CHAPTER -3
METHODOLOGY

3.0 METHODOLOGY

- Preparation of single depression plan and steps associated with influencing the form to outline
- Preparation of various sorts of shape bases
- Preparation of plan for multi depression top form and its examination with direct door.
- Preparation of H-sprinter plan.
- Design and examination of 8 and 16 pit outline with regular sprinter and H-sort sprinter.
- Checking the attainability of roundabout exhibit pit outline.
- Gating approval techniques and methodologies
- Integral approval of sprinter outlines ideas and conclusions.

STEP 1: SINGLE CAVITY MOLD DESIGN AND ITS PROCEDURE

3.1 SINGLE CAVITY MOULD:

In a solitary form cavity the cavity of the part to be done by and large arranged at the inside bit with the goal that the plastic material from the pass on and specifically into the depression. The kick the bucket is appended to the segment and is evacuated physically after the discharge of the segment. The outline of pit having a solitary shape is process by and large utilized for making of a solitary depression form with a technique for infusion shaping. Plastic, a novel class of material appears, by the raise of their distinctive properties, cost kept up among the materials like metals and earthenware production and it is not being consistent with say many lean toward for infusion forming as there are diverse plastic items. Every item to be shaped has its curious issues that are to be analyzed amid outlining of molds. It is genuinely necessary for the outline of shape with fundamental prerequisites and limit of the machine. Prior to the form configuration is initiated, and is important to inspected for squeeze limit that will be required for fruitful operation. The fundamental contemplations are shot limit, plasticizing rate, bracing power, infusion weight. To accomplish least general Mold estimate ideal demeanor of pit is required and furthermore to obtain the
adjusted bracing a right holes of the design are required.

3.2 PROCEDURE TO BE FOLLOWED FOR MOULD DESIGN:

To set up a shape having single pit base for multipurpose utilization with material sort to be utilized is required choice of the material properties to plan a form cavity is certainly required. Trim machine (infusion) determination and formats of cavities in the shape having a solitary pit, Selection of outline programming is additionally required. Plan of sustain framework is significantly required for the examination of stream investigation which can be watched and reenactments will produce with various temperatures and pressures. To break down temperature varieties in shape filling for various types of plastics and further concentrated with NANO idea plastic materials

3.3 DESIGN SOFTWARE: UNI GRAPHICS (UG-NX8):

Uni illustrations (UG) is the most much of the time utilized plan programming's in exhibit days. It is for the most part utilized for outlining parametric, strong and surface displaying. Amid the procedure of investigation a static, dynamic, electro-attractive and fem examination utilizing volume techniques can be performed by utilizing UG.

By including machining modules fabricating technique can be effectively finished utilizing UG and the motivation behind why now a days it has straightforwardly turned into the contender for other programming resembles CATIA, SOLID WORKS and so on.,

3.4 METHODOLOGY 2

3.4.1 STEP2: DESIGN AND ANALYSIS OF CAP MOULD

Top is one significantly utilized item now days. May be it is made of various materials the fundamental need of the top is to close the delta and outlet for a fluid or a gas. It is by and large fabricated by plastic material and produced in a procedure called shaping. Sprinter configuration is most vital in form filling idea to acquire the best quality approach in completing level parts in top trim. Entryway outline and filling ideas need to enhance with mean weight and sources of info should have been check by investigative reproduction pre check for form for machining and trail run.

3.4.2 REQUIRED MATERIALS FOR CAP MOLD:

Material adjustment has done from copper to TZM amalgam to accomplish
better outcomes. Molybdenum is alloyed with these two items and is sanitized with immaculate and fine carbides to acquire TZM. It is an amalgam with a blend of 0.50% of Ti and 0.08 % of Zi and 0.02 % of Ca to acquire awesome utility for the most elevated ability/high temperature applications, particularly over 2000°f.

### 3.4.3 SPECIFICATIONS OF THE MATERIAL:

- **Commerce name** - RA12MN40
- **Density** - 905 [g/cm3]
- **ITT** - (230 °C/ 2,16 kg) 40 [g/10 min]
- **Young modulus** - E 1340 [MPa]
- **Shear modulus** - G 481,3[MPa]
- **Parallel shrinkage** - 1,386 [%]
- **Perpendicular shrinkage** - 2,004 [%]
- **Maximum shear rate** - 100 000 [1/s]

### 3.4.4 MOULDIN MACHINE TECHNICAL CHARCTERIZATION:

- **Clamping force** - 3200 [kN]
- **Tie bars in between distance** - 720 x 720 [mm]
- **Mold mounting plates** - 1040 x 1040 [mm]
- **Mold height** - 300 – 800 [mm]
- **Max. ejector stroke** - 250 [mm]
- **Max. ejector force** - 86 [kN]
- **Max. weight of moveable mold half** - 2900 [kg]

The complete cap mould design is done by using Catia. The design is done with respected dimensions and has accuracy in complete design. All parameters should be applied with required states.

### 3.4.5 MESH STEPS:

1. When acquiring the part, guarantee the option Dual Domain is picked.
2. resulting to getting the thing part in IGES organize, right tap the option Create Mesh in the plane of used examination and snap Generate Mesh.
3. It is always difficult to pick the length of edge as a default with starting as a gage. In any case, it by and large possible to hack down the length down to ½
of the basic quality which will result of better work and may give better result, however there the point where the additional work thickness has no indicated that examination comes to fruition are varied yet has made through and through extended computational time.

