Design of Multi-Cavity Injection Mold for Tensile and Flexural Test Specimens

by

Kum Chee Mun

Dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Engineering (Hons)
(Mechanical Engineering)

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
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UNIVERSITI TEKNOLOGI PETRONAS

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January 2008

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

KUM CHEE MUN

ABSTRACT

The purpose of this project is to design a multi cavity mold allows me an opportunity to learn about the mold and the injection molding process. With the increasing number of students in Universiti Teknologi PETRONAS that utilize the materials laboratory and using the ISO 3167 molded sample for multi purpose testing and with the existing design which can be further utilized to produce more specimens for learning purposes has lead to the design of the new mold. Gathering of information need to be done on the current and with research on mold design, the new mold is redesigned with the use of design software CATIA. The design of the new mold consists of new parts for the multicavity mold and existing design and parts of the current mold. Components are reutilized so that fewer new components are needed. The design of the mold follows closely with the design guidelines and existing design such as runner design and mold plate thickness allows the mold to be designed within the parameters. In the new mold design, new parts that were redesigned are the core plate, cavity plate and the ejector plates. Existing components such as ejector pins and springs were redesigned to fit into the new two cavity mold. Other components such as the rise bars, setting plate are reuse to fit into the new design.

ACKNOWLEDGEMENT

I would like thank my Final Year Project theses supervisor, Dr Azmi Abdul Wahab for his guidance and help in completing this project. I would like to thank him for his support throughout the project timeline. I would also like to thank the UTP laboratory technicians for their help in gathering information and data about the injection molding machine and the mold. I would like thank my parents for their unconditional support and prayers towards the duration of this project. Lastly, I would like to thanks my fellow friends for supporting and assisting me in completing this dissertation.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

The materials laboratory in Universiti Teknologi PETRONAS have an injection molding machine that is capable of producing one sample of ISO standard ISO 3167 "ISO Multipurpose Test Specimen" per molding cycle. The type of injection molding machine that is used in the materials laboratory is Tat Ming Mechatronic ME20III which has a tonnage of 20 tons. The molding temperature used is 210°C and the existing mold is a two-plate mold. The materials that are used to mold the tensile test samples are Polyethylene (PE), Polypropylene (PP) and High-Density Polyethylene (HDPE). The mold in the laboratory is a cold runner mold in which the runner is cooled, solidified and ejected with mold part during each molding cycle.

1.2 PROBLEM STATEMENT

In UTP, there's only an injection molding machine which is the Tat Ming Mechatronic ME20III which has a tonnage of 20 tons. The injection molding machine is one of the highly utilized equipment in the materials lab and used to produce the ASTM standard samples for tensile and bending tests. The current mold can only mold one sample in a molding cycle. This is due to the mold having only one cavity and currently more sample are needed for stress and bending tests.

1.3 OBJECTIVE

The objective of this project is to design a multi-cavity mold to double the output of each molding cycle to produce samples for tensile and bending tests. The increased output enables more specimens to be produced within a molding cycle to cater to the additional requirements of specimens for tensile and stress tests.

1.4 SCOPE OF STUDY

The scope of study of this project is to design a multi-cavity mold that can produce both dogbone tensile test samples and bending test samples. The cavities were designed in the way that some existing parts can be shared and reused in the new mold. This design will be more economical and will save fabrication time of the new mold cavity. The specimen produced is in accordance to ISO 3167 for tensile and bending tests shown in Figure 1.1.

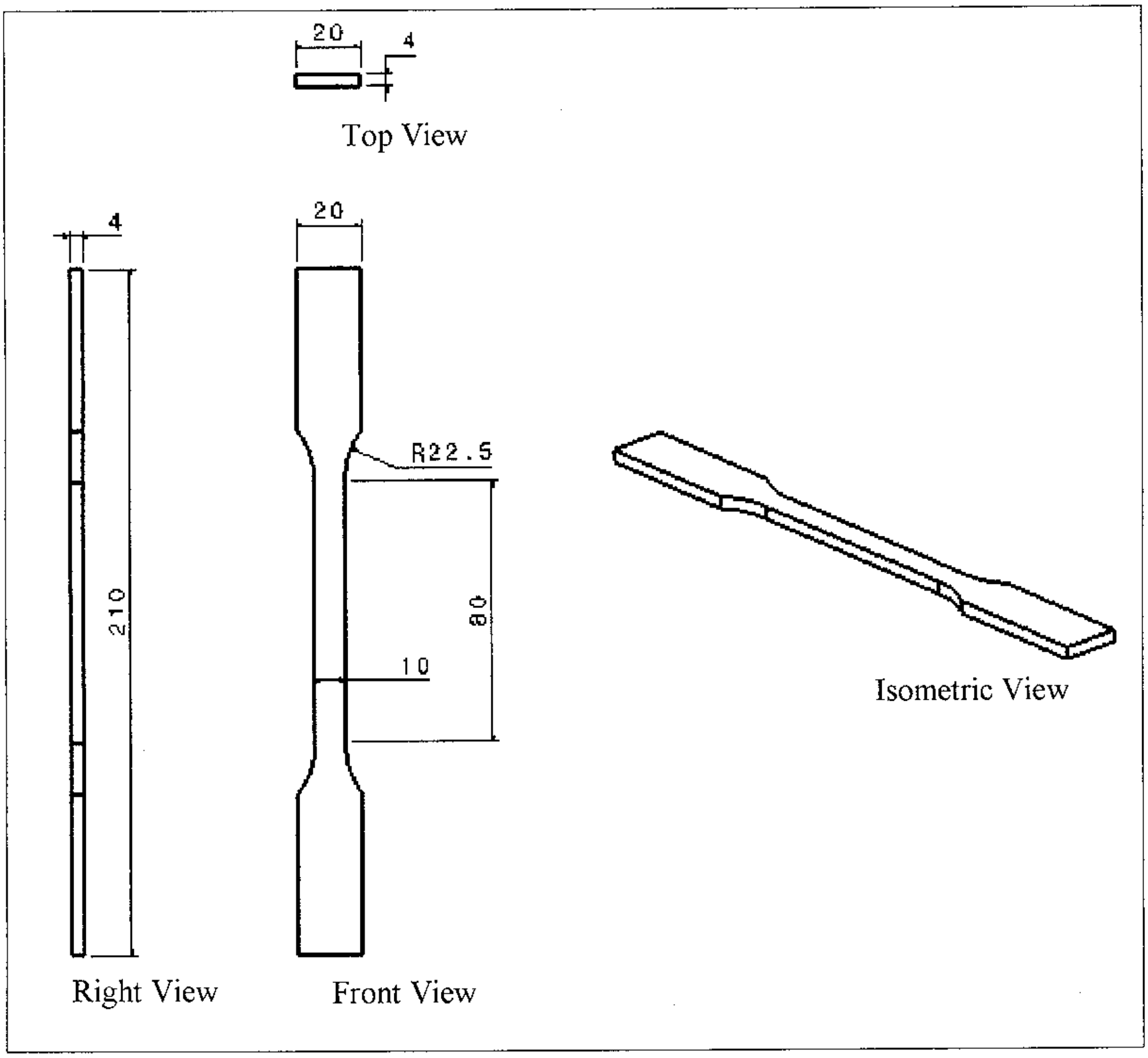


Figure 1.1 : ISO 3167 Test Specimen

CHAPTER 2

LITERATURE REVIEW

2.1 ISO TEST SAMPLE

The ISO test sample specified in Plastic Technology Laboratories Incorporation website [1] shows that ISO standard specimens allows for multipurpose test such as Tensile, Flexural, Izod and Heat Deflection Temperature (HDT). Therefore with this ISO specimen dimensions, one test sample can run four different tests. Table 1.1 shows the specifications of the tensile specimen used in the design of the new multi cavity mold.

Table 1.1: Tensile Specimen Specifications

Specimen Dimensions (mm)	ISO Tensile Properties
Overall Length (min)	150
Length of Narrow Section	80±2
Radius (tab to gage)	20-25
Overall Width	20±0.2
Width of narrow section	10±0.2
Preferred Thickness	4±0.2
Gauge Length	50±0.5
Preferred Specimen Type	Type 1A (ISO 3167)

2.2 INJECTION MOLDING

Injection molding is a cyclic process of forming resins into desired shape by means of an injection molding machine and mold. The injection molding process of thermoplastic material consists of three main stages: [5]

(1) injection or filling

(2) cooling and

(3) ejection

In the first stage of the cycle, the material in molten state flows through the mold passages and subject to rapid cooling. The polymer melts then solidifies under holding pressure of the injection system. After a period of cooling time, the mold is opened, the molded part is ejected and the machine reset for the next cycle to begin.

An injection mold is an assembly of platens and molding plates typically made of tool steel. The mold shapes the plastics inside the mold cavity and ejects the molded part. The stationary platen is attached to the barrel side of the machine and is connected to the moving platen by tie bars as shown in Figure 2.1. The cavity plate is generally mounted on the stationary plate that houses the injection nozzle. The core plate moves with the movable platen which is guided by the tie bars. There are two types of mold; a two-plate mold and a three-plate mold. Majority of molds consist of two halves where the mold is used for parts that are typically gated on or around the edge with the runner in the same mold plate as the cavity. The three-plate mold is typically used for parts that are gated away from their edge. The runner is in two plates, separated for the core and cavity.

