



DESIGN AND EVALUATION OF TWO CAVITY INJECTION MOULD FOR HANGER

K. Divakara Murthy¹, Dr. P Jamaleswara Kumar²,

¹Research scholar, ²Associate Professor

^{1,2} Department Of Mechanical Engineering, KL University

Abstract

Tool Design is the process of designing and developing the tools, methods and techniques necessary to improve manufacturing efficiency and productivity. It gives industry the machine and special tooling needed for today high speed, high volume production. It does this at a level of quality and economy that will ensure that the cost of the product is competitive. Since no single tool or process can serve all the forms of manufacturing, tool designs an ever changing, growing process of creative problem solving. Plastic is a synthetic polymer of high molecular weight. It is composed of repeating organic chemical units. Polymer is a single large molecule. It is formed as a result of the union of two or more molecules of the simpler substances.

Plastics did not enter our lives with the fanfare of other revolutionary inventions, but more by the process of infiltration. Plastic being the synthetic materials where at first considered to be cheap substitute for them better known and more expensive materials. Plastic articles are not only replacing wood, metal and other materials but because of their particular qualities. They function better than other materials for specific process. Through the year's plastics have curved the right as material themselves and not as substitute for their materials. Not only are plastics more useful, adaptable and practical than the material. They have supplemented, but uses of plastics have been found for which no other material can be used.

The plastics industry is one of the fastest growing major industries in the world. Every year there is an increase in the amount of plastics used in all types of products. These

are emerging both as product innovations and as existing products converted from materials to plastics for competitive and economic advantage. These plastic components can be made by various molding processes, the process to be employed and the material to be used for the purpose entirely depends on the application of the component.

Index Terms: AUTO-CAD, CATIA, Lathe Machine, CNC, Injection Moulding.

I.INTRODUCTION

The modern-day injection mould tool is often a complex arrangement of mechanical, electrical, pneumatic and hydraulic components expected to fulfill a range of demanding tasks. Whatever the complexity, the mould design must essentially specify a tool that will operate satisfactorily in production. To achieve this, it must meet the following prime objectives:

- It must operate at the required production rate or better and last at least for the predicted design life.
- It must be well designed and produce mouldings to the required specification.
- The design must specify a tool that will operate consistently and be reliable in production.
- It should not be prone to frequent breakdowns and should not require frequent maintenance or servicing.

These objectives are not simple to achieve. At every cycle, the tool is clamped together under high loads and is subject to high injection pressures and high heat levels from the incoming polymer. During the cooling cycle, the moulding is cooled until it reaches ejection temperature, when the tool opens and the moulding is ejected.

All these factors combine to make the mould tool a highly stressed dynamic heat exchanger.

It is important, therefore, to ensure that the mould design takes all these factors into consideration. Additionally, there are several other requirements that need to be considered, among which are the following:

- The number of impressions required
- The type of tool needed, e.g., two-plate, side core, split, multi-plate, hot runner and so on
- The mould materials
- The cavity construction
- The required life of the tool
- Temperature control
- The Moulding material

There are three golden rules in injection moulding:

- Good mould design
- Good-quality tool making
- Competent injection moulding

If all three of these can be achieved, all projects will result in success. If any one of them is missing, trouble will result.

II PLASTIC MATERIALS

Plastics materials belong to a larger family of materials known as *synthetic organic polymers*. By 'synthetic' is meant man-made; the term 'organic' to a chemist signifies that they are carbon-containing compounds; and the term 'polymer' comes from the Greek word meaning 'having many parts'.

To summaries there are three terms commonly used in plastics technology.

- **Synthetic** (man-made)
- **Organic** (carbon based)
- **Polymer** ('many-units')

2.1. Types of Plastics Materials

There are two main types of plastics materials:

- **Thermoplastics**
- **Thermosetting plastics**

2.1.1. Thermoplastics: -

Thermoplastics are resins that repeatedly soften when heated and harden when cooled. Most thermoplastics are soluble in specific solvents and can burn to some degree. Softening temperatures vary with polymer type and grade. Because of thermoplastics' heat sensitivity, care must be taken to avoid degrading, decomposing, or igniting the material.

Nylon, acrylic, acetal, polystyrene, polyvinyl chloride, polyethylene, and cellulose acetate are just a few examples of the many rigid thermoplastic resins currently available. Also within this group are highly elastic, flexible resins known as thermoplastic elastomers (TPEs).

Most thermoplastic molecular chains can be thought of as independent, intertwined strings resembling spaghetti (Figure-1). When heated, the individual chains slip, causing plastic flow. When cooled, the chains of atoms and molecules are once again held firmly. When subsequently heated, the chains slip again.

There are practical limitations to the number of heating/cooling cycles to which thermoplastics can be subjected before appearance and mechanical properties are affected.

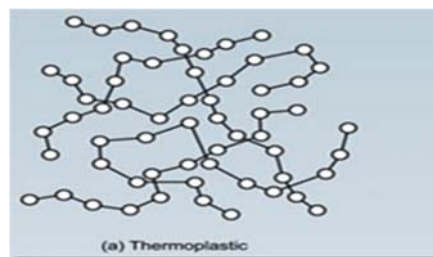


Fig 1 Structure of Thermoplastics

Most commonly used thermoplastics are:

ABS (Acrylonitrile-butadiene styrene), CA (Cellulose acetate), CAB (Cellulose acetate butyrate), EVA (Ethylene-vinyl acetate), HDPE (High-density polyethylene), HIPS (High-impact polystyrene), LDPE (Low-density polyethylene), PA6 Type 6 Nylon (polyamide), PBTP (PBT) (Polybutylene terephthalate), PC (Polycarbonate), PET (Polyethylene terephthalate), PP (Polypropylene), PS (Polystyrene), PTFE (Polytetrafluoroethylene)

High Density Polyethylene (HDPE).

This material has a density in the range 935-965 kg/m³ and is more crystalline than LDPE.