4. Snap Mesh Now.

**3.4.6 MESH ERROR FIXING:**

Numerous blunders may happen in work measurements. It is extremely basic to have A. shortcomings or deformities on the work, for example, free edges, component covers, components not arranged, too high angle proportion, et cetera, because of change of the record between one plan programming to another. The blunders happened can be corrected consequently with the Mesh Re-match Wizard. The sorts of flaws that are regularly settled with Mesh Repair Wizard are free edges, covered components, openings, and components not situated. Proportion happened can be settled with that technique if there are not very a significant number of them. Yet, regularly that technique can just fix a portion of the proportion happened components and unfit to settle the rest. At the point when that happens, that is the opportunity to physically the ASPECT RATIO.

**3.5 STEP 4: OBSERVATION OF 16-CAVITY MOULD AND ITS OPTIMIZATION.**

Uni-illustrations programming most broadly utilized as a part of world’s exceedingly best in class strategies, for example, PC supported outline/PC helped assembling and designing as programming bundle created by Siemens it offers a few pre-pressed arrangement ‘for NC machining. Accessible the scope of level of capacity of these arrangements quicken during the time spent programming which will enhance the efficiency of an assortment in average assembling challenges, from essential machining to mind boggling, numerous pivot and machining of multi-work as same as the bite the dust and form fabricating it likewise blends strong and surface displaying systems into an arrangement of energy stuffed devices.

By utilizing PLM programming 3d plan improvement with center, depression extractions advertisement outline of form turn out to be simple with shape wizard procedures in the product. Sprinters and doors outline methods wind
up noticeably less demanding for the examination of form with ideal arrangements. The examination is directed with Ansys programming which is principally utilized for discovering reproduction that is distinctive at various focuses with exactness.

3.5.1 STAGES INVOLVED:
- FILL STAGE
- PACK STAGE
- HOLD STAGE

3.5.2 REQUIREMENTS IN EXTRACTION OF MOLD:
- Surface temperature circulation to finish everything and base sides of additions and separating planes
- The temperature contrast appropriation in plane surface separating
- Mold surface outside and inner temperature computation and furthermore of the cooled circuits.
- Drop down weight of the circuit up and down the cooling. Variety in coolant temperature
- The cooling circuit stream rate
- Reynolds number in each cooling circuit

3.5.3 COMPUTER AIDED ENGINEERING (CAE) INJECTION SIMULATION:
The best programming bundle utilized as a part of process for infusion forming is programming bundle of shape stream; however there are other late programming bundles that allows the infusion forming operation parameters. Some of these product bundles incorporate particular fascinating components, specifically the reenactment of Metallic Injection Molding (MIM), Powder Injection Molding (PIM), Microcellular infusion forming with by the utilization of supercritical liquid (SCF, for example, carbon dioxide (CO2) or nitrogen (N2) and others. Presently a days there are four primary programming bundles financially accessible:
- The Mold Flow programming
- The Moldex3D programming
- The Soft Sigma Software
• The Sim POE Mold

3.5.4 THERMAL MANAGEMENT:
The second-most critical issue emerging from the investigation was warm administration; the changeability in temperature influenced process durations, part quality, repeatability, and potentially device life. Without a dynamic cooling framework, the process durations inquire about were any longer than what could be normal from a metal instrument, even one without dynamic cooling too.

In the event that every one of the powers are missing and there is no stream there will be a spillage in door. The powers left in the hold arrange are then connected and after that the door begins solidifying to destroy the spillage of the liquefy. As in some specific conditions and apparatus the pack and the hold are consolidated into a solitary form. The point of this paper is to distinguish and select the ideal conditions for the mechanical procedure of infusion trim of chose part to decide the ideal conditions. Infusion process is influenced by number of components that effects on profitability and precision of infusion forming and in addition on the general cost related with its creation.

TABLE 3.1 INJECTION TEMPERATURES FOR THE MOULD TRAIL FROM BHANODAYAM INDUSTRY, CHERLAPALLI.

<table>
<thead>
<tr>
<th>Selected temperature profiles</th>
<th>Temperature of jet(°c)</th>
<th>Temperature at screw(°c)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Phase 1</td>
</tr>
<tr>
<td>1</td>
<td>340</td>
<td>330</td>
</tr>
<tr>
<td>2</td>
<td>325</td>
<td>315</td>
</tr>
<tr>
<td>3</td>
<td>320</td>
<td>310</td>
</tr>
<tr>
<td>4</td>
<td>315</td>
<td>305</td>
</tr>
<tr>
<td>Temperatur profile</td>
<td>Weight of mould (g)</td>
<td>Dosing time (sec.)</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>1</td>
<td>7.654</td>
<td>2.453</td>
</tr>
<tr>
<td>2</td>
<td>7.642</td>
<td>2.463</td>
</tr>
<tr>
<td>3</td>
<td>7.639</td>
<td>2.486</td>
</tr>
<tr>
<td>4</td>
<td>7.628</td>
<td>2.503</td>
</tr>
<tr>
<td>5</td>
<td>7.619</td>
<td>2.53</td>
</tr>
</tbody>
</table>

3.6 METHODOLOGY -3

3.6.1 STEP 5: ANALYSIS OF MOLD FLOW 16 CAVITIES AND 8 CAVITIES

To ascertain the coveted length and range of a sprinter a procedure is utilized which is as of now accessible by following kazmer strategy, the whole sprinter arrange format was outlined and created as a stream chain which are having components and hubs for inquire about reason, another rendition and h-stretching will be utilized. Since this configuration is symmetrical, examination the separating procedure will be done on the half side of the sprinter, with supposition that disintegrate will stream also to the following half furthermore, on the half side; examination will be performed on the lower half of the sprinter.

3.7 MOLD MANUFACTURING PROCESS PLAN:

3.7.1 MATERIAL SELECTION:
Bill of Materials contains data viewing size of different parts and in addition different materials utilized for assembling the part. In infusion shape as can be seen in Bill of Materials following materials are utilized because of their particular properties which are required for the long existence of the device considering the cost viewpoint.