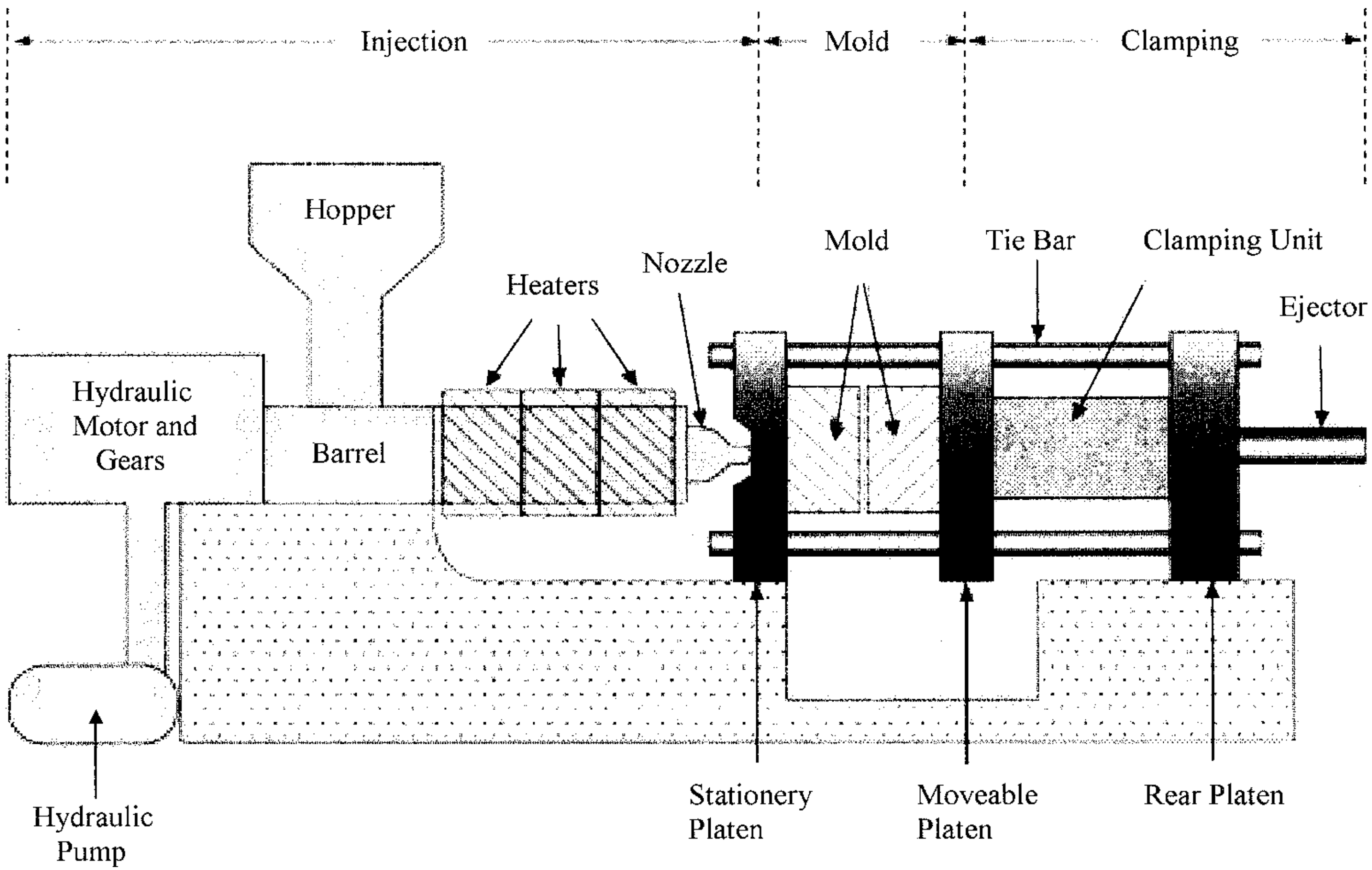


Figure 2.1: Injection Molding System [6]

2.3 MAIN COMPONENTS OF INJECTION MOLDING MACHINE

An injection molding machines is composed of the following components and their functions. (Refer to Figure 2.1)

(1) Plasticizing Unit

This unit is used for melting down the predetermined quantity of solid resin into fluidity.

(2) Injection Unit

This unit is used for injection melted resin into the mold cavity quickly through a nozzle.

(3) Mold clamping unit

This unit is used for opening and closing the mold. It exerts a strong clamping force when the mold is filled with resin under pressure to keep the mold close against its inside pressure.

(4) Power unit

This unit generates hydraulic power or pneumatic power to open and close the mold.

(5) Control unit

The unit controls the operations of the injection mold according to he predetermined program.

2.4 MOLD BASE COMPONENTS

The mold base of the injection molding machine consists of these components:

(1) Sprue Bushing

The sprue bushing in an injection mold is the component that allows molten plastic to enter the mold and begin its travel to the cavity image.

(2) Core and Cavity Plates

The core and cavity plates are the components that form the molded part. It is the parting line when the mold open and close.

(3) Runners and Gates

When the molten plastic are injected into the mold, it enters through the sprue bushing, it must be directed through the runner system and gates to the cavity image to form the finished part. The runner is like a pathway into the face of the mold base. The gate is located at the end of the runner system which is designed to allow molten plastic to enter the cavity at proper velocity and volume needed to fill the cavity in a controlled condition.

(4) Cavity Image

The cavity image is the shape of the final molded product that is to be produced when molten resin flows into the core and cavity plates.

(5) Ejector Pins

Ejector pins are used to push or eject the finished product out of the mold at the end of the injection molding cycle.

2.5 DESIGN CONSIDERATIONS

There are measures to be taken in designing the multi cavity mold. Though it is a 2 cavity mold, most of the original mold design and components are retained.

2.5.1 Mold Material

The mold material that is used to produce the mold is carbon steel which can be used for mold base, ejector housing and clamp plate. Carbon steel can be easily machined to the size wanted.

2.5.2 Parting location

The distance from the center point of one specimen to the other is 50mm. The location either in lines or surfaces at which the core and cavity components interface on mold closure is referred at the parting. The parting location on the molded component is determined by the complexity of the core and cavity interface [2].

The parting design is an important design step in mold design. The parting lines and surface should include undercut features. In this design, the test specimen is flat and there are no undercut in the design so no side cores or side cavities are needed. The parting line of the test specimen can be set at the front surface of the specimen. This is because the surface of the specimen is flat. This can avoid fabrication of the cavity for the specimen other than the runner.

2.5.3 Gate Positioning Considerations

Gate positioning is important for the melted resin to reach mold cavity with the desired runner system or mold type. A gating location on the perimeter of the mold cavity can be fed by in a two plate cold runner system that is being used in the existing system. The type of gate that is used is also important to ensure the material that is used able to fill up the entire mold cavity smoothly.

2.5.4 Product surface finish

Universiti Teknologi PETRONAS, the existing mold is used for laboratory testing. A high quality surface finish is usually not necessary.

2.5.5 Ejector Method and Location

Although this is a new mold design, the ejector components sizes are the same as the existing one. The location of the ejector pins will be redesigned to accommodate the two cavity mold.

2.5.6 Location of Cavities and Cooling Channels

The two-cavity location will be redesigned to accommodate the mold size as of the existing mold size. It is best to place the cavities as close to the center of the mold as it maximizes the flow of the thermoplastic into the mold and minimizes wastage of materials due to extra length of the runner. The cooling channels are placed close to the mold cavities without breaking through the steel and causing leaks to the mold.

2.5.7 Venting

Air will be compressed when plastic is injected, so to eliminate trapped air in the mold, venting is required. The faster trapped air is eliminated, the easier and quicker the plastic can enter.

2.5.8 Runner design

The runner design should be able to provide balanced flow to all cavities in the mold and maximize the efficiency of the flow channel. The cross section should be large enough for mold pressure to fill the runner not excessive and also small enough to reduce waste and cooling time.

2.6 DESIGN GUIDELINES [8]

2.6.1 Consistent Wall Thickness

The wall of the plastic sample must be uniform in thickness. This is the basic design parameter which will eliminate many manufacturing problems. Parts with uniform walls will fill properly and will fit together because variable shrinkage is minimized. Wall thickness variations should not exceed 10% in high mold shrinkage plastics because even this slight difference can introduce processing and quality problems.

2.6.2 Proper Gate Location

If varying wall thickness cannot be avoided, a mold design should have a proper gate location. If this is not supplied, attaining uniform injection of the molded sample will be nearly impossible. The most effective gate location is where the melt enters at the thickest portion of the cavity and then flows to the narrower areas.

2.6.3 Optimal Wall Thickness

This concerns the minimum wall thickness, since thinner specimens are less expensive. Two factors contribute to this: first, thinner parts require less raw plastic material and second, they cool faster. To determine the most suitable wall thickness, the product requirement has to be determined. Generally, strength dictates the wall thickness.

2.6.4 Radius Corners

During injection molding, the molten plastic has to flow through turns or corners. Rounded corners will ease plastic flow, so the corners of all components must have a radius. In contrast, sharp inside corners result in stress concentration particularly during the cooling processes when the top of the sample tries to shrink and the material pulls against the corners.

If the inside and outside radii of a sample are equal to half of the nominal wall thickness, a uniform wall around the corner can be achieved. Both sides of the corner will display equal amounts of shrinkage, and sink marks will be averted entirely. As the plastic goes around a well-proportioned corner, it will not be subjected to increases in area and sudden changes in direction. Cavity packing pressure stays consistent. This leads to a strong, dimensionally stable corner that will resist warpage in molded parts.

2.6.5 Draft Angles

Draft angles are needed so that a plastic sample can be released from the mold without distortion or damage. The high pressures of injection molding force the plastic to touch all the surfaces of a mold's cores and cavities. Sometimes, shrinkage will actually make it easier to take the part out of the mold, but in other cases, shrinkage will cause the part to stick to the mold's cores. These problems can be avoided by applying draft angles to the design.

Draft angles must be provided for several part details. For example, the sidewalls that are perpendicular to the mold's parting line must be drafted. Other areas that require draft angles include mounting flanges, gussets, holes, hollow bosses, louvers and other holes.

CHAPTER 3

METHODOLOGY

3.1 PROCESS FLOW

The process flow for creating the multi cavity mold is as following:

1. Identify current mold design and measure mold dimension
2. Recreate mold base design using CATIA design software
3. Design of the mold
4. Design of core plate and cavity plate
5. Design mold gate on the mold
6. Design runner on the mold
7. Design spring and ejector plate component
8. Design cooling channel
9. Inserting other mold components to complete mold

3.2 PRELIMINARY TASKS

The tasks required for designing the mold begins with the identification of new parts to be designed and parts from the existing mold that can be reused. Measurements are then taken on the current mold to obtain the dimensions of the current mold components. Any parts that can be reused within the new mold are identified in order to reduce the costs of the new mold.

3.3 DESIGN STEPS

3.3.1 Measurements and data collection

Measurements are taken on the current mold in the UTP materials laboratory to obtain the dimensions of the components and parts. Measurements are done mainly using a caliper since the drawings of the current mold is not available. Some data about the injection molding machine were referred from the user's manual for the ME20 III Injection Molding Machine.

3.3.2 Mold design

The design of the mold will reuse the same mold base of the existing unit in the UTP laboratory. This will make the design easier since the existing design has been tested and has run smoothly all the while. The design of the multi cavity mold will require components such as the core and cavity plate to be redesigned. The ejector plates, springs and ejector pins are also redesigned to fit in with the new mold design.

3.3.3 Part design

The ISO 3167 test specimen is referred to obtain confirmation of the specimen dimensions. The design of the new multi cavity mold is done by duplicating the existing design. Referring to the existing design of the mold with the sprue, runner and gate, the new design will closely resemble the existing design but the gate location and the runner branching will be different. Gate placement and gate type are used based on the current design. The finished molded part will be incorporated into the core and cavity design so that the mold will be able to produce twice the number of samples.

3.3.4 Ejector plate design

The ejector plates have to be redesigned to fit in with the new multi cavity mold. Additional springs and ejector pins are designed to eject the two cavity mold and have the strength to retract after ejecting the parts. Ejector pins have to be placed on strategic points to eject the sprue, runner and the molded part out after molding.

3.3.5 Cooling channel and venting

The cooling channel of the new mold will reuse the existing design of the mold as the existing design of the mold is able to cool a two-cavity mold. The existing cooling channel has a 'U' shape cooling channel which is can also be used to cool the two-cavity mold, since the cooling water is able to flow through the molded part and also the sprue and runner area. Venting of the molded part is necessary to eliminate air trapped in the molding area. Proper venting will allow melted resins to inject more quickly into the molded area with less injection pressure.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 RESULTS

The design of the new mold that feature new core and cavities are shown in Figure 4.1. It shows the design of the mold test specimen with a new runner design and gate location. Figure 4.2 shows the assembled design of the new two cavity mold designed using CATIA software. Figure 4.3 shows the top view of the core plate with the new design has 8 ejector pins to eject the molded specimens. The venting has the same design as the existing mold in UTP. Figure 4.4 shows the explode view of the entire mold design showing all the mold plates and components such as ejector pins, cap screws, leader pins and also springs.