It is also slightly more expensive but as it is much stronger and stiffer it finds numerous applications in such things as dustbins, bottle crates, general purpose fluid containers and pipes. One of the most exciting recent developments in this sector has been the introduction to the marketplace of Metallocene-based polyethylene's.

Metallocene have been recognized as suitable catalysts for the manufacture of polyethylene's since the 1950s. However, it is

only recently that their use has been perfected. Their big advantage is that they are single site catalysts so that the polymer molecules which are produced tend to be all the same - a fact which offers an array of superior properties.

Traditional catalysts for polyethylene (Ziegler Natta catalysts) are multi-sited so that they produce polymers with short, medium and long molecules. In the new Metallocene grades of polyethylene, the absence of low molecular weight species results in low extractable, a narrow melting range and free-flowing material even at low densities. The absence of high molecular weight species contributes excellent melting point control, clarity and improved flexibility/toughness at low temperatures.

Metallocene-based polyethylene does not offer the lower production costs associated with LLDPE. Hence there will be a price premium for the new materials but this is felt to be justified in view of their improved property profile.

2.1.2 Thermosetting plastics

Thermosets are plastics that undergo chemical change during processing to become permanently insoluble and infusible. Phenolic, amino, epoxy, and unsaturated polyester resins are typical thermoset plastics. Natural and synthetic rubbers such as latex, nitrile, millable polyurethane, silicone, butyl, and neoprene, which attain their properties through a process known as vulcanization, are also thermoset polymers.

The structure of thermoset plastics is also chainlike and, prior to molding, very similar to thermoplastics. However, cross-linking is the principal difference between thermoset and thermoplastic systems (Figure-1). When thermosets are cured or hardened, crosslinks are formed between adjacent molecules, resulting in a complex, interconnected network. These cross bonds prevent the individual chains from slipping, thus preventing plastic flow when heat is added. If excessive heat is added to the thermoset resin after the cross-linking is complete, the polymer is degraded rather than melted. This behavior is somewhat similar to an egg when it is cooked; further heating does not return the egg to its liquid state, it only burns.

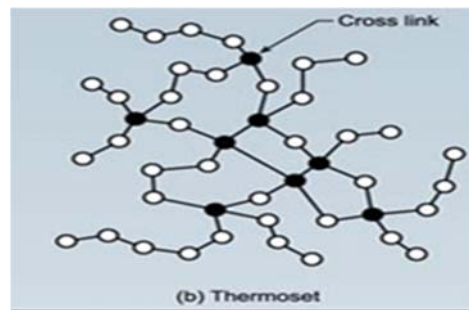


Fig 2 Structure of Thermoset

III DESIGN CONCEPT AND CALCULATION

3.1. Pre-design Requirements

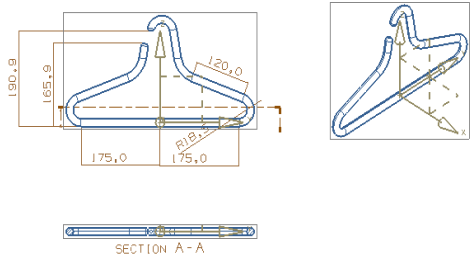
Before starting a mould design, the designer should be in possession of the following information (some items of which have been mentioned previously).

- An unambiguous fully detailed component drawing.
- Specifications of the moulding material including grade and color.
- The moulding machine specifications.
- All the estimating details including any sketches.
- Tool specifications as follows:
 - Number of impressions.
 - Type of mould e.g., two-plate, three-plate, split, side core, hot runner, etc.
 - Type of runner system.
 - Type of gate.
 - Method of de-gating.
 - Use of robotics.
 - Estimated cycle time.

3.2 Golden Rules

1. Never start a mould design without all the necessary information.
2. If an established design works well, don't embark on a totally new design if you can base your design on the established one.
3. The simpler the design the more reliable and efficient it will be.
4. Always sketch two or three alternative approaches to the design before committing yourself to the first one you think of.
5. Draw a sufficient number of views so that the design can be understood fully.

3.3. Detail Drawing of Component for which Mould to design



Material = HDPE
 (High Density Polyethylene)
 Density of HDPE = 0.94 g/cm³
 Volume=197789.46mm³ = 197.789cm³
 Shrinkage value for HDPE = 0.030 mm/mm
 Thermal Conductivity = 0.52 w/mK
 Total Heat Content = 718. kJ/kg
 Mass = p×v = 0.94×10⁻³×197789.46 = 185.92 g = 186g

ALL DIMENSIONS ARE IN MM		PROJECTION	SCALE	TIME:-			
			1:1				
	N A M E	D A T E					
DRAWN	S. H. K	02 - 06 - 12	GENERAL TOLERANCE	TITLE: - COMPONENT FOR INJECTION MOULD TOOL DESIGN			
CHECKED	G. D. B	15 - 06 - 12	0=+-0.5				
APPROVED	G. S. A	18 - 06 - 12	0.00=+-0.01				
INDO-GERMAN TOOL ROOM, AURANGABAD			EXERCISE NO.	D R G. N O	DR G.T Y P E S H E T N O.	SH E E T S I Z E	C O N T. S H E E T N O.
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3.4. Specification of HDPE component & solid model

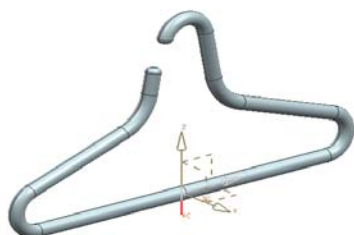


Fig 3 Component Drawing

3.5. Machine available & its Specification
 DGP WINDSER-SP-130

SPECIFICATION	
Screw Diameter (mm)	45
Injection Pressure (bar)	2200
Stroke Volume (cm ³)	300
Screw Stroke (mm)	190
Max. Injected Weight(grams)	270
Injection Rate (cm ³ /s)	169
Plasticizing Rate (g/s)	20.5
Screw L/D ratio	20
Screw speed max. (rpm)	165
Heating Capacity (kW)	12.7
No. of Heating Zone	5
Nozzle Holding Zone	60
Closing Force (kN)	1300
Mould operating stroke (m)	550
Min. mould height	200
Max. Daylight	750
Distance between tie rod h×w (mm)	380×380
Size of mould plate h×w (mm)	585×585