➤ **M.S. :-**
- These steels have intermediates properties to those of low carbon and highcarbon steels.
- These steels have medium hard, not so ductile and malleable.
- These steels have medium tough.

<table>
<thead>
<tr>
<th>Composition of this steel is shown below</th>
<th>C%</th>
<th>Mn%</th>
<th>Si%</th>
<th>S%</th>
<th>P%</th>
<th>Cr%</th>
<th>Ni%</th>
<th>Mo%</th>
<th>V%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.25</td>
<td>0.6-0.9</td>
<td>0.1-0.35</td>
<td>0.055</td>
<td>0.55</td>
<td>0.2-0.35</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

➤ **C45 :-**
- These steel is plan carbon steel. This is Indian standard designation
- This is mild steel having carbon of 0.40-0.50%
- Properties of steel similar to the mild steel

➤ **EN – 31:-**
- EN stands for “Emergency Number”. This is British standard.
- This has higher hardenability as Carbon percentage is higher. Due to which its hardness is high of the order of 58 ~ 60 HRC. As hardness increases wear resistance increases.
- This steel is mainly used for making guide pillar and guide bush as both are under constant due to sliding fit in operating condition wear resistance required is high. Also this material is cost effective. So it is used for making Guide Pillar and Guide Bush
• Austenitising Temperature ranges from 830 – 860 °C
• Tempering Temperature required is minimum 175°C
• Quenching Medium:- Oil

<table>
<thead>
<tr>
<th>Composition of this steel is shown below</th>
<th>Mn</th>
<th>Si</th>
<th>Cr</th>
<th>P</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>C %</td>
<td>0.9-1.2</td>
<td>0.3-0.75</td>
<td>0.1-0.35</td>
<td>1.0-1.6</td>
<td>0.05MAX</td>
</tr>
</tbody>
</table>

➢ **EN – 8:-**

• This steel comes under the category of Medium Carbon Steel.
• As Carbon percentage is less hardenability of this steel is less and hardness that can be achieved is maximum 40 – 45 HRC.
• Thus it has moderate hardness and therefore it is used where frictional movement or rubbing is less. So it is used for making Washer and support pillar in mould where rubbing is not severe.
• Composition of this steel is shown below

<table>
<thead>
<tr>
<th>C %</th>
<th>Mn</th>
<th>Si</th>
<th>P</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3-0.45</td>
<td>0.6-1.0</td>
<td>0.05-0.35</td>
<td>0.05MAX</td>
<td>0.05MAX</td>
</tr>
</tbody>
</table>

➢ **H-13 :-**

• Symbol H-13 is hot work tool steel and it is AISI designation system.
• This is chromium type steels contain 3 to 7 % Cr and carbon content between 0.35 to 0.55%.
• These steels having high ductility, toughness and resistance to splitting.
• Hardening temperature-1020 to 1050 °C
• Quenching medium – Air.
• Hardness after quenching - 46 to 52 HRC.
- Tempering temperature - 250 to 550 °C.
- Hardness after tempering - 54 HRC.

➤ **OHNS:-**
- OHNS stands for “Oil Hardened Non Shrinking Steel”
- This steel contains Manganese as the alloying element.
- This steel is readily available and is of low cost
- Its dimensional stability as well as wear resistance is fair. Also it has good machinability. So generally it is used for making Rest button in mould.
- Austenitising Temperature ranges from 760 – 800 °C
- Tempering temperature ranges from 200 – 220 °C
- Quenching Medium:- Oil
  Composition of O2 grade steel is shown below

<table>
<thead>
<tr>
<th>C %</th>
<th>Mn</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.90</td>
<td>1.60</td>
</tr>
</tbody>
</table>

➤ **STAVAX :-**
- This is Plastic Mould Steels.
- These steels having excellent polishability
- These steels having wear resistance.
- Through hardening stainless steel with excellent polishability and wear resistance
- Hardening temperature - 1010-1050 0c
- Soft anneal-890 0c
- Quenching medium-oil, gas
- Hardness after tempering-54 HRC
Composition of this steel is shown below

<table>
<thead>
<tr>
<th>C %</th>
<th>Mn</th>
<th>Cr</th>
<th>Mo</th>
<th>V</th>
<th>Si</th>
<th>Ni</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.38</td>
<td>0.5</td>
<td>13.6</td>
<td>~</td>
<td>0.3</td>
<td>0.9</td>
<td>~</td>
</tr>
</tbody>
</table>

Heat Treatment of steel may be defined as an operation or combination of operations involving the heating and cooling the steel in solid state; so as to modify its properties and to make it suitable for a particular uses.

Purposes of Heat Treatment –

Motivations behind Heat Treatment – The warmth treatment is improved the situation following purposes

- To enhance machinability.
- To create a hard surface on a pliable inside.
- To refine grain measure.
- To mitigate inward anxiety or wipe out the impact of chilly working.
- To increment mechanical properties.
- To enhance attractive and electric properties.
- To change concoction sythesis.
- To increment cutting properties of steel.
- To expel gasses.

Solidifying

It is a strategy for steel warming, 40 - 50°C over the upper basic temperature for hypo eutectoid steel or 40 - 50°C above lower basic temperature for hyper eutectoid steel, drenching for a predetermined time. The hardness acquired by solidifying process relies on following –

- Carbon content
- Quenching rate
- Work measure

Extinguising Store treating – it is a procedure in which a steel is warmed at the solidifying temperature drenched for a predefined time and extinguished in isothermal shower having temperature 180°C to 300°C, kept simply over the martensite begin line. The material is held there for a period just before the nose of the bainite line. A short time later it is cooled in air. The final result it martensite.
Objective:
- Less distortions or warping
- Less change in volume
- Less change of quenching cracks & internal stresses

3.8 DESIGN INPUTS

Customer gives information to the marketing department regarding their requirement. Before starting the design activities following things should be made clear with the customer.