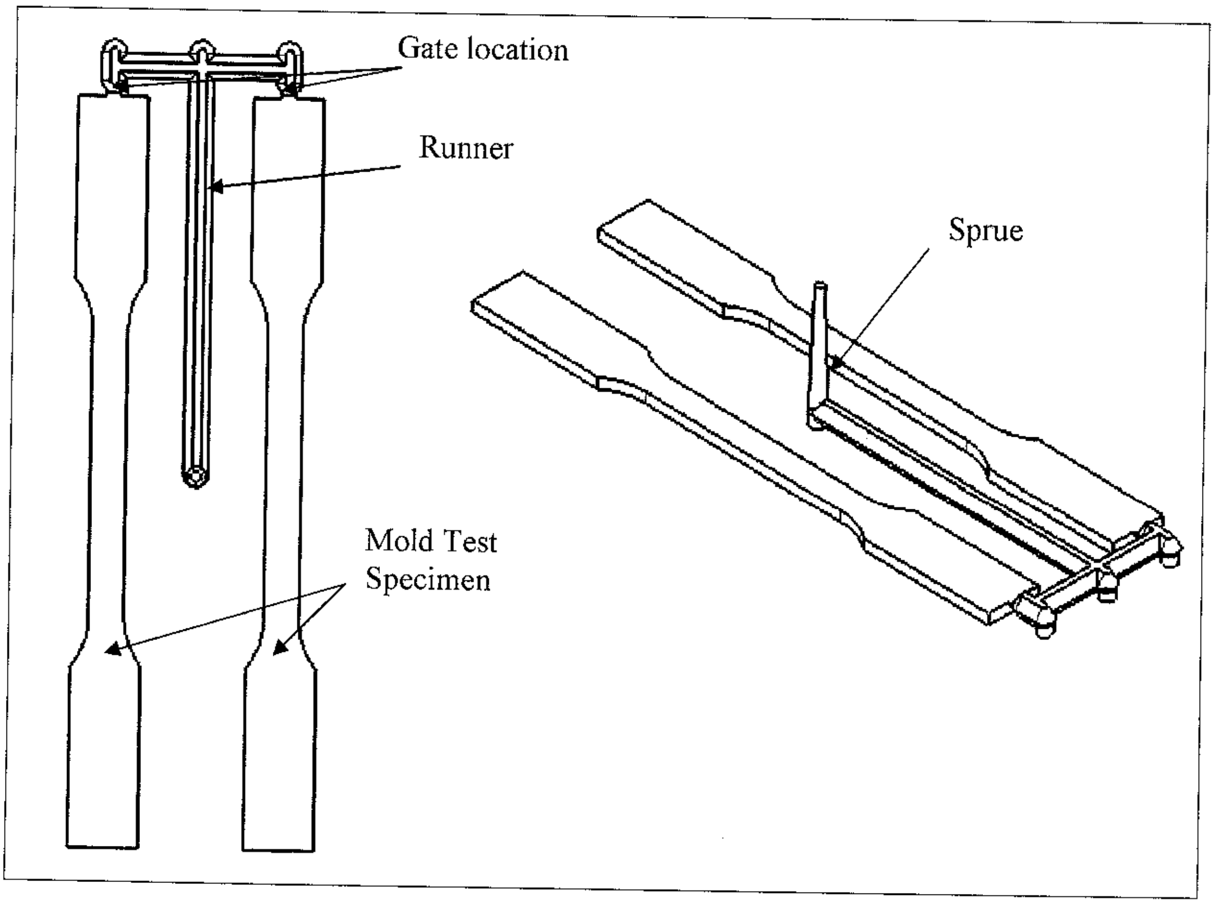


Figure 4.1: Part and cavity design

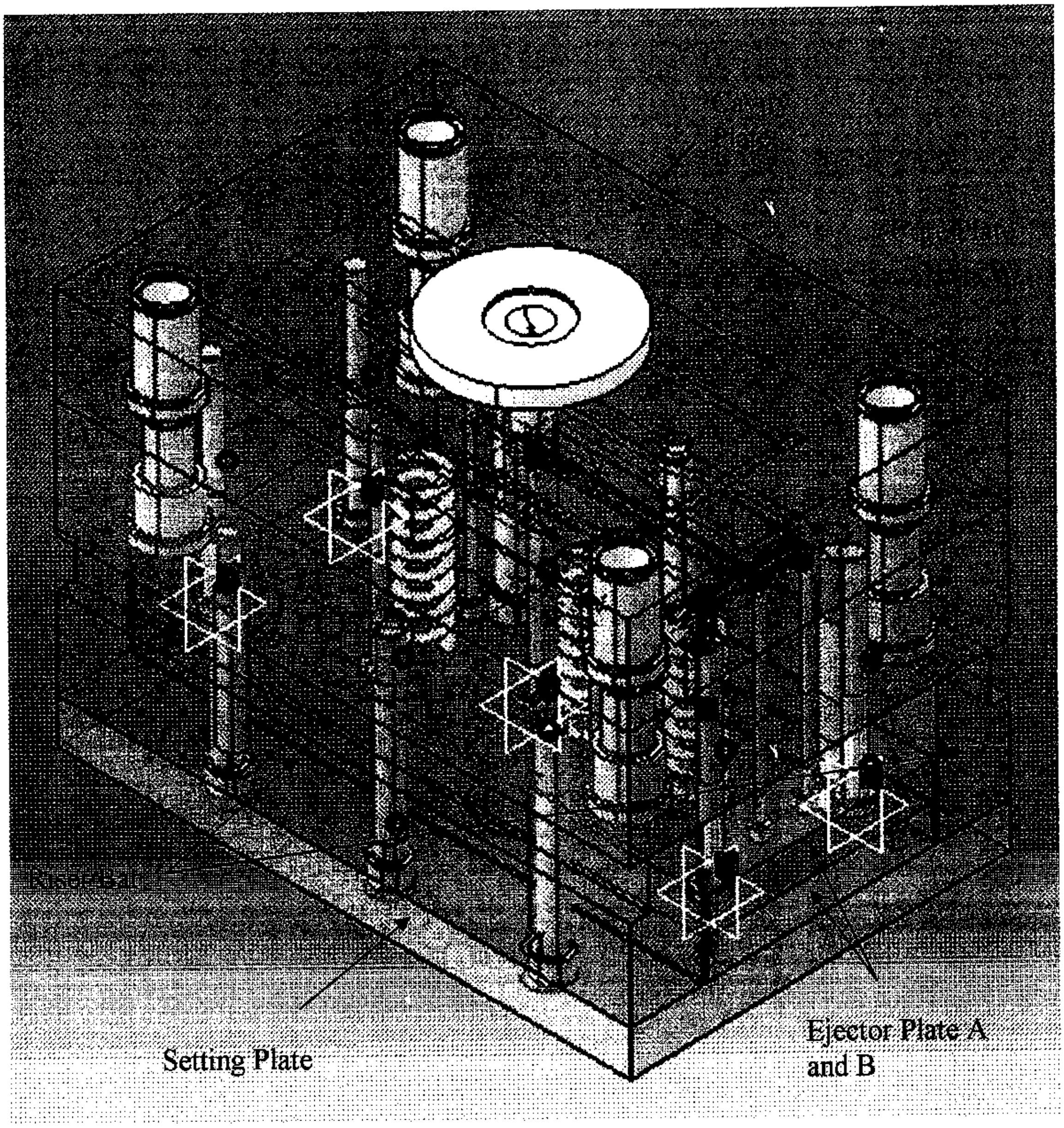


Figure 4.2: Mold Design using Catia design software

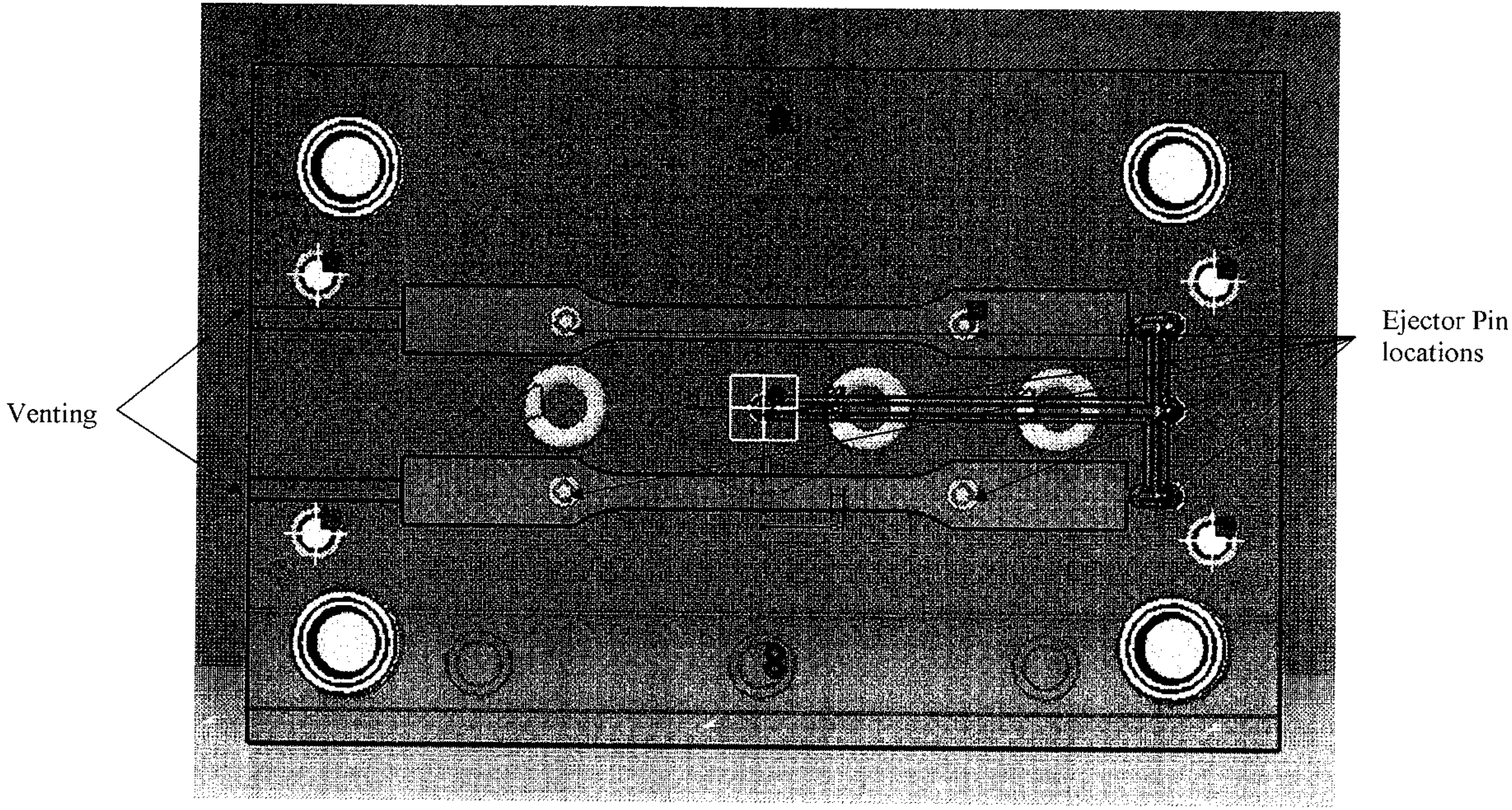


Figure 4.3: Ejector Pins location on the molded part and the venting of the molded part