Ejector Force (kN)	42
Ejector Stroke (mm)	95
Referring to polystyrene depending upon material and processing conditions. 10kN=1 Tonne	

3.6. Calculation of No. of Cavity

a) Calculation of No. of cavities from shot capacity:

From machine specification stroke volume=300cm³
=300×10³mm³

1) Shot capacity for HDPE= Stroke Volume × Density × C

$$W = V_s \times \rho \times C$$

Where,

V_s= stroke volume of machine in mm³

ρ = Density of HDPE in g/mm³

C = constant.

=0.95 for amorphous material

= 0.85 for crystalline materials

As HDPE is a crystalline material therefore C=0.85

$$W=300 \times 10^3 \times 0.95 \times 10^{-3} \times 0.8 = 242.25 \text{ g.}$$

2) No. of component (N_s) = $\frac{0.85 \times W}{m}$
(Considering 85% of rated shot capacity)

Where,

W= Shot capacity of HDPE in (g)

m = mass of component in (g)

$$\frac{0.85 \times 242.25}{186}$$

$$= 1.107$$

But consider 1. cavity

Hence number of component by shot capacity is 1.no. s

b) Calculation of No. of cavities from Plasticizing capacity:

Based on 85% of rated plasticizing capacity From machine specification Plasticizing rate of polystyrene = 73.8kg/hr = 20.5g/s

1) Plasticizing rate of HDPE (kg/hr) = Plasticizing rate of polystyrene for given machine (kg/hr)

$$\times \frac{\text{total heat content PS (kJ/kg)}}{\text{total heat content HDPE (kJ/kg)}}$$

$$= 73.8 \text{ kg/hr} \times \frac{239.4 \text{ kJ/kg}}{718.2 \text{ kJ/kg}}$$

$$= 6.8 \text{ g/s}$$

2) Minimum cycle time from plasticizing capacity (t_c) = $\frac{m}{p}$ (in second)

Where,

p= plasticizing capacity of HDPE (g/s)

m = mass of component in (g)

$$t_c = \frac{186}{6.8} = 27.35 \text{ s}$$

But in actual practice cycle time is considered 17 to 40 second. Here t_c is for only cavity filling time but in actual practice runner, sprue gate require time to fill, therefore total time should be more than t_c (minimum cycle time)

$$T_c = 40 \text{ s}$$

3) No. of cavity from plasticizing capacity (N_p) = $\frac{0.85 \times p \times T_c}{m}$

Where,

p= plasticizing capacity of HDPE (g/s)

m = mass of component in (g)

T_c = total cycle time in (s)

$$= \frac{0.85 \times 6.8 \times 40}{186}$$

$$= 1.21$$

$$= 1$$

Hence number of component by plasticizing capacity is 1.no. s

c) Calculation of No. of cavities from Clamping pressure:

From machine specification rated clamping capacity (P_c) = 1300KN

$$= 1300 \times 10^3 \text{ N} = 1300 \times 10^3 \text{ MPa}$$

No. of cavity from clamping capacity (N_p) = $\frac{P_c \times A_m}{c}$

$$\frac{P_c \times A_m}{c}$$

Where,

A_m = Projected area of moulding including

Runner, component & sprue in mm².

As runner projected area is 832.92mm².

Projected area of component is 49985.500mm².

$$A_m = 50809.42 \text{ mm}^2.$$

P_c = machine clamping capacity in MPa.

$$N_p = \frac{1300 \times 10^3}{63 \times 50809.42} = 0.42$$

No. of cavity from clamping capacity is 1No's

Hence taking minimum of all these methods i.e. number of cavity / component can be manufactured by SP-80 Machine for given HDPE material component is **ONE**.

3.7. Gate Design

A gate is a small opening (or orifice) through which the polymer melt enters the cavity. Gate design for a particular application includes selection of the gate type, dimensions and location. The gate design is largely determined by:

- The part geometry (wall thickness, etc.)

- Part specifications (appearance, tolerances, etc.)
- Material used
- Fillers used
- Cycle time
- De-gating requirements

For given HDPE component submarine gating is desirable.

a). Gate width (W) = $\frac{n\sqrt{A}}{30}$

Where,

A_m = Surface area of moulding including Runner, component & sprue in mm^2 .

n = material constant for HDPE = 0.60

$$W = \frac{0.6\sqrt{49985.50}}{30} = 4.4 \text{ mm}$$

b). Depth of gate (h) = $n \times t$

Where,

t = wall section thickness mm

n = material constant for HDPE = 0.60

h = $8 \times 0.60 = 4.8 \text{ mm}$

3.8. Runner Design

The purpose of the runner is to transport the melt from the sprue to the gates. There are three basic parameters for runner geometry:

- The cross-sectional shape
- The diameter
- The cavity layout

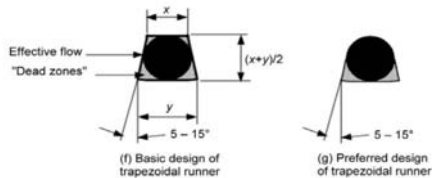


Fig 4 Runner cross-sections

There are number of runner cross-section between them modified trapezoidal is best suitable for two part two cavity. Fig shows modified trapezoidal runner cross-sections.