The **component related input** from the customer may be in the form of

- 2D Component Drawing
- 3D Component Model
- Existing Sample of Component
  The **Tool related input** from the customer may be in the form of
  - Type of Mould / Die
  - No. of Cavities
  - Production Rate
  The **Material related input** from the customer may be in the form of
  - Component Material
  - Shrinkage
  - Component weight
  - Die Set Material
  - Core/Cavity Material

**Aesthetic & Functional Requirements** of Component that should be discussed with the customer are as follows

- Type of gate
- Location of gate
- Parting Line Constraints
- Ejection mark constraints
**Other inputs** required from the customer are as follows

- Reference Information
- Standard Parts
- Side Core Actuation Method
- Machine Specification

**3.9 DESIGN PLANNING AND CONSIDERATION:**
The main objective of my project is to design a Two cavity injection mould, with automatic ejection of runner system, with form pin ejection because component having internal undercut.

**3.9.1 DESIGN PLANNING:**

- Material used for the component, its applications.
- Shrinkage of the material.
- Calculate the weight of the component.
- Study the detail of the component.
- Type of mould required for the component to be produced.
- Machine available for the component.
- Injection pressure required.
- Type of runner system & gate required.
- Type of ejection system weather blade, stripper etc.
- Split and side core consideration if the component is having any groove or notch on its sides.
- Cycle time required for the component for complete fill.
- Effective cooling in a short duration is necessary.
- Cooling channels must be lick proof.
- Selection of the material for core & cavity.
- Adding of shrinkage to core & cavity dimensions.
- Parts in the assembly must not foul with each other in operation.
- The layout of the tool must not be oversized.
- Prepare 2dimensional assembly and details of the various components of the tool.
- Prepare 3dimensional models of components which are to be produced by
Computer aided manufacturing (CAM).

Machine selection for making any plastic moulding should be based principally on max. shot capacity, max. die opening and die size, max. & min. die height, clamping force and operating stroke, length of shot stroke, tie bar distance, over-all size and cost.

The thumb rule for selection of plastic moulding machine is to use the smallest machine that will do the job. This will ensure fundamental economy of operation, since the larger the machine, the slower its cycle. Clamping force is not necessary the deciding factor in the selection of a plastic moulding machine. Die dimensions must be considered. The machine adequate tonnage for casting a part may have insufficient platen area or tie-rod spacing for the die, or the opening stroke may not be sufficient for removal of component.

Machine available for this case is SP 80.

**TABLE 3.3 MACHINE SPECIFICATIONS FOR SP 80**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Injection pressure</td>
<td>1575 bar</td>
</tr>
<tr>
<td>2</td>
<td>Screw diameter</td>
<td>40 mm</td>
</tr>
<tr>
<td>3</td>
<td>Stroke volume</td>
<td>120 cu.cm</td>
</tr>
<tr>
<td>4</td>
<td>Max. Injection weight</td>
<td>137 gms.</td>
</tr>
<tr>
<td>5</td>
<td>Injection rate</td>
<td>185 cc/s</td>
</tr>
<tr>
<td>6</td>
<td>Plasticising rate</td>
<td>12 gm/s</td>
</tr>
<tr>
<td>7</td>
<td>Screw L/D ratio</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>Screw stroke</td>
<td>135 mm</td>
</tr>
<tr>
<td>9</td>
<td>Screw speed (max.)</td>
<td>220 rpm.</td>
</tr>
<tr>
<td>10</td>
<td>Locating speed (max.)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Locating ring diameter</td>
<td>125 mm</td>
</tr>
<tr>
<td>12</td>
<td>Nozzle type</td>
<td>Round nozzle</td>
</tr>
<tr>
<td>13</td>
<td>No. of heating zones</td>
<td>4</td>
</tr>
</tbody>
</table>

**INJECTION UNIT CLOSING UNIT**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Closing force</td>
<td>800 KN.</td>
</tr>
<tr>
<td>15</td>
<td>Mould opening stroke</td>
<td>450 mm.</td>
</tr>
<tr>
<td>16</td>
<td>Min. mould height</td>
<td>200 mm.</td>
</tr>
</tbody>
</table>
TABLE 3.4 MOULD DETAILS

<table>
<thead>
<tr>
<th></th>
<th>Moulding machine</th>
<th>SP80</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Weight of feed system</td>
<td>6 grms.(approx.)</td>
</tr>
<tr>
<td>3</td>
<td>Total shot weight</td>
<td>52 grms.</td>
</tr>
<tr>
<td>4</td>
<td>Locating ring Dia</td>
<td>12 of 8 mm</td>
</tr>
<tr>
<td>5</td>
<td>Sprue bush Radius /Dia</td>
<td>R12/dia 5 mm</td>
</tr>
<tr>
<td>6</td>
<td>Minimum ejection stroke reqd.</td>
<td>20 mm</td>
</tr>
<tr>
<td>7</td>
<td>Type of ejection</td>
<td>PIN EJECTION.</td>
</tr>
<tr>
<td>8</td>
<td>Minimum daylight</td>
<td>207mm.</td>
</tr>
<tr>
<td>9</td>
<td>Total height</td>
<td>207 mm.</td>
</tr>
<tr>
<td>10</td>
<td>Overall mould size(HxLxW)</td>
<td>246x246x207mm</td>
</tr>
<tr>
<td>11</td>
<td>Total weight of mould</td>
<td>180 kg.Approx.</td>
</tr>
<tr>
<td>12</td>
<td>Weight of injection side</td>
<td>76 kg. Approx.</td>
</tr>
</tbody>
</table>
### 3.10 MOULD CALCULATION:

**A) Weight Calculations :-**

Weight of Component = Volume $\times$ Density

= $7.115 \times 1.14$

= 8.11 grams.