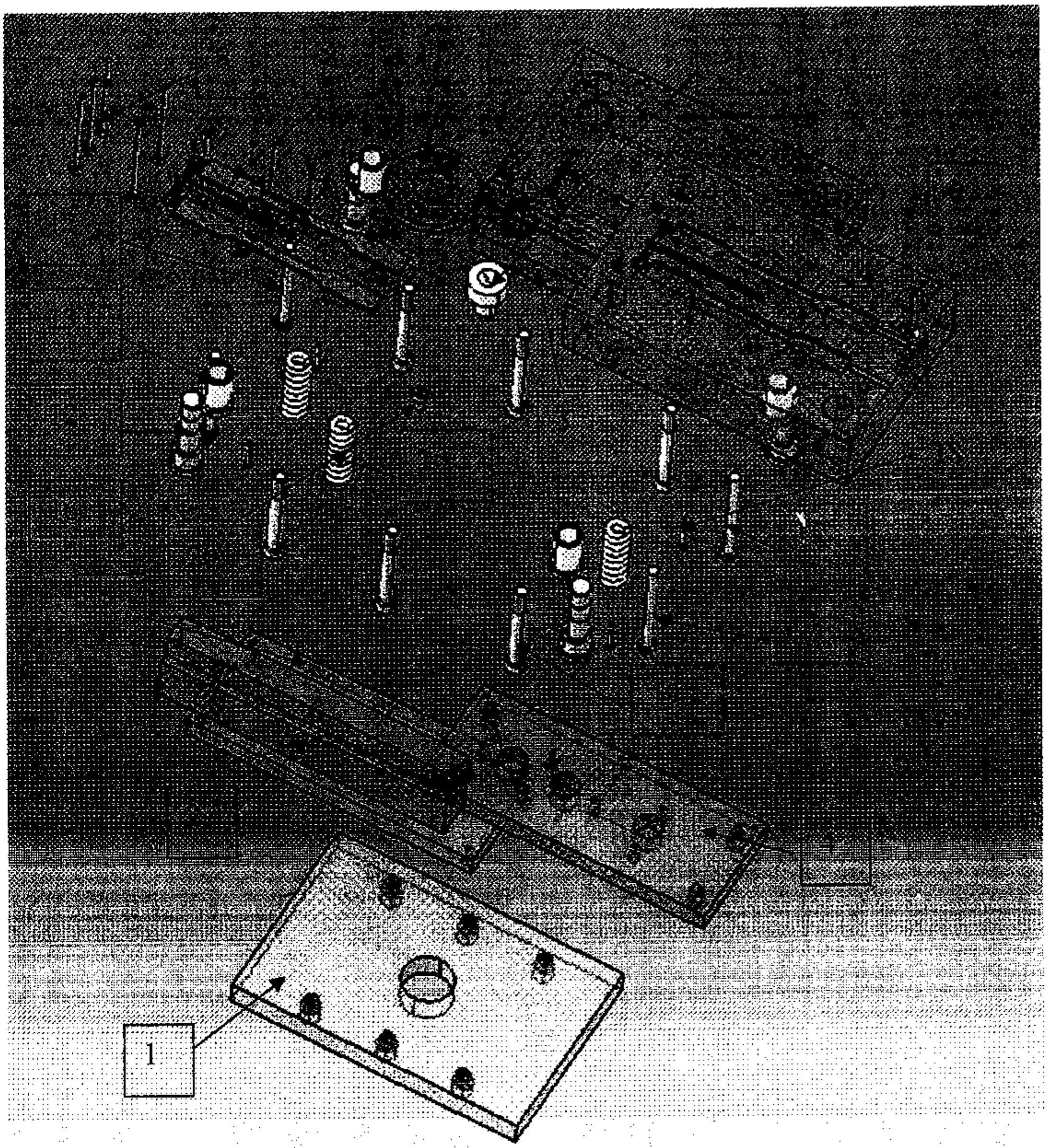


Figure 4.3: Exploded view of the mold design (Refer to Appendix Table A1 for name of components)

4.2 DISCUSSION

From the design of the mold, it is known that there are twenty one components designed and assembled into a mold. Components such as setting plate, riser bar 1 and 2 are the same as the existing mold in UTP. Other parts such as ejector plate A and B, core and cavity plate are redesigned into a multi cavity mold. Other 'off-the-shelf' components in the design are cap screws, leader pins, bushings, ejector pins, sprue bushings. These components can be bought so the parts are not being redesigned for this new mold.

The new mold reuses many existing components such as the setting plate, riser bars, locating ring, sprue bushing, leader pin, spring and also screws. Only a few new components such as the core and cavity plate and ejector plate incorporated into the design. The mold also has additional springs and ejector pins to support the two cavity mold. The mold base dimensions of the original design are able to support a multi cavity design which enables many reusable components such as venting and cooling channel. The existing single cavity design is on the right of the mold but the cooling channels surrounds the entire mold thus enables the new multi cavity mold to reuse the same cooling channel design. The venting design is also the same as the existing design. The screws, leader pin and bushing reuse much of the original mold components due to the same mold size being different only in the core and cavity with the ejectors plates.

4.2.1 Mold Material [8]

Materials used for molds must satisfy requirements where they must withstand forces and pressures developed during the molding process, have good wear resistance, possess good heat transfer and machineability. Different components from the same mold are produced from different steels. Table 4.1 shows the steel type, their applications and properties for the components of the mold. Different components within the mold are produced from different steels. The mold frame can be made out of less specialized steels because it needs only to have good strength and machinability. The more expensive component will have higher durability and will less likely need replacement. Steel with high thermal conductivity helps to reduce cycle time and provide uniform cooling.

Table 4.1: Mold Steels, Applications and Properties [8]

Steel Type	AISI Designation	Hardness (Rockwell C)	Thermal Conductivity [W/(m°C)]	Common Applications
Prehardened	P-20	30-36	29	Mold Plates
Stainless	420SS	50-52	23	Cavities and cores
Air Hardened	H-13	50-52	24.6	Cavities and cores, gate inserts, ejector pins, return pins and leader pins

4.2.2 Deflection of Core Plates

The core plate on the injector half of the mold must resist the forces developed from clamping and from injection pressures. The core plate is susceptible to deflection because it is suspended on the open space of the ejector housing. The core plate must be sufficiently thick and rigidly supported by riser bars to resist deflection. The calculation below are used to determine the thickness of the core plate needed to resist deflection in excess of 0.005mm. The assumption is that there are no support pillars, the two slides of the plate are fully constrained and there is distributed load of 20 metric tons (20,000kg) based on the injection machine clamping force of 20 metric tons. The clamp should be at maximum load to deflect the plates. The modulus of elasticity (*E*) of the support plate steel is 207Gpa.

With the loading case, the plate deflection (y) can be determined as follows.

$$y = \frac{Fl^3}{384EI}$$

$$I = \frac{bd^3}{12}$$

$$y = \frac{Fl^3 12}{384E(bd^3)}$$

where d = plate thickness

b = plate width

l = plate length = 200mm – 38mm – 38mm

= 124mm

E = modulus of elasticity = 207GPa = 207GN/m^2

F = loading force

From the equation, the required plate thickness can be found by manipulating the equation to solve for d (plate thickness)

$$d = \sqrt[3]{\frac{Fl^3 12}{384Eby}}$$

$$d = \sqrt[3]{\frac{(20{,}000 \times 9.81N)(124 \times 10^{-3} m)^3 (12)}{(384)(207 \times 10^9 N/m^2)(300 \times 10^{-3} m)(5 \times 10^{-6} m)}}$$

$$d = 0.0335m$$

From the calculation, it is known that the required plate thickness to maintain a deflection of 0.005mm is 0.0335m (33.5mm). This will not have any deflection as the design of the core plate is 60mm that is thick enough to withstand the clamping force and injection pressure.

4.2.3 Cold Runner Design

Runners are used to deliver the melt from the injection nozzle through the mold to the cavities. Although the ideal runner will have a full round cross section since it has the lowest ratio of surface area to cross sectional area, the two halves of the mold must be machined with a half round channel that must match when the mold is closed to obtain the full round channel. It also requires an alignment to within 0.05mm to avoid related misalignment problems. Thus the design here is the trapezoidal runner which requires being machined in only one half of the mold. This trapezoidal design is also less costly than the circular design.

4.2.4 Runner Balancing

It is an important objective of a runner in a multicavity mold to deliver identical melt conditions to each of the cavities in the mold. The two cavity mold that is designed has geometrically balanced runners where all the runner branches are the same length with symmetrical cross sectional shapes. With this two cavity design the flow will be identical due to the identical shape and length of the runner.

4.2.5 Vent Design

The vents at the perimeter of the cavity must be shallow enough for the air to escape but not the molten plastic material. This type of materials that is use in this mold are crystalline materials such as polypropylene (PP) and polyethylene (PE) so the depth of the vent is commonly set at 0.015mm [7]. The length of 6.5cm which is from the top perimeter of the molded part to the top end of the core plate on the design with the depth of 0.015mm is similar to the existing mold design. The venting is situated at the top of the molded part which allows air to be relieved while the mold cavity is filled with molten plastic.

CHAPTER 5

CONCLUSION

5.1 CONCLUSION

In the design stage of the project, there were many information and considerations to be made in order to create a good design in terms of size, space, cost, quality, moldability and the fabrication of the mold. Ability to handle and fully utilize software such as CATIA helps to create a better design, while evaluations and analyses of the design using this software helps rectify weaknesses and improve the design. In this study, parts were designed singularly and assembled into a mold. Certain parts of the mold were created using the template that is available in the software such as screws, ejector pins, bushing, leader pin and also locating ring. Improvements can be made by optimizing the design of the mold through better gate location, sprue design and also venting to enhance the molded resin to flow into the mold and create a good part. Though the mold is not for high production, improvements can be made so that more material types can be use to produce the specimens. It may also possible to create more than a two cavity mold for use in Universti Teknologi PETRONAS to accommodate more students in the future.

5.2 RECOMMENDATIONS

With the design of the new mold, simulation of the molding process should be done to obtain molding feasibility analysis. Filling analysis can be done to check usefulness of the design. With molding simulation, process parameters can be adjusted to produce good specimens. Stress analysis on components and assemblies can also be done on the design via Finite Element Analyses.