From design data book of moulding

$$D = \frac{\sqrt{m} \times \sqrt[4]{L}}{3.7}$$

Where,

L = runner length in mm

m = mass of component in (g)

D = diameter of runner in mm

$$= \frac{\sqrt{186} \times \sqrt[4]{36}}{3.7}$$

= 9mm

3.9. Pressure drop calculation during injection of melt:

Total volume of moulding (V_T) = runner volume (V_R) + sprue volume (V_S) + component volume (V_C)

$$V_T = V_R + V_S + V_C$$

1) Runner volume (V_R) = Area \times length of runner

Where, in two cavities, runner length is 72mm

$$\text{Area} = \frac{\pi}{4} D^2 = \frac{\pi}{4} \times 9^2 = 63.61 \text{ mm}^2$$

$$V_R = 63.617 \times 72 = 4580.44 \text{ mm}^3$$

2) Sprue volume (V_S)

$$V_S = \frac{\pi}{12} \times h (D^2 + D \times d + d^2)$$

Where,

L = Sprue height mm.

d = entrance dia. of sprue or smaller dia. in mm.

1 D = diameter of larger in mm.

$$= \frac{\pi}{12} \times 82 (6^2 + 6 \times 3 + 3^2) = 24344.1 \text{ mm}^3$$

3) Component volume (V_C) = 197789.46 mm^3

$$V_T = V_R + V_S + V_C$$

$$= 4580.44 \text{ mm}^3 + 24344.1 \text{ mm}^3 + 197789.46 \text{ mm}^3 = 226714.1 \text{ mm}^3$$

A) Pressure drop in sprue (P_1)

Considering fill time = 3 second

$$\text{Flow rate (Q)} = \frac{\text{total volume}}{\text{fill time}} = \frac{226714.1 \text{ mm}^3}{3} = 75571.33 \frac{\text{mm}^3}{\text{sec.}}$$

$$\text{shear rate} = \frac{4Q}{\pi r^3}$$

Where,

r = inlet radius of Sprue = 1.5 mm

$$= \frac{4 \times 75571.33}{\pi \times 1.5^3} = 28509.74 \text{ sec}^{-1}$$

Shear stress (S_s) = Shear rate \times melt viscosity

Where,

Melt viscosity of HDPE = .1 poise

$$S_s = \frac{.1 \text{ N-Sec}}{10 \text{ mm}^2} = 28509.74 \times .01$$

$$S_s = 285.09 \text{ N/mm}^2$$

$$\text{Pressure drop in sprue (} P_1) = \frac{S_s \times L}{r}$$

$$= \frac{285.09 \times 82}{1.5} = 15584.9 \text{ N/mm}^2$$

$$= 15.58 \text{ kPa}$$

$$= 0.1558 \text{ bar}$$

B) Pressure drop in Runner (P_2)

Volume after subtracting sprue volume = 202370.1 mm^3

Flow rate considering flow time 3 sec

$$\text{Flow rate (Q)} = \frac{\text{total volume}}{\text{fill time}} = \frac{202370.1 \text{ mm}^3}{3} =$$

$$67456.7 \frac{\text{mm}^3}{\text{sec.}}$$

$$\text{Shear rate} = \frac{4Q}{\pi r^3}$$

Where,

r = inlet radius of runner = 4 mm

$$= \frac{4 \times 67456.7}{\pi \times 4^3}$$

$$= 1342.008 \text{ sec}^{-1}$$

Shear stress (S_s) = Shear rate \times melt viscosity

Where,

Melt viscosity of HDPE = .1 poise

$$= \frac{.1 \text{ N-Sec}}{10 \text{ mm}^2}$$

$$S_s = 1342.008 \times .01 \\ = 13.42008 \text{ N/mm}^2$$

Pressure drop in Runner (P_2) = $\frac{S_s \times 2 \times L}{r}$

$$= \frac{13.42008 \times 82}{2.5} = 440.178 \text{ N/mm}^2$$

$$= 0.440178 \text{ kPa}$$

$$= 0.00440178 \text{ bar}$$

Total Pressure drop in mould flow system (P_t)

$$= P_1 + P_2$$

$$= 0.1558 \text{ bar} +$$

$$0.00440178 \text{ bar} = 0.16020 \text{ bar}$$

6.9 Mould cooling Calculation.

a) Mass of moulding including runner

& sprue = $V \times \rho$

$$= 197789.46 \times 0.94 \times 10^{-3}$$

Where,

V = for two

$$\text{component} \times 1 = 197789.46 \times 1 = 197789.46 \text{ mm}^3$$

$$= 186 \text{ g}$$

$$= 0.186 \text{ Kg}$$

Maximum wall thickness of component = 8mm

From machine specification plasticizing capacity of SP-130-73.8 kg/hr.

Mass of moulding = 0.186 kg

b) Rate of Production = plasticizing capacity of SP-130

$$= \frac{\text{Mass of moulding}}{\text{plasticizing capacity of SP-130}} \\ = \frac{73.8 \text{ kg/hr}}{0.186 \text{ kg}} = 396.77 \text{ no's}$$

But in actual practice mould opening take some time. Therefore, considering rate of production less than obtained by theoretically.

Rate of Production = 125 nos.

c) Total heat content in HDPE moulding in one

$$\text{hour} = 125 \times 0.186 \times 718.2$$

$$= 16698 \text{ kJ/hr.}$$

Density of HDPE = 0.94 g/cm³

d) Mass of plastic material injected in to mould =

mass of moulding \times rate of production

$$= 0.186 \times 125 = 23.2 \text{ kg}$$

e) Heat to be transferred from mould per hour

$$(Q_m)$$

$$Q_m = m \times Q$$

Where

Q = Heat content of HDPE = 718.2 kJ/kg

m = Mass of plastic material injected in to mould (kg)

$$Q_m = 23.2 \times 718.2 = 16662 \text{ kJ/hr.}$$

But in actual practice half of heat to be transferred to the mould & other half of the heat removed by the conventional methods of heat transfer such as convection, conduction.