**B) Shot capacity :-**

The screw type machine is normally rated in terms of “Swept Volume” of the injection cylinder (Cu. Cms.).

Machine Available is SP 80. For SP 80 Swept Volume is 100 cm$^3$

Shot capacity (g) = Swept Vol. (Cm$^3$) $\times$ p $\times$ C

p = Density of plastic at normal temperature (g/cm$^3$)

C = 0.95 for amorphous materials.

Shot capacity (g) = $100 \times 1.14 \times 0.95$

= 108.3 grams

**C) Plasticising capacity:**

Plasticizing rate of material B (g/hr) = plasticizing rate of material A (g/hr) $\times$ QA/QB

A = Nylon66

B = Nylon (Material actually to be used)

Q = Thermal capacity of the material (cal/g) (Heat content)

QA = 239.4 KJ/Kg

QB = 567 KJ/Kg

Machine Available is SP 80, Plasticizing rate = 4.7 g/S

Plasticizing rate of material B (g/hr) = $4.7 \times (3600/1000) \times (239.4/567)$

P$_B$ = 19.844 Kg/hr

**D) Locking Force Calculations :-**

The clasping power required to keep the shape shut amid infusion must surpass the power given by the result of the opening weight in the pit and the
aggregate anticipated region of all impressions and sprinters. Lower clipping
esteems can be utilized with screw presses attributable to the lower infusion
weights conceivable with these machines.
Thin segments require a high infusion strain to fill and along these lines
require all the more clasping power. Simple streaming materials like high
dissolve file polyethylene and polystyrene fill all the more promptly and thus
require a lower bracing power. In the case of screw injection 2/3 to 1/2 times
of injection Pressure should be taken for Clamping purposes. Max. Injection
pressure may be obtained from press manufacture’s data sheet.
(A) Projected Area of the component = 2500 mm
(E) Total Projected Area =5200 mm
(F) Clamping Force = (Total Projected Area X 1/2 Injection pressure)

= 520 X 0.5 X 1500
= 39.75 Tons

(G) Locking Force = 1.2 X clamping force
(20% safety)
= 19.87 Tons

E) Determination of number of Cavities:
The number of cavities in injection moulds is determined in most cases by the
machine performance, but sometimes by the moulding shape or the mould
locking pressure.
1) Determined by Shot Capacity:
(Based on 85% of rated shot capacity)

\[ N_s = \frac{0.85W}{m} \]

Ns = No. of cavities based on shot capacity
W = Rated shot capacity for particular polymer (g)
m = Moulding weight per cavity(g)
Ns = 0.85 X 108.3 / 10
= 9cavity

2) Determined by plasticizing capacity:
(Based on 85% of rated plasticizing capacity)
\[ N_p = \frac{0.85P / T_c}{3600m} \]

\( N_p \) = No. of cavities based on plasticizing capacity.

\( P \) = Rated plasticizing capacity for particular polymer (g/hr)

\( T_c \) = Overall cycle time (Sec.) = 4 seconds

\[ N_p = \frac{(0.85 \times T_c)}{3600m} \]

\[ N_p = \frac{(0.85 \times 19.84 \times 1000 \times 30)}{(3600 \times 10)} \]

= 14 cavity

3) Determined by clamping capacity:

\[ N_c = \frac{C}{P_c \times Am} \]

\( N_c \) = No. of cavities based on clamping capacity

\( C \) = Rated clamping capacity (KN)

\( P_c \) = Clamping pressure in KN.

\( Am \) = Projected area of moulding (Sq. Cm.) including runners.

FOR first Component

\[ N_c = \frac{600}{(63 \times 1000 \times 2588 \times 10^{-6})} \]

= 4 cavity

4) Min. Wall Thickness

\[ t = 3 \ C \ P \ d4 \]

E.Y.

\[ t = \text{Min. wall thickness (cm)} \]

\[ y = \text{Max. Deflection of Side Wall} = 0.005cm \]

\( P_c = \text{Max. Cavity Pressure} = 600 \text{ bar} \)

\[ d = \text{Total Depth of Cavity Wall} = 1.5 \text{ cm} \]

\( E = \text{Modulus of Elasticity} = 2.1 \times 10^6 \text{ Kg/cm}^2 \)

\( c = \text{constant} = \frac{L}{D} = 0.9 \)

<table>
<thead>
<tr>
<th>Ratio of the length of Cavity wall to the depth of Cavity wall (L/d)</th>
<th>Value of C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ratio of length/depth = 50/18 = 0.27
So value of c = 0.044 from table

\[
\begin{align*}
1.0 & \quad 0.044 \\
1.5 & \quad 0.084 \\
2.0 & \quad 0.111 \\
3.0 & \quad 0.134 \\
4.0 & \quad 0.140 \\
5.0 & \quad 0.142 \\
\end{align*}
\]

F) DETERMINATION OF GUIDE PILLAR DIAMETER

Side Thrust (Q) = a \times h \times Pf

Where,

- a = Max. Side of Core = 80 mm
- h = height of core = 18 mm
- Pf = cavity pressure = 500 Kg/cm²

\[Q = 80 \times 18 \times 600 = 8640 \text{ K}\]

\[
d = \sqrt{\frac{4Q}{\pi Nfs}}
\]

\[
d = \sqrt{\frac{4 \times 8640}{3.14 \times 4 \times 16}}
\]

\[
d = 13.11 \text{ mM}
\]