REFERENCES

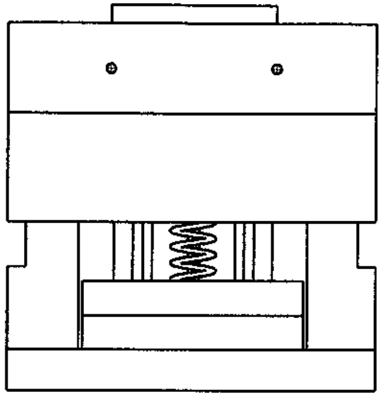
1. Plastic Technology Laboratories, Inc, 2007 <http://www.ptli.com/speakiso.asp>
2. J.Y.H. Fuh, Y.F. Zhang, A.Y.C Nee, M.W. Fu, 2004, *Computer-Aided Injection Mold Design and Manufacture,* New York, Marcel Dekker, Inc
3. Robert A. Malloy, 1994, *Plastic Part Design for Injection Molding: An Introduction,* Cincinnati, Gardner Publications, Inc
4. Catia V5R14 Software
5. John P. Beaumont, *Runner and Gating Design Handbook: Tools for Successful Injection Molding*, Hanser Publishers
6. The Chemical Engineers' Resource Page http://www.cheresources.com/injectionzz.shtml
7. Osswald, Turng, Gramann, 2001, *Injection Molding Handbook,* Hanser Publishers
8. Efunda Engineering Fundamentals, 2008 <http://www.efunda.com/DesignStandards/plastic_design/plastic_intro.cfm>

APPENDIX

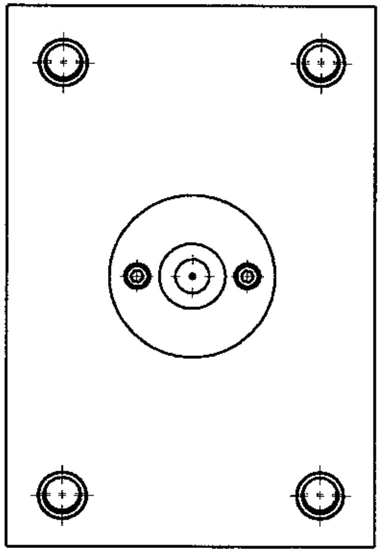
Table A1: Bill of material for mold components (refer to Figure 4.4)

Item No.	Quantity	Part Number	Drawing No.	Nomenclature	Comment
1	1	Setting Plate	SP001		Same as existing design
2	1	Riser Bar 1	RB101		Same as existing design
3	1	Riser Bar2	RB201		Same as existing design
4	1	Ejector Plate A	EP101		
5	1	Ejector Plate B	EP201		
6	1	Core Plate	CO001		
7	1	Cavity Plate	CA001		
8	1	MoldedPart	MP001		
9	1	Ejector Pin Assembly	EA001		
10	3	Spring_DFR_2	N/A	DFR25-77	Same as existing design
11	1	LocatingRing_Fw80(2)_2	N/A	Fw80/90x10	Same as existing design
12	4	LeaderPin_FSN_1	N/A	FSN-20-26-66	Same as existing design
13	4	Bushing_Fw20_3	N/A	Fw20/46x20	Same as existing design
14	1	Ejector Pin 10 x 112a	EP001		
15	1	Ejector Pin 10 x 112b	EP001		
16	1	Ejector Pin 10 x 112c	EP001		
17	1	Ejector Pin 10 x 112d	EP001		
18	4	CapScrew_M_20	N/A	M4*30	Reuse existing components
19	6	CapScrew_M_21	N/A	M12*100	Reuse existing components
20	2	CapScrew_M_24	N/A	M8*16	Reuse existing components
21	1	SprueBushing_Fw31-with radius_2	N/A	Fw31/18x36/3/16	Same as existing design

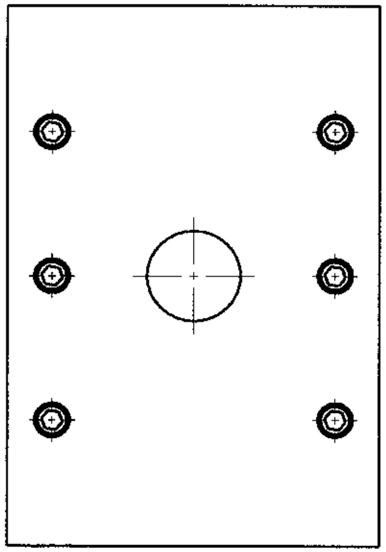
Mold components such as capscrew, ejector pin, spring, locating ring, bushing and leader pin in this design follow closely with the existing mold in the laboratory and thus the design of this new mold reuse existing components with new design.



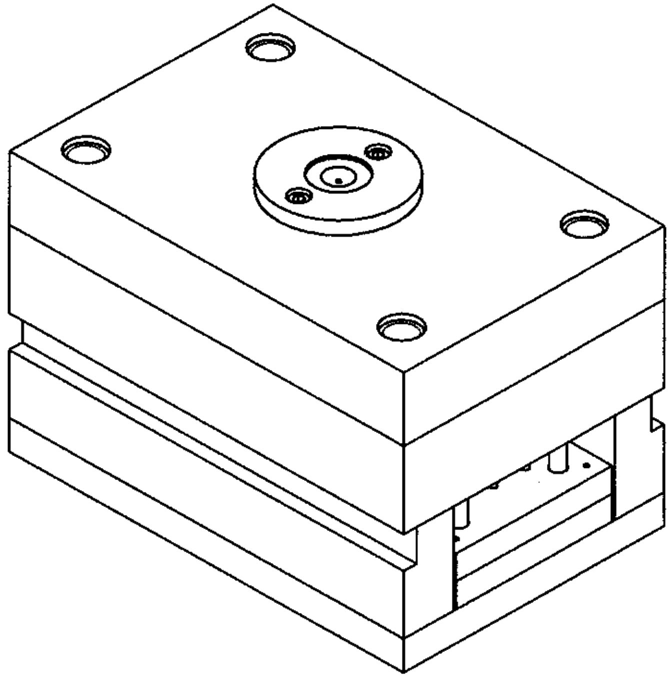
Bottom view



Front view



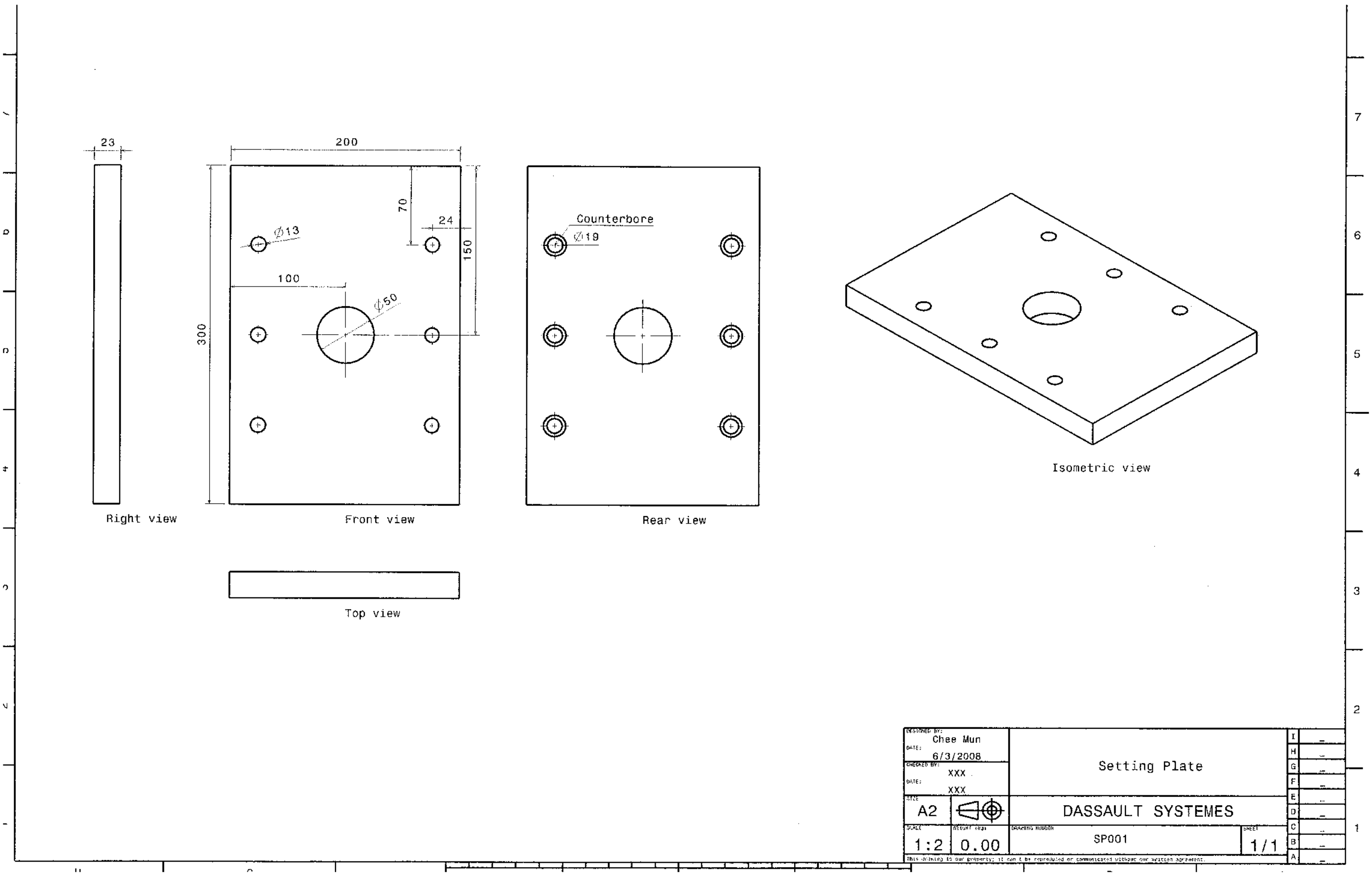
Rear view



Isometric view

DESIGNED BY: Chee Mun DATE: 6/4/2008	Mold Assembly		
CHECKED BY: XXX DATE: XXX			
SIZE A2		DASSAULT SYSTEMES	
SCALE 1:2	WEIGHT (kg) 0.00	DRAWING NUMBER N/A	SHEET 1/1