Therefore,

$$Q_m = 166.62/2 = 8331.12 \text{ kJ/hr.}$$

f) Amount of water to be circulated per hour (Q_w)

$$Q_w = k m_1 (t_{out} - t_{in}) \times C_p$$

Where,

m_1 = mass of water circulated

C_p = specific heat capacity of water

$$= 4200 \text{ J/kg K} = 4.2 \text{ kJ/kgK}$$

($t_{out} - t_{in}$) is usually 3 to 5^o

K = constant to allow for heat transfer efficiency

But in practice,

$$Q_w = Q_m = k m_1 (t_{out} - t_{in}) \times C_p$$

$$m_1 = \frac{Q_m}{k (t_{out} - t_{in}) \times C_p}$$

$$= \frac{8331.12}{0.64 \times 5 \times 4.200} = 619.87 \text{ kg/hr.}$$

g) Solidifying time (T)

$$T = \frac{\rho \times a}{\lambda_a (t_{mat} - t_{mould})} \times \frac{t^2}{8}$$

Where,

ρ = density of HDPE kg/mm³

a = Heat content of HDPE = 718.2 kJ/kg

λ_p = thermal conductivity of HDPE = 0.52 w/mK = 0.52 \times 1000 kw/mk

t = Maximum wall thickness of component = 8mm = 0.008m

t_{mat} = melting temperature of HDPE in K

t_{mould} = temperature of mould in K

$$T = \frac{940 \times 718.2 \times 1000}{0.52(230 - 30)} \times \frac{8^2}{8} = 51.931 = 52 \text{ second}$$

l) Minimum clamping force required (F),

F = projected area \times pressure in cavity

$$F = 5080.9 \times 63 = 32620.12 \text{ kg}$$

Where,

Pressure in cavity is considered as 63 Mpa

Minimum clamping force required (F) = 32.62 tons

m) Injection pressure from machine specification = 2200 bar

IV SELECTION OF MOULD BASE

There are no of mould base manufacturing companies like DME, HASCO, DMS, etc.

HASCO®

K - Order Number
 Product group: K 20 / 396 546 / 136 / 2312
 Plate type
 Plate sizes
 Plate thickness
 Steel quality

Steel grades				
Material No.	1 1730	1 2162	1 2764	1 2767
EN Classification	C 45 W 3	21 MnCr 5	X 19 NiCrMo 4	X 45 NiCrMo 4
Composition (%)	C:0.45 Si:0.30 Mn:0.70	C:0.21 Si:0.25 Mn:1.25 Cr:1.20	C:0.19 Si:0.25 Mn:0.40 Cr:1.25 Mo:0.20 Ni:4.0	C:0.45 Si:0.25 Mn:0.40 Cr:1.25 Ni:0.25 Ni:4.0
Tensile strength on delivery	approx. 640 N/mm ²	approx. 690 N/mm ²	approx. 830 N/mm ²	approx. 830 N/mm ²
Type	Plain carbon steel	Standard case hardening steel	Special case hardening steel (suitable for high-glass finish)	Special through hardening steel (suitable for high-glass finish)
Example of use	Unhardened parts for the manufacture of moulds, tools and jigs	Cavity plates and inserts for the manufacture of injection moulds	Cavity plates and inserts for the manufacture of injection moulds. Especially for extra high punch.	Cavity plates and inserts for plastic processing. Mould parts for high compressive and tensile loading, high-glass finish is possible.
Material No.	1 2083	1 2311	1 2312	1 2343
EN Classification	X 42 Cr 13	42 CrMoMs 7	42 CrMoMs 9 B	X 38 CrAlV 5 1
Composition (%)	C:0.42 Si:0.40 Mn:0.30 Cr:13.0	C:0.42 Si:0.40 Mn:1.50 Cr:1.90 Mo:0.20 S:0.008	C:0.41 Si:0.40 Mn:1.80 Cr:1.90 Mo:0.20 S:0.008	C:0.38 Si:1.0 Mn:0.40 Cr:5.30 Mo:1.20 S:0.002
Tensile strength on delivery	approx. 780 N/mm ²	approx. 1080 N/mm ²	approx. 1080 N/mm ²	approx. 780 N/mm ²
Type	Corrosion-resistant through hardening steel	Pre-hardened tool steel	Pre-hardened tool steel (easy machining)	Standard hot-work tool steel
Example of use	Cavity plates and inserts for the manufacture of injection moulds, especially used for processing moulding chemically aggressive material	Cavity plates and inserts for the manufacture of injection moulds. Good polishable. Striving surface-etching and structure etching is possible.	Cavity plates for the manufacture of injection moulds. For die casting and injection moulding.	Cavity plates and inserts for plastic processing. Mould parts for high compressive and tensile loading, high-glass finish is possible.

Further details about these steels you will find in the HRSICO-steel-leaflets.

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HASCO®

K 60
 K 60-400-400-3-1150-2140-2164-2167-2312-2343
 20 1000

K 70
 K 70-400-400-3-1150-2140-2164-2167-2312-2343
 20 1000

K 60/70
 K 60/70-400-400-3-1150-2140-2164-2167-2312-2343
 20 1000

Z 00
 Z 00-400-400-3-1150-2140-2164-2167-2312-2343
 20 1000

Z 03
 Z 03-400-400-3-1150-2140-2164-2167-2312-2343
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Z 20
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 20 1000