We consider pillar diameter 20 mm

G) RUNNER CALCULATION

Weight of the molding (w) = Weight of Component + Weight of Feed System

\[
w = 50 \text{ gm} + 15\% \text{ of Component Wt.} = 57.5 \text{ gm}
\]

\[
D = \text{length of Component}
\]
\[
\sqrt{57.5 \times 4 \times 50} / 3.7 = 5.44 \text{ mm}
\]

We consider runner diameter 6 mm

**H) GATE CALCULATION**

**HEIGHT OF GATE,**

\[ h = n \times t \]

Where,

- \( n \) = material constant = 0.8
- \( t \) = wall thickness = 1.5 mm

\[ h = (0.8 \times 1.5) = 1.2 \text{ mm} \]

Height of the gate is 1.2 mm

**WIDTH OF THE GATE**

The width of the gate controls flow rate

\[
W = \frac{n\sqrt{A}}{30}
\]

Where

- \( W \) = gate width (mm)
- \( A \) = surface area of Cavity (mm²)
- \( n \) = material constant.

\[ W = 0.8 \sqrt{10531.221} / 30 \]

Width of gate = 2.73 mm

Width of gate = 3.0 mm

**FORM PIN CALCULATION**

\[
M = E \tan \phi, \quad M = \text{Withdrawing Movement}
\]

\[ 4 = 18 \tan \phi, \quad E = \text{Ejection movement} \]

\( \phi = 11° \)
Figure 3.1 shows the complete 8-cavity mould

Figure 3.2 shows the working of 8-cavity in cup moulding
Figure 3.3 shows the complete 16-cavity mould

Figure 3.4 working of 16-cavity in moulding

TABLE 3.5 SHOWS DIFFERENT TYPES OF RUNNERS COMPARISON

<table>
<thead>
<tr>
<th>Runners Type</th>
<th>Fill Time</th>
<th>Time to Reach Ejection Temp</th>
<th>Deflection</th>
</tr>
</thead>
</table>

158
<table>
<thead>
<tr>
<th>Analysis Type</th>
<th>Max Aspect Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid plane/Dual Domain</td>
<td>06:01</td>
</tr>
<tr>
<td>Mid plane/Dual Domain—noncritical</td>
<td>20:01</td>
</tr>
<tr>
<td>areas</td>
<td></td>
</tr>
<tr>
<td>Tetra elements</td>
<td>50:01:00</td>
</tr>
</tbody>
</table>

TABLE 3.6 SHOWS IDEAL ASPECT RATIO FOR DIFFERENT TYPES OF ANALYSIS IN 8, 16 CAVITIES

The two best alternatives for being a sprinter arrangement of the Trolley Opener item Is it gives sensibly fill time, and the Deflection is bring down contrasted with the two sorts of trapezoidal. Time to achieve discharge temperature is additionally exceptionally effective contrasted with other two. On the off chance that you watch obviously the machining procedure of what is going on of half-round and full-roundabout sprinters, there are a few factors that are to be considered amid the way toward assembling of a sprinter framework where cooling channels are required.

A sprinter with finish round way is considered as a perfect sprinter since it executes more adjust in stream of soften amid cooling. As this sort of sprinter framework in the machining will take additional time and higher accuracy according to the prerequisite of machining the sprinter on the two plates. On the off chance that the arrangement between sprinter coordination in the two plates is not flawlessly coordinate, it will require a noteworthy additional cost time to settle the blemish and it will prompt a deformity in the last item part. It can likewise influence the age cycle of the form plate itself. Because of this high exactness that is required on making an assortment of sprinters, it might make variety in cost be more costly than different sorts. The sprinters mass
will likewise increment as offer of the generation weight; in this manner prompts higher vitality squander in plasticizing. The cooling additionally assumes part since parcel of time is required to get it cool in bigger sprinters. The opposite side, the Half-roundabout sprinter has a lower surface region which implies less weight added to the item weight. The time taken to get the productivity amid the assembling will be higher since it expects procedure to be proceeded in one hole plate just; lessening the danger of having the sprinters misaligned in the two plates. In the cooling perspective, it can be seen from the table 11 that it requires shorter investment in the cooling stage because of littler size.

Giving the outcomes that all the four sorts of sprinter framework does its errand to superbly convey the thermoplastic material to the pit, for this situation the half-round channel will be the most reasonable alternative for the specific Trolley Opener item. understanding concerning the user profile from the customers associated with unique manufacturer store, Based on the market as well as psychographic features (b) to discover differences in the event that any kind of between ‘Browser’ as well as ‘Purposive’ clients as (c) to look at the differences which arise as well as pull ramifications for that retailer.

3.11 OPTIMIZATION OF UNIQUE GATE VALIDATION:

The results of the research tend to be the following: 73. 9 % from the customers that frequented the store had been guys. Three-fourths males belonged to the age group associated with 21-30. This particular obviously pointed out which there is a good below rendering associated with ladies customers the ones within the ages associated with over forty years. The majority of the customers arriving at the store had been college students (33%) as well as youth professionals employed in the private sector that belong to wealthy families along with earnings over 4.5 lakhs.

The customers had been grouped into, “purposive” (The respondent that experienced arrive to the store upon which day time using the purpose to purchase concerning self/Family member/friend), “browser” (The respondent that experienced arrive to the store upon which day time with no purpose to buy), “purposive patrons” (Customers that experienced revisited the store
following a 12 months using the purpose to buy). From the total sample 68.5% from the customers arriving at the store had been calculated as the relaxation pointed out the reason behind go to end up being possible to browse and eye-port shop. Majority of the customers had been discovered to end up being customers as well as had been returning to the store inside 12 months. 78% of the customers experienced return along with purpose to purchase as well as they were categorized because calculated customers. The no customers had been requested to stipulate their purpose of reviewing also it had been discovered which 39% pointed out they would certainly review as the exact same percentage had been uncertain associated with review.