I	_
H	_
G	_
F	_
E	_
D	_
C	_
B	_
A	_



23
200
300
70
24
150
100
Ø13
Ø50
Counterbore
Ø19
Right view
Front view
Rear view
Top view
Isometric view
DESIGNED BY: Chee Mun
DATE: 6/3/2008
CHECKED BY: XXX
DATE: XXX
SIZE A2
SCALE 1:2
WEIGHT (kg) 0.00
Setting Plate
DASSAULT SYSTEMES
DRAWING NUMBER SP001
SHEET 1/1
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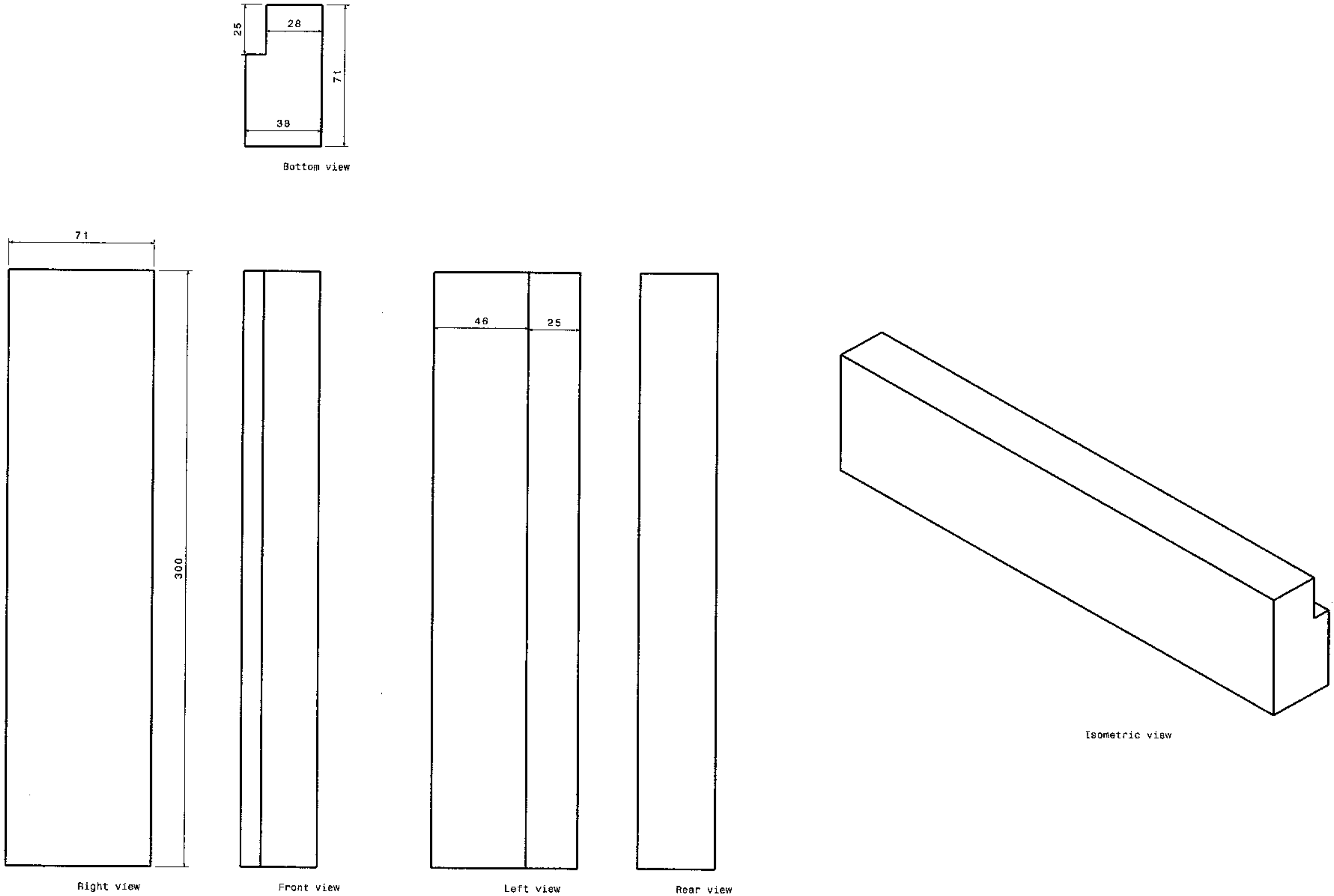
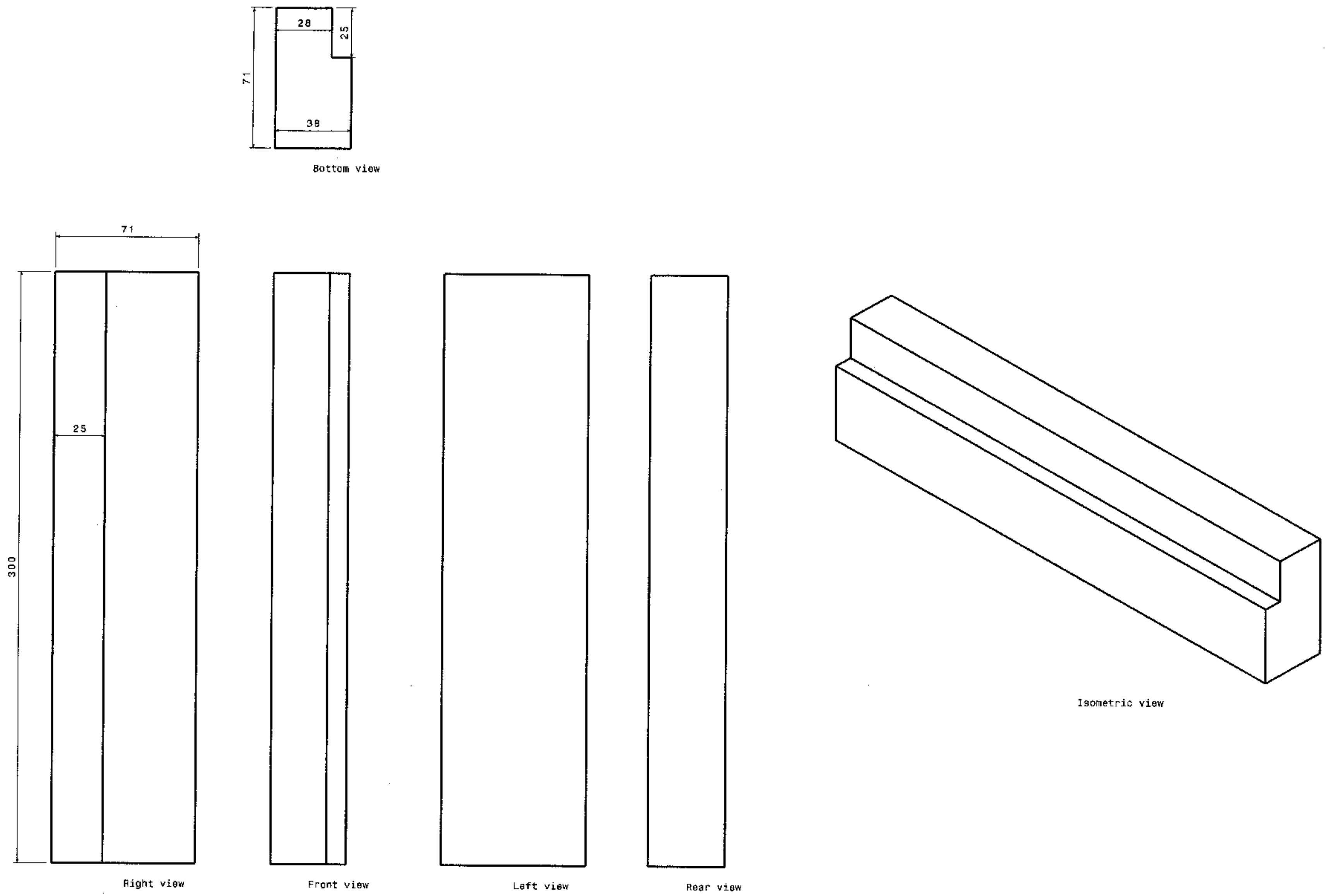


Chee Mun	Riser Bar 1
6/3/2008	
XXX	
XXX	
A1	DASSAULT SYSTEMES
1:1 0.00	RB101 1/1



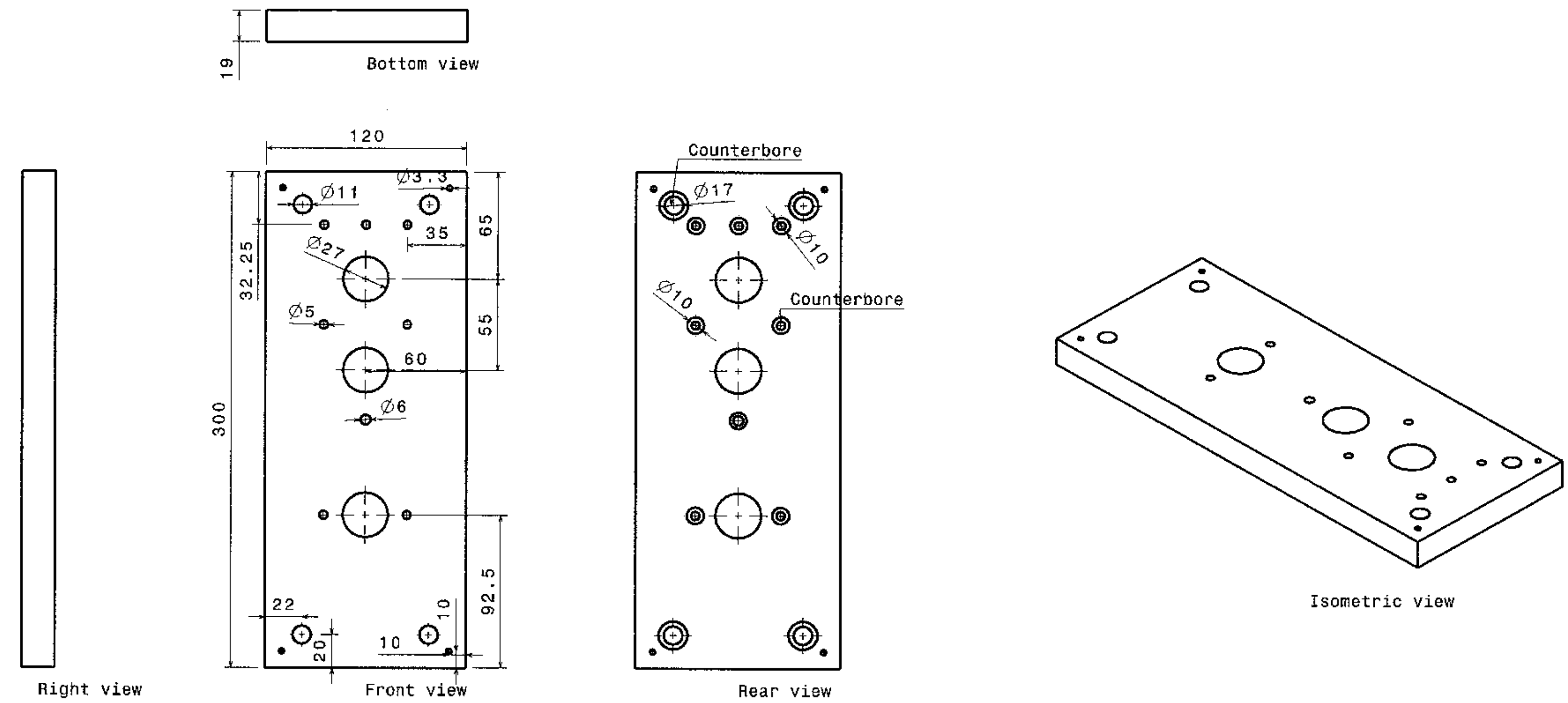
Chee Mun
6/3/2008
XXX
XXX

Riser Bar2

A1

DASSAULT SYSTEMES

1:1 | 0.00 | RB201 | 1/1



DESIGNED BY: Chee Mun DATE: 6/3/2008 CHECKED BY: XXX DATE: XXX	Ejector Plate A	
SIZE: A2	DASSAULT SYSTEMES	
SCALE: 1:2	WEIGHT (kg): 0.00	DRAWING NUMBER: EP101 · SHEET: 1/1