Z 691
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Z 10
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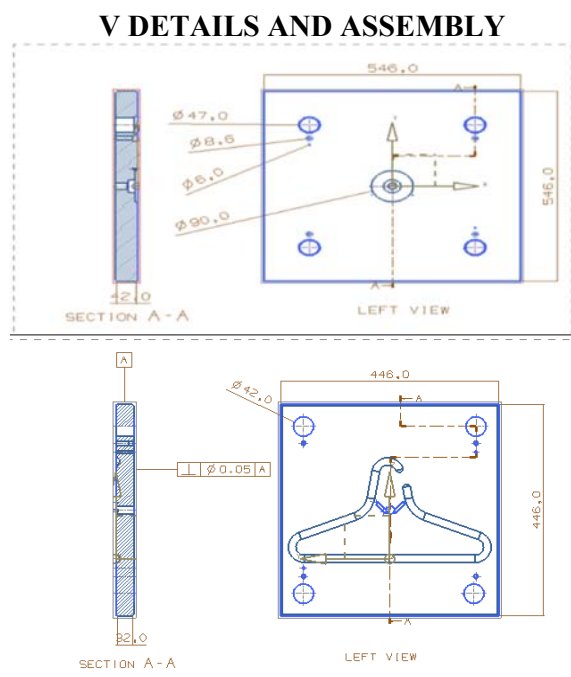
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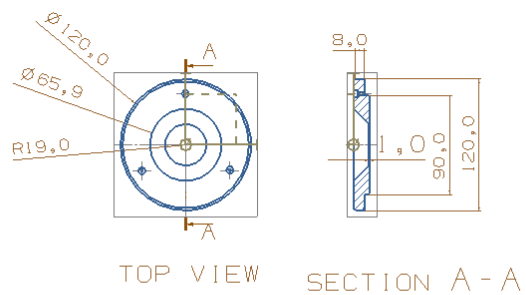
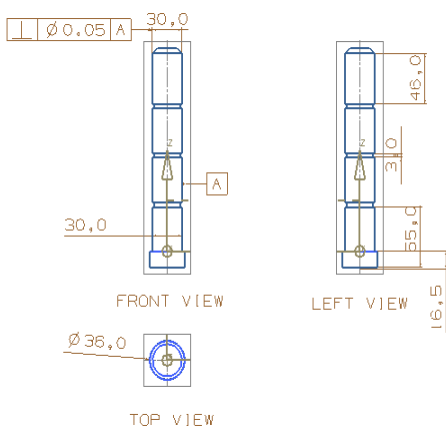
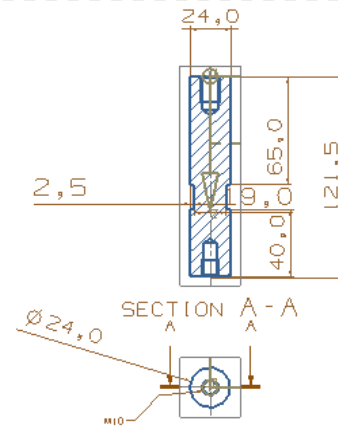
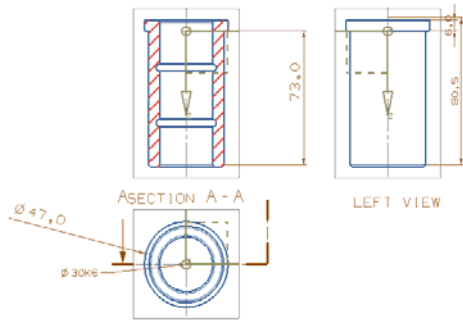
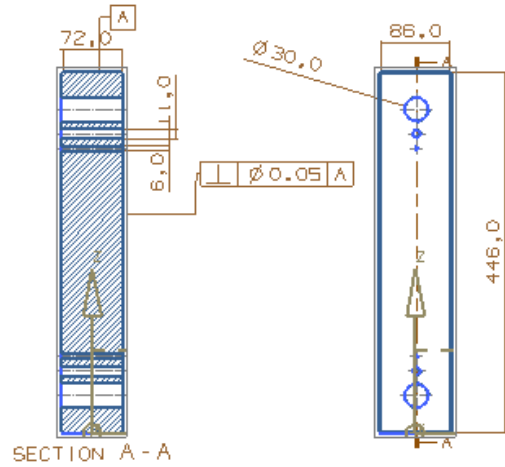
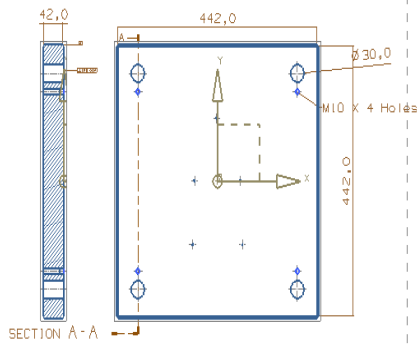
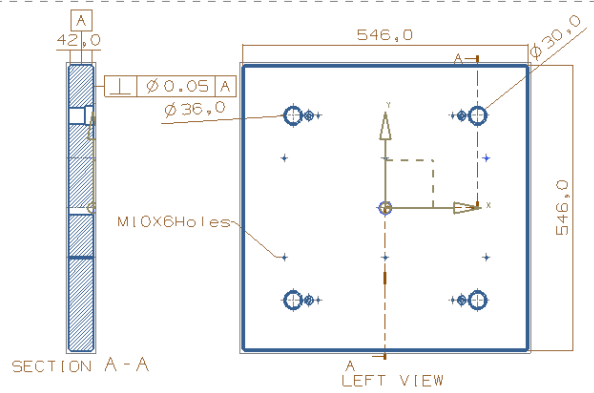