3.11.1 GATE LOCATION:
CAE programming application method is utilized to examine the infusion entryway area and to demonstrate the infusion profiles for a few door positions to improve the sprinter and cooling channels of form. A near investigation between these profiles must be done at the same time with a thorough inspecting of the accompanying criteria:

• Process capacity: it discloses the plans to accomplish a one of a kind want in a shape filling operation.
• Initial contribution of weight amid infusion (least): infusion machine can be defined (Clamp drive)

• Geometric confinements: assess the over-packing of infused material

• Thickness: this procedure is executed to inspect the entire thickness of the part which permits us for a decent pressing phase of thermoplastic.

The fundamental utilization of this kind of investigation is the analyze procedure for the likelihood of plastic parts with absconds amid the filling. The position and geometry received for the infusion gate(s) impact the nature of the plastic part through the accompanying:

• Filling profile of the form
• Quality and area of the welding line
• Direction of the atomic introduction
• Dimensional precision
• Sink marks control
• Shrinkage and voids control
• Cavity weight appropriation
• Trapped air and deficient filling
• Residual stresses
• Warpage and evenness

3.11.2 THE PROCESSING WINDOW:
The examination of the handling window permits the recognizable proof of the best preparing conditions for the infusion shaping procedure, to be specific: perfect form temperature, infusion time and cementing temperature. The assessment of the diverse door areas thought the investigation of a few infusion profiles (weight, shear rate and temperature) in various locales of the part permit the choice of the best area. The impact of material on weight necessities and shear rate are likewise assessed. This investigation rapidly gives proposals to the infusion time, shape temperature, and dissolve temperature esteems that ought to be utilized as preparatory contribution for a full stream examination.

3.11.3 ANALYSIS OF CAVEITY FILLING (FILL):
The filling procedure begins on the infusion door and the dissolved plastic streams along the ways that offer less resistance to the stream. Entryway area in the form configuration gives the total uniform filling of shape cavity. The material properties of dissolved polymer conduct need to watch and examine with warm conditions to fill investigation with time to check the financial cost contemplations. The fill investigation speaks to the limit of the liquefied plastic to fill the depression from the infusion door. Normally is the second examination performed amid an improvement infusion forming study. This sort of investigation assesses the accompanying parameters for every district of the part:
• Reliability and filling time
• Performance infusion weight
• Melt front temperature
• Location of welding lines
• Positioning of captured gasses

The principle goal of the filling examination is to foresee the position of welding lines and entangled gasses. These deformities ought to be maintained a strategic distance from in stylish districts of the part. Stream front temperatures changes can likewise be assessed all together stay away from material debasement.

3.11.4 FILLING AND PACKING (HOLDING) PRESSURE (FLOW):

The concurrent investigation of both, filling and pressing weight, is imperative to pre-duct the estimation of the pressing weight (additionally known like holding weight) and the holding time. These are essential preparing parameters that ought to be transmitted to the assembling office. This investigation permits the recreation of three vital strides of the embellishment stage: filling, stream and pressing.

3.11.5 RUNNER BALANCES (RUNNER BALANCE):

To play out the sprinter adjust examination is important to assess first the dispatching so as to distinguish the weight profile amid the weight change between the filling and the pressing stages. This examination permits the forecast and streamlining of the best cross segment measurement for a few sprinters. The goal of this advancement is the uniform filling of all sprinters and the weight and temperature homogeneity. De-pending on the format of the sprinters the sprinter balance analysis can propose alterations on the cavities dissemination on the shape.
3.11.6 COOLING (COOL):
Cooling reproductions enable clients to upgrade shape and cooling circuit configuration to accomplish uniform part cooling, limit process durations, take out part war page because of cooling elements, and lessening general assembling costs.
The cooling examination permit to:
- Optimize part and form outlines to accomplish uniform cooling with the mini-mum process duration.

- View the temperature contrast between the center and cavity form surfaces.
- Minimize uneven cooling and leftover worry to decrease or kill part war page.
- Predict temperature for all surfaces inside the form: part, sprinters, cooling channels, embeds.
- Predict the required cooling time for the part and frosty sprinter to decide general process duration.
The outcomes about that can be acquired through this investigation is the accompanying:

3.11.7 STEPS INVOLVED IN EXTRACTION OF THE PART:
- Cavity surface temperature circulation.
- Distribution of temperature contrasts crosswise over inverse surfaces of the hole.
- Distribution of normal plastic temperature at race time.
- Distribution of most extreme plastic temperature at decision time.
- Relative position of the pinnacle temperature at race time.
- Distribution of solidified layer thickness.
- Temperature profile through thickness for every hole component

3.11.8 WAR PAGE AND SHRINKAGE (WAR PAGE AND SHRINKAGE):
- The twist examination permits:
- The assessment of the last part shape before machining the form
• The assessment of both single cavity and multi-cavity molds

• Scale shrinkage and war page comes about for better representation of misshapening
• Export twist geometry in the STL configuration to use as a source of perspective when estimating the form
• The figuring of leftover anxieties creating amid the whole cycle, including impacts of the temperature and weight disseminations, polymer properties, introduction, and geometric elements of the part

• The representation of the frozen-in worry through the part divider thickness

• The assurance of worry before discharge (compelled by the form) and after launch (unconstrained)

3.12 COMPARISON WITH CIRCULAR GATE SYSTEM DESIGN

Plan of form with roundabout entryway is to contrast the door outline and H-entryway plan for better outcomes in plan enhancement. To plan multi-hole shape frameworks with the utilization of programming apparatus form outline Siemens 8.0.