I	–
H	–
G	–
F	–
E	–
D	–
C	–
B	–
A	–

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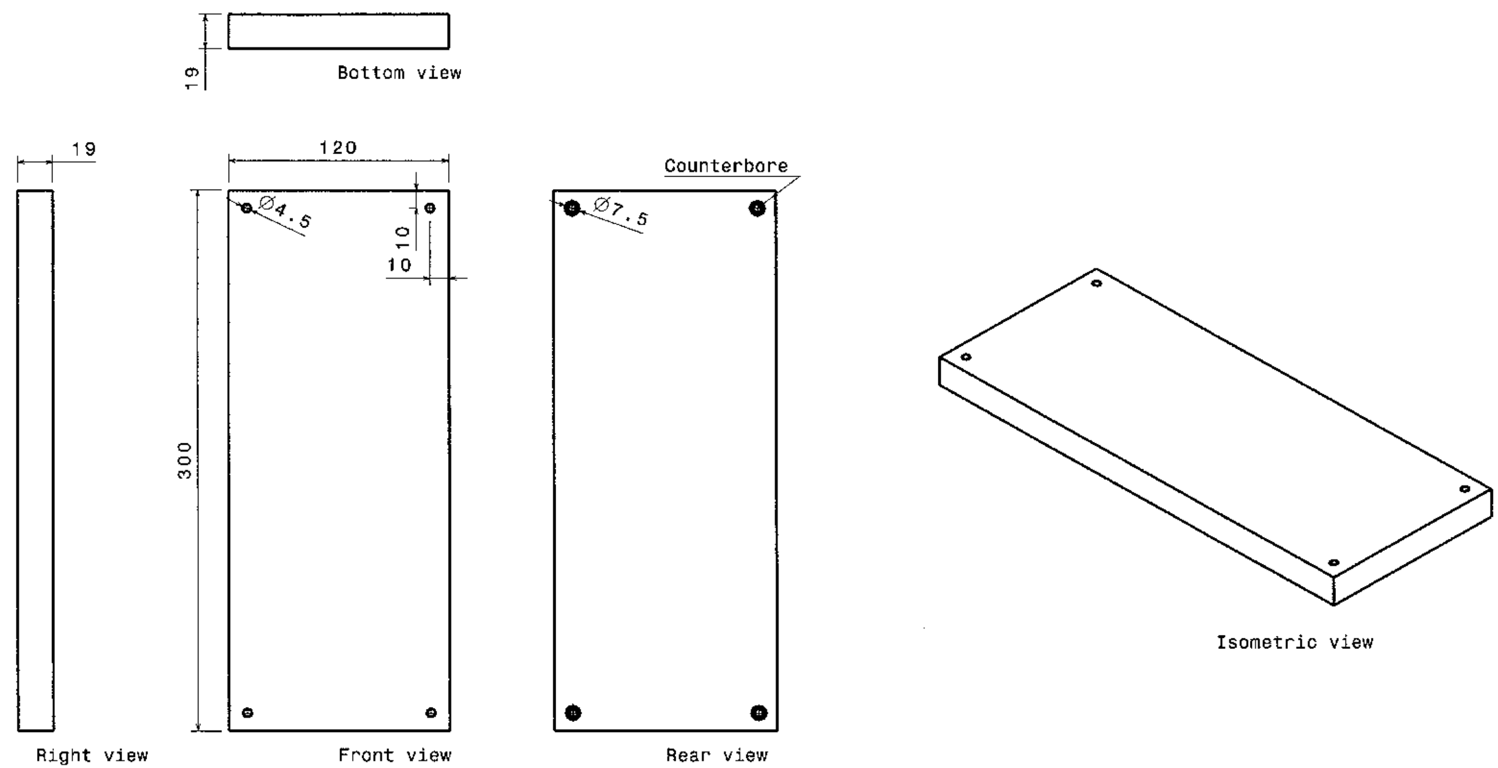
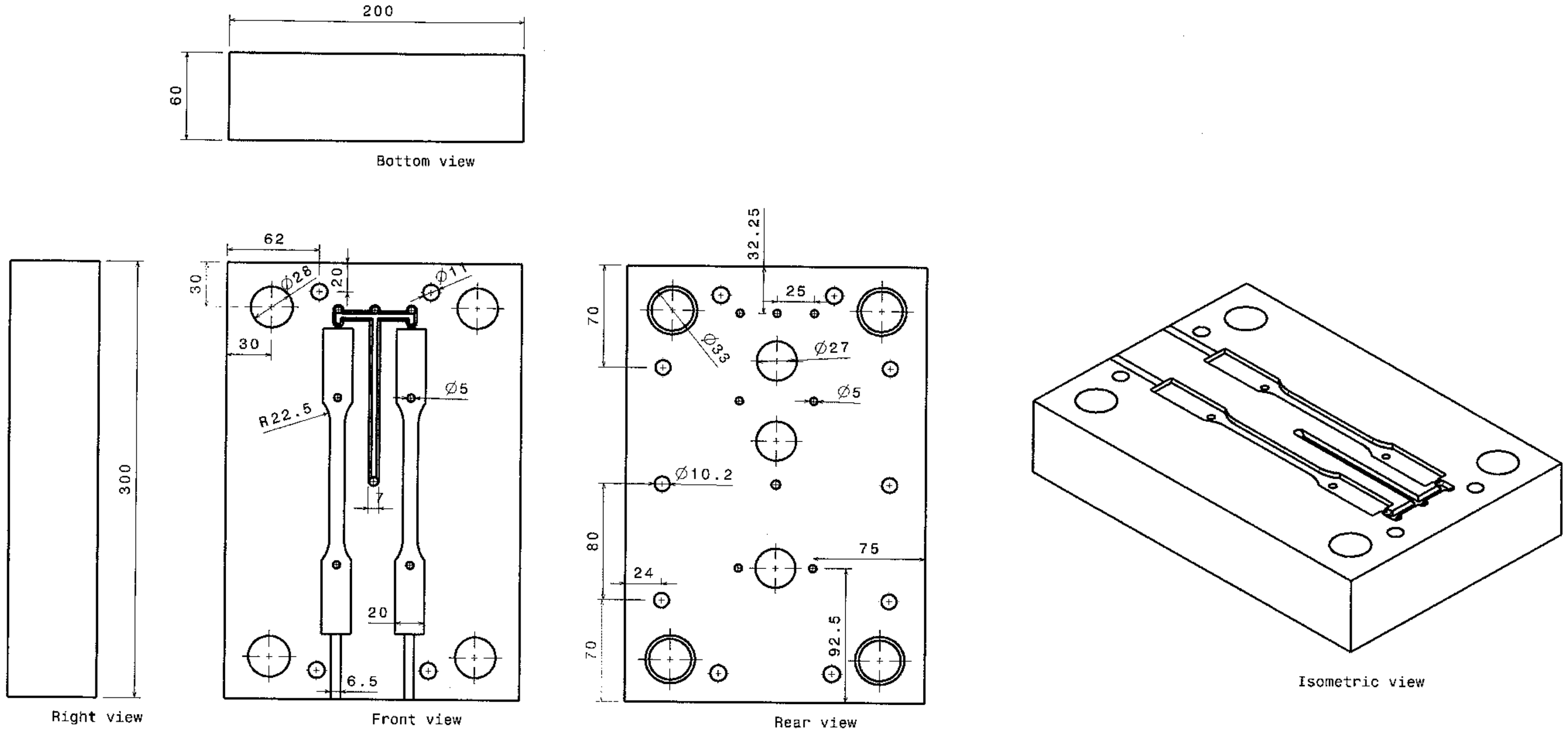


DESIGNED BY: Chee Mun DATE: 6/3/2008	Ejector Plate B	
CHECKED BY: XXX DATE: XXX		
SIZE A2	DASSAULT SYSTEMES	
SCALE 1:2 / WEIGHT (kg) 0.00	DRAWING NUMBER EP201	SHEET 1/1