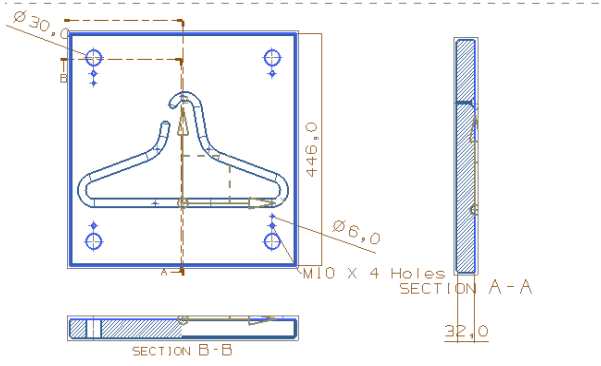
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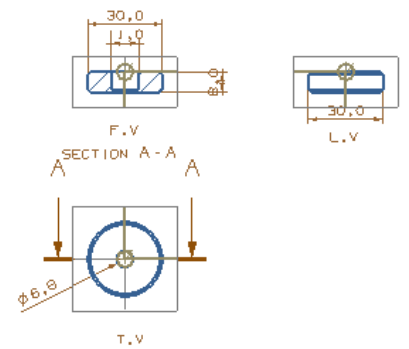
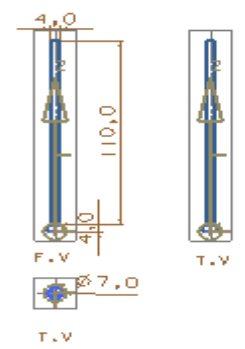
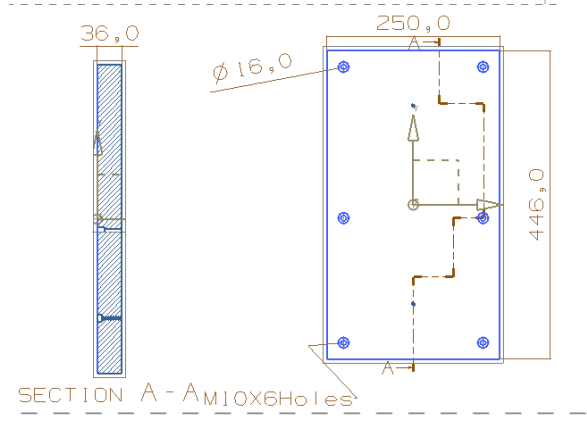
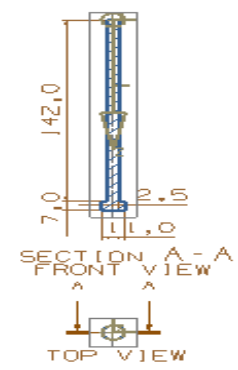
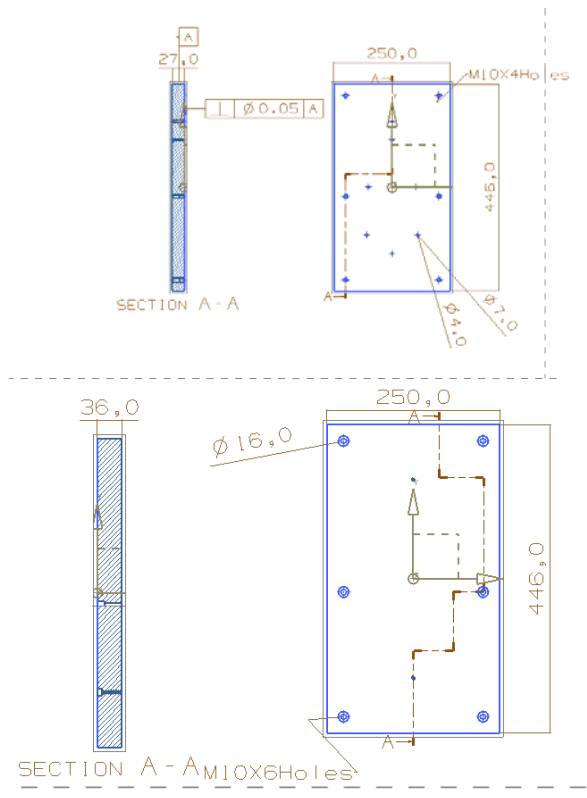
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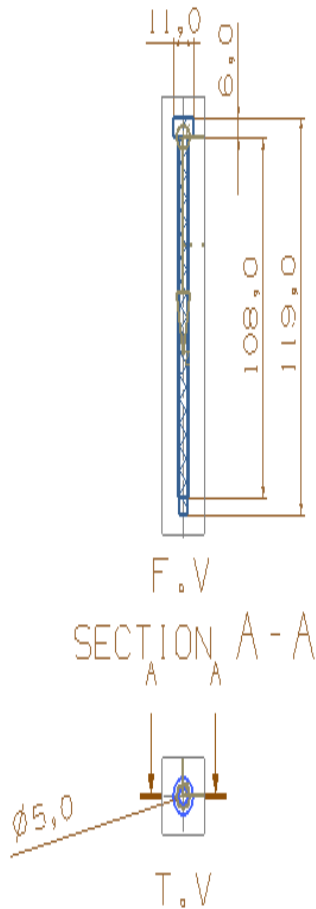
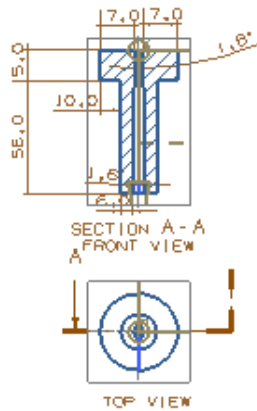
K 10
 K 11
 K 12
 K 13
 K 15
 K 16
 K 20
 K 251
 K 30
 K 40