Part choice and configuration demonstrated as follows
3.13 MANUFACTURING PROCESS PLAN F MULTI-CAVITY MOLD

As work piece amounts and expenses in form are generally high, extensive economy can be influenced by picking a proper succession of operations and the correct kind of tooling. The procedure design should consider the aggregate cost: material, tooling, work (time). Process arranging for the most part incorporates the accompanying contemplations.

- Quantity required – aggregate and yearly,
- Work piece – shape and size,
- Work piece – dimensional resiliances,
- Work piece – material confinements,
- Equipment accessible for assembling.

In each apparatus, the procedure arranging done an imperative part and it is trailed by previously mentioned focuses. To make the parts of the apparatus, it is important to take after the correct philosophy of assembling, so one can get exact dimensional soundness for that specific part inside fitting time.

In Mold additionally every one of the parts of the device are produced by considering all previously mentioned succession and picking of machining grouping. Beneath specified sheet communicates all the perspective of machining grouping of the apparatus. So also every one of the parts of the
apparatus are fabricated by the same went with the same pattern.

1) Design organize: -
Subsequent to outlining the device arranged the individual part illustrations for assembling the parts and get together illustration. At that point print out are taken and filled them in process arranging.

2) Manufacturing stages: -
Subsequent to getting the part illustrations material demand is raised to the store office. At that point crude material is sliced by make drawing size with reasonable remittances in size. Then pre-machining is finished by measure with pounding stipends in estimate. Subsequent to keeping up the measurements and references seat work is finished on the plates, such as boring, tapping.

3) Precise operations: -
In the shape apparatus the exactness relies on the measure of the center and hole. So a considerable measure of fixation is made on assembling of center and hole. The center and cavity sister produced inside the required resiliences and keeping up their clearances.

4) Heat treatment: -
In warm treatment organize we need to get ready for arrangement of segment to be warm treated this is essential in light of the fact that as indicated by this succession we need to fabricate part.

5) Assembly arrange: -
As we arrange for form base to merchants, just mfg.of embed and other segment is to get ready for legitimate stream.

- All the highlights of the part with measurements and their references as for the gathering.
- The part is examines and the plans for grouping of process like ordinary, non-traditional and CNC machining, warm treatment in process and stage assessment and so on.
- Special necessities for the tooling, cathode, and CAD/CAM bolster for the projects required for the Core and Cavity embeds that are to be machined on the CNC machines and so on are arranged ahead of time
to meet the procedure stream and to keep up the conveyance plan.

- Stage illustrations of every part coming and going out from process are made for the comfort of the machine administrator demonstrating the references, resistance examination, producing recompenses utilizing the ordinate dimensioning and review approach.

- A constant follow up for the machine accessibility is made for the fulfillment of the occupation in the arranged day and age to keep up the conveyance date.

- The above data is connected for all procedures identified with the part demonstrating most punctual begin and complete date of each procedure regarding material arranging, date of accessibility of extraordinary tooling, anode, CAD/CAM information, month to month need list and so forth. The begin and complete date can be taken from the occupation cards the soonest complete date of gathering can be investigated for the main trial and is imparted to all the interface offices about arranging and their help.

We were given with the 3D model of a component for which we have design a mould. Component material was NYLON. As per customer demand we design a two impression mould. After studying a component we put our component for mould flow analysis. Mould flow analysis can do analysis of different gating locations. Accordingly we can decide how many gate points we can provide. And which are the best possible places of gating. So finally we decided gate points. We decided pin ejection system for ejection of component.

**SUMMARY:**

<table>
<thead>
<tr>
<th>Part Name:</th>
<th>Panal housing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Revision:</td>
<td>1</td>
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<tr>
<td>Material Supplier:</td>
<td>Generic Shrinkage Characterised Material</td>
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<tr>
<td>Material Grade:</td>
<td>Generic PA66 (Leona)</td>
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<tr>
<td>Max Injection Pressure:</td>
<td>180.00 MPa</td>
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<tr>
<td>Parameter</td>
<td>Value</td>
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<tr>
<td>---------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Mold Temperature</td>
<td>60.00 deg.C</td>
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<td>Melt Temperature</td>
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<td>Model Suitability</td>
<td>Part model was highly suitable for analysis.</td>
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<td>Filling Analysis</td>
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<td>Moldability</td>
<td>Your part can be easily filled with acceptable quality using the current injection locations.</td>
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<td>Confidence</td>
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<td>Weld Lines</td>
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<td>Air Traps</td>
<td>Yes</td>
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<td>Shot Volume</td>
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<td>Filling Clamp Force</td>
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<td>Packing Clamp Force Estimate @20%:</td>
<td>(4.78) MPa 1.18 tonne</td>
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<tr>
<td>Packing Clamp Force Estimate @80%:</td>
<td>(19.11) MPa 4.71 tonne</td>
</tr>
<tr>
<td>Packing Clamp Force Estimate @120%:</td>
<td>(28.66) MPa 7.07 tonne</td>
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<tr>
<td>Clamp Force Area</td>
<td>24.18 sq.cm</td>
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<td>Cycle Time</td>
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<tr>
<td>Cooling Quality</td>
<td>Your part will have large problems cooling and may cause problems with ejection.</td>
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<tr>
<td>Surface Temperature</td>
<td>-5.06 deg.C to 2.86 deg.C</td>
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<td>Freeze Time Variance Range</td>
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<td>Sink Mark Analysis</td>
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