DESIGNED BY: Chee Mun		Core Plate			I –
DATE: 6/3/2008					H –
CHECKED BY: XXX					G –
DATE: XXX					F –
SIZE A2		DASSAULT SYSTEMES			E –
					D –
SCALE 1:2	WEIGHT (kg) 0.00	DRAWING NUMBER C0001		SHEET 1/1	C –
					B –
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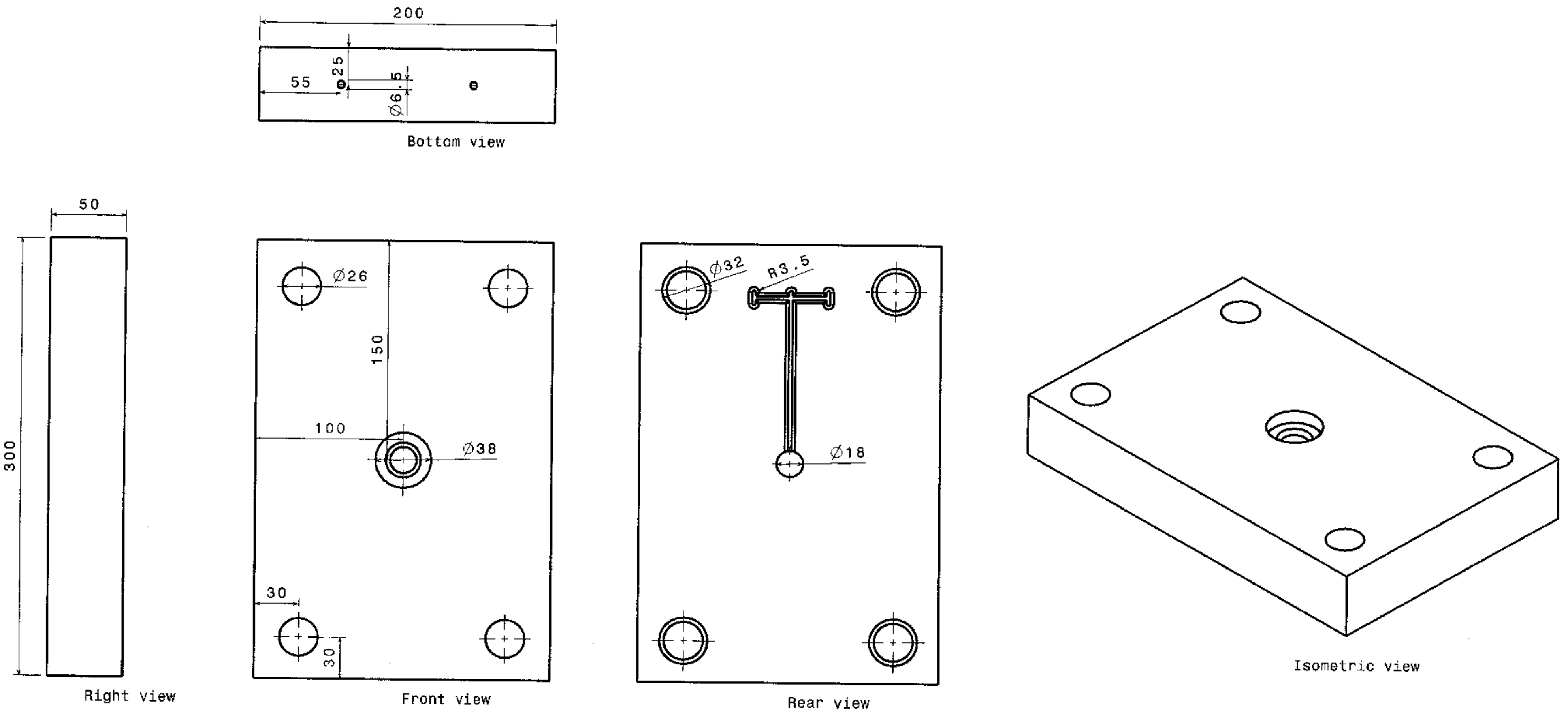
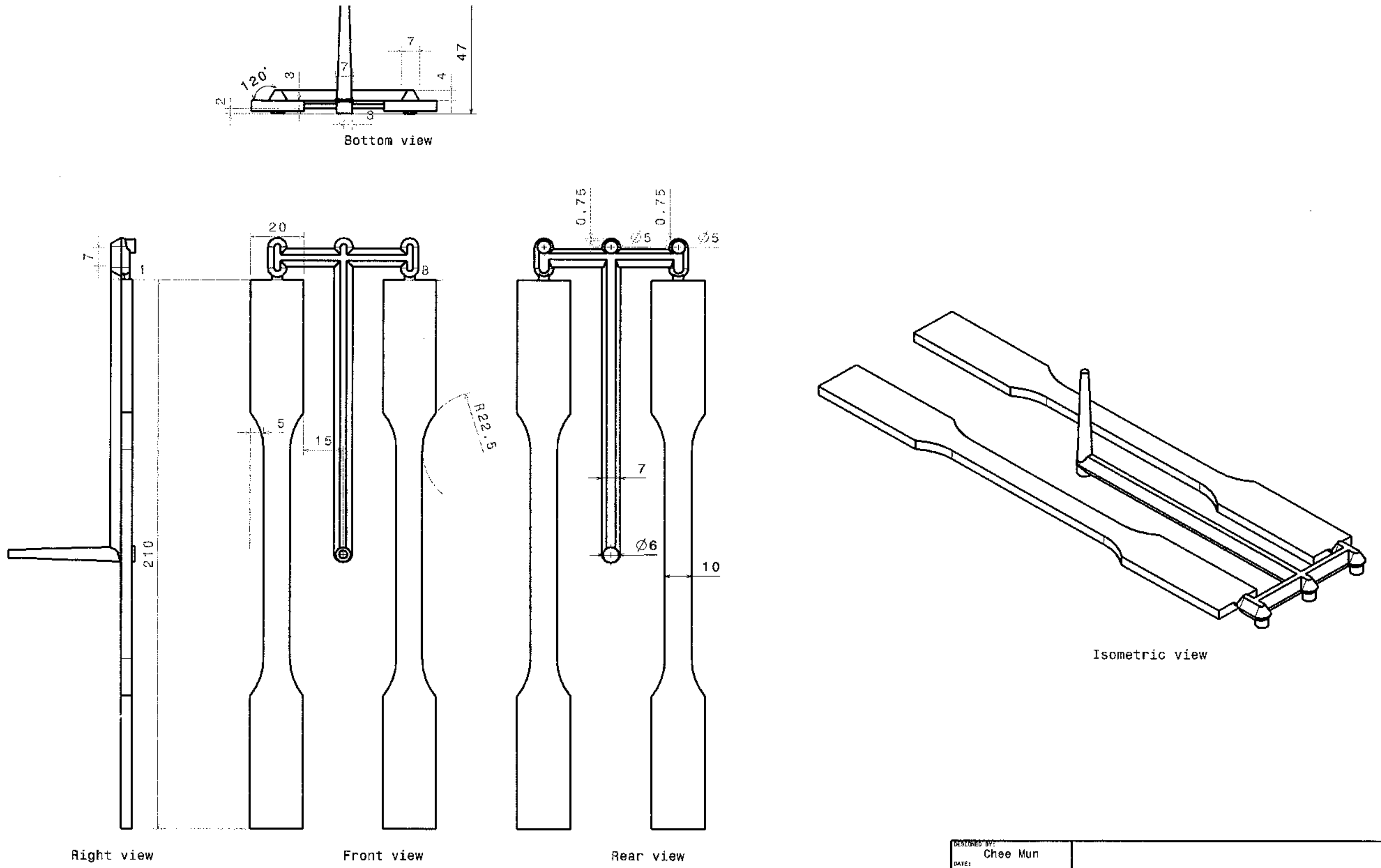
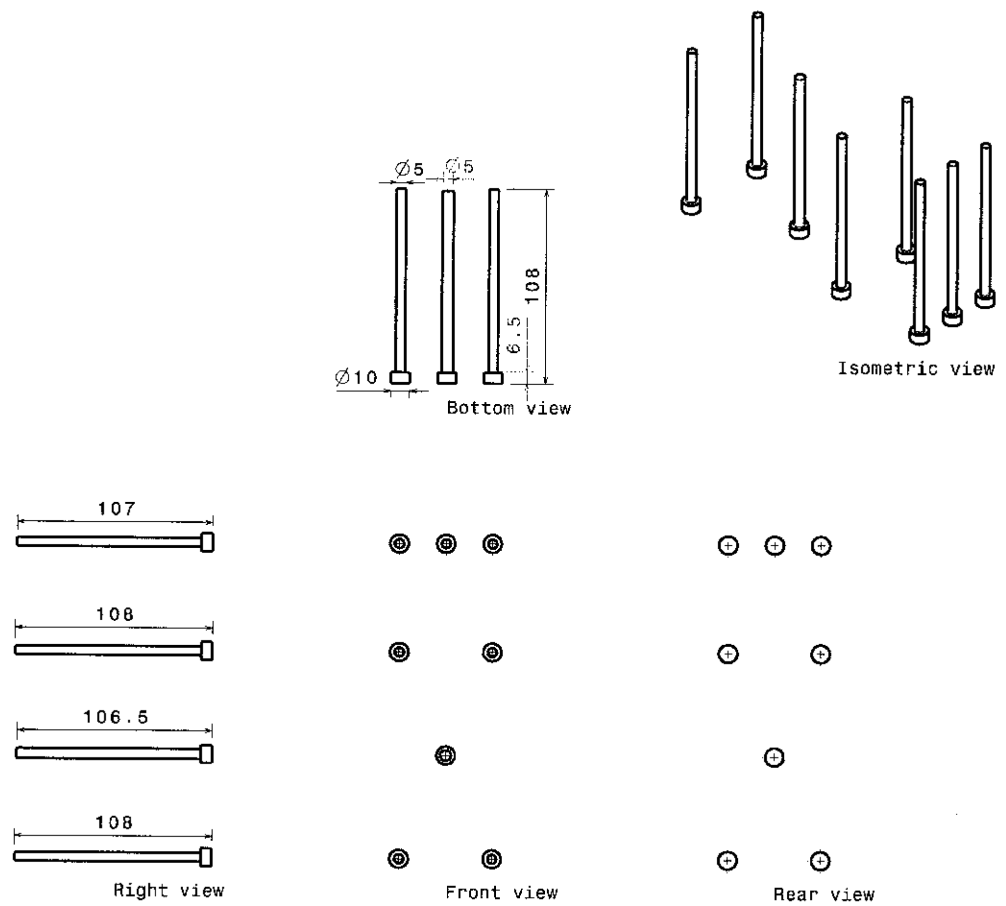


DESIGNED BY: Chee Mun DATE: 6/3/2008	Cavity Plate	
CHECKED BY: XXX DATE: XXX		
SIZE: A2	DASSAULT SYSTEMES	
SCALE: 1:2	WEIGHT (kg): 0.00	DRAWING NUMBER: CA001 — SHEET: 1/1

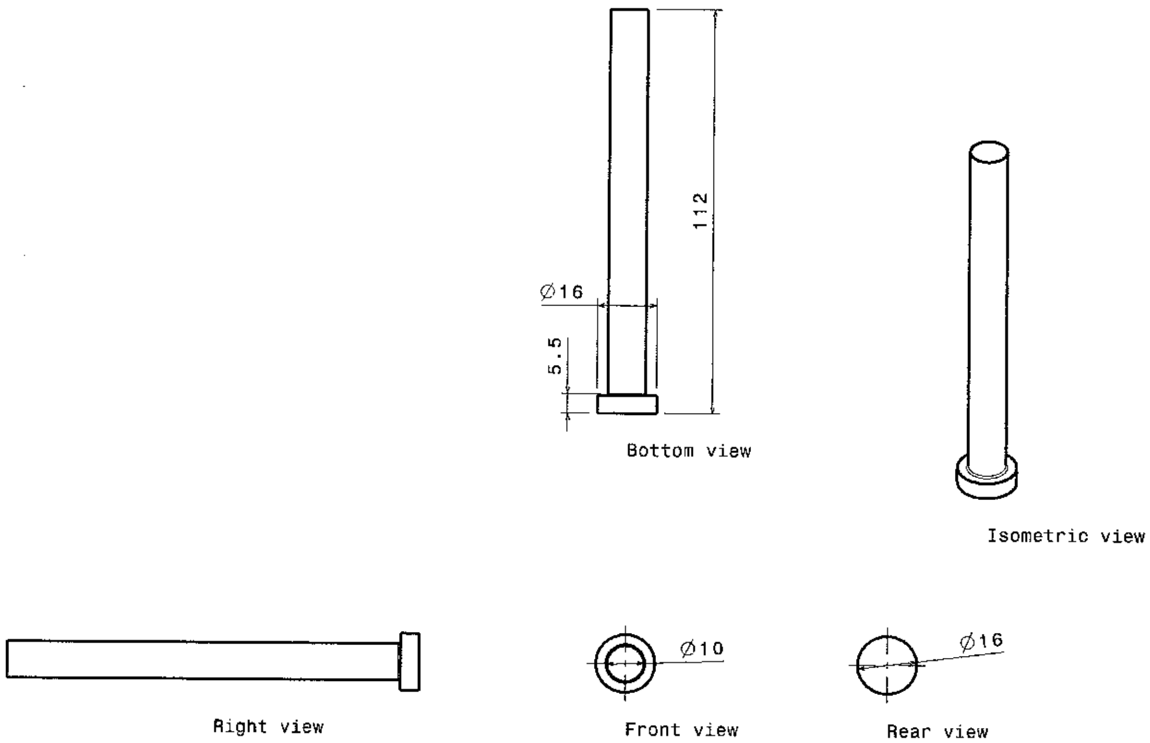


DESIGNED BY: Chee Mun DATE: 6/3/2008 CHECKED BY: XXX DATE: XXX	MoldedPart	
SIZE: A2	DASSAULT SYSTEMES	
SCALE: 1:1 WEIGHT (kg): 0.00	DRAWING NUMBER: MP001	SHEET: 1/1



DESIGNED BY: Chee Mun DATE: 6/4/2008 CHECKED BY: XXX DATE: XXX	Ejector Pin Assembly	
SIZE: A2	DASSAULT SYSTEMES	
SCALE: 1:2 WEIGHT (KG): 0.00	DRAWING NUMBER: EA001	SHEET: 1/1

I	–
H	–
G	–
F	–
E	–
D	–
C	–
B	–
A	–



DESIGNED BY: Chee Mun	Ejector Pin 10 x 112a Ejector Pin 10 x 112b Ejector Pin 10 x 112c Ejector Pin 10 x 112d		I	–
DATE: 6/4/2008			H	–
CHECKED BY: XXX			G	–
DATE: XXX			F	–
SIZE A2	DASSAULT SYSTEMES		E	–
			D	–
SCALE 1:1	WEIGHT (kg) 0.00	DRAWING NUMBER EP001	C	–
		SHEET 1/1	B	–
			A	–