at the lowest possible forming temperature. At higher forming temperatures, but identical forming sequence, the article's base becomes thicker. The reason: at higher temperature, less stress exists in the material and friction between plug and sheet is simultaneously being increased.

Air-exhaust cross-sections total: its influence on wall thickness distribution

If the sum-total of air-exhaust cross-sections in a negative tool is too small, a counter-pressure is generated when the plug enters the tool. That increases the frictional force between material and plug, time-delaying the material from being released from the plug by the forming air. Result: article with thicker base.

4.8.2 Combined forming- and punching tool for edgeless moldings

Contrary to a standard forming-/ punching tool with shear cut, here the die plate moves and the cutting die is fixed (Fig. 4.52).



b)

Fig. 4.52
Forming- and punching tool for edgeless moldings
a) tool, b) molding
1 cutting die, 2 prestretcher, 3 downholder, 4 completed article before ejection, 5 die plate, 6 ejector



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Industria y Comercio

SUPERINTENDENCIA

2020

Bogotá, D.C.,

Doctora:

Mónica Wolf Wasserman

Apoderada

Oficio N°: 13064**ASUNTO:**

Radicación N°	00-53003
Trámite	003
Evento	001
Actuación	330
Folios	001

Con fundamento en lo previsto por el artículo 42 de la Decisión 486 de la Comisión de la Comunidad Andina, en concordancia con lo dispuesto en el artículo 85 de la misma decisión, se le comunica que la oposición presentada en su calidad de apoderada de la sociedad Multidimensionales S.A., dentro de la solicitud de patente de Modelo de Utilidad que se adelanta en el expediente de la referencia, no se acepta, teniendo en cuenta que fue presentada extemporáneamente, por cuanto el término para su presentación venció el día 13 de marzo de 2002 y el escrito de oposición con sus anexos fue radicado el día 01 de abril del mismo año.

Notifíquese el presente oficio conforme a lo dispuesto en el numeral 5.2., literal e), del capítulo quinto del título primero de la Circular Única N° 10 de 2001.



ALIX CARMENZA CESPEDES DE VERGEL
Jefe de la División de Nuevas Creaciones.

1 JUL 2002

El anterior oficio fue notificado por fijación en lista de fecha, _____.

202021

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