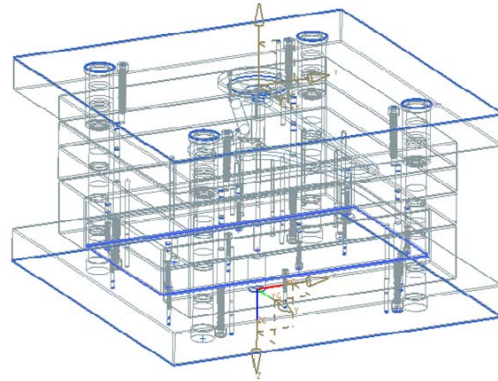




22	DOWEL	STD	02	Ø80	50-60
21	GUIDE BUSH FOR KNOCK OUT	En31	01	Ø28×20	-
20	GUIDE BUSH	En31	04	Ø42×76	60-62
19	CAP SCREW	STD	04	M4×0.75×40	-
18	CAP SCREW	STD	01	M6×1×40	-
17	KNOCKOUT BAR	STD	01	Ø24×120	-
16	SPRUE PULLER	En31	01	Ø6×116	60-62
15	PUSH BACK PIN	En31	02	Ø6×113	60-62
14	EJECTOR PIN	En31	05	Ø4×109	60-62
13	REST BUTTON	En8	06	Ø30×08	48-52
12	CAP SCREW	STD	04	M10×1.5×75	-
11	EJECTOR PLATE	M.S	01	496×250×36	-
10	RETAINER PALTE	En31	01	496×250×27	48-52
09	BACK PLATE	M.S	01	546×546×46	-
08	SPACER	M.S	02	496×46	-
07	CORE BACK PLATE	M.S	01	496×496×46	-
06	CORE PLATE	H13	01	496×496×36	50-54
05	GUIDE PILLER	En31	04		60-62
04	CAVITY PLATE	H13	01	496×496×36	50-54
03	FRONT PLATE	M.S	01	546×546×46	-
02	SPRUE BUSH	En31	01	Ø38×82	60-62
01	LOCATING RING	M.S	01	Ø120×15	-
PA RT NO	DESCRIPTI ON	MATE RIAL	QTY	FINIS H SIZE	HRC



Final Assembly Drawing



Bill of Material

VI PROCESS PLANNING AND DETAILS: -

As work piece quantities and costs in mould are usually high, considerable economy can be affected by choosing an appropriate sequence of operations and the right type of tooling. The process plan should take into account the total cost: material, tooling, labor (time). Process planning generally includes the following considerations.

- Quantity required – total and annual,
- Work piece – shape and size,
- Work piece – dimensional tolerances,
- Work piece – material limitations,
- Equipment available for manufacturing.

In every tool, the process planning done a vital role and it is followed by above mentioned points. To manufacture the parts of the tool, it is necessary to follow the proper methodology of manufacturing, so that one can get accurate dimensional stability for that particular part within appropriate time.

In Mould also all the parts of the tool are manufactured by considering all above mentioned sequence and choosing of machining sequence. Below mentioned sheet expresses all the view of machining sequence of the tool. Similarly, all the parts of the tool are manufactured by the same followed suit.

1) Design stage: -

After designing the tool prepared the individual part drawings for manufacturing the parts & assembly drawing.

Then print out are taken & filled them in process planning.

2) Manufacturing stages:

After getting the part drawings material requisition is raised to the store department. Then raw material is cut according to make drawing size with suitable allowances in size. Then pre-

machining is done according to size with grinding allowances in size.

After maintaining the dimensions & references bench work is completed on the plates, like drilling, tapping.

3) Precise operations: -

In the mould tool the accuracy depends upon the size of the core & cavity. So a lot of concentration is made on manufacturing of core & cavity. The core & cavity size manufactured within the required tolerances & maintaining their clearances.

4) Heat treatment: -

In heat treatment stage we have to plan for sequence of component to be heat-treated this is important because according to this sequence we have to manufacture component.

5) Assembly stage: -

As we order for mould base to vendors, only mfg. Of insert and other component is to plan for proper flow.

6.1 MANUFACTURING PROCESSES

PLANNING: -

- All the features of the part with dimensions & their references with respect to the assembly.
- The part is studied and the plans for sequence of process like conventional, non-conventional & CNC machining, heat treatment in process & stage inspection etc.
- Special requirements for the tooling, electrode, and CAD/CAM support for the programs required for the Core & Cavity inserts that are to be machined on the CNC machines etc. are planned in advance to meet the process flow & to maintain the delivery schedule.
- Stage drawings of each parts coming & going out from process are made for the convenience of the machine operator showing the references, tolerance analysis, manufacturing allowances using the ordinate dimensioning and inspection methodology.
- A continuous follow up for the machine availability is made for the completion of the job in the planned time period to maintain the delivery date.
- The above information is applied for all processes related to the part indicating earliest start & finish date of each process with respect to material planning, date of availability of special tooling, electrode, CAD/CAM data, monthly priority list etc. The start & finish date can be taken from the job cards the earliest finish date of assembly can be analyzed for the first trial and

is communicated to all the interface departments about planning and their support.

6.2 MANUFACTURING PROCESSES PLANNING FOR EACH PART

➤ All the features of the part with dimensions & their references with respect to the assembly.

The part is studied and the plans for sequence of process like conventional, non-conventional & CNC machining, heat treatment in process & stage inspection etc.

➤ Special requirements for the tooling, electrode, and CAD/CAM support for the programs required for the Core & Cavity inserts that are to be machined on the CNC machines etc. are planned in advance to meet the process flow & to maintain the delivery schedule.

➤ Stage drawings of each parts coming & going out from process are made for the convenience of the machine operator showing the references, tolerance analysis, manufacturing allowances using the ordinate dimensioning and inspection methodology.

➤ A continuous follow up for the machine availability is made for the completion of the job in the planned time period to maintain the delivery date.

The above information is applied for all processes related to the part indicating earliest start & finish date of each process with respect to material planning, date of availability of special tooling, electrode, CAD/CAM data, monthly priority list etc. The start & finish date can be taken from the job cards the earliest finish date of assembly can be analyzed for the first trial and is communicated to all the interface departments about planning and their support.

VII CONCLUSION

A complete mould designer must have a thorough knowledge of the principles of the mould making as the design of the various parts of the mold depends on the technique adopted for its manufacturer. Case studies of the various mould of same kind have been conducted prior to the design process. Proper evaluation of the previous designs was performed and created something even better instead of simply keeping to what was done previously. The various demands of the customer were considered while designing of the tool. The final mould design is prepared after the part design has been specified and all requirements affecting the design of mould have been clarified. The outcome is a near perfect design and the trial made on the mould just about confirms it.

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