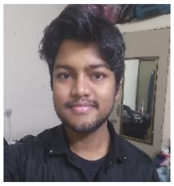
# TA212 – Manufacturing processes–II
# 2nd Sem 2024-25

## Group No. 19

# MECHANICAL FORK LIFTER




Shashwat Shrivastava 230958

Sunny Kumar 2301054

Sanyam Jain 230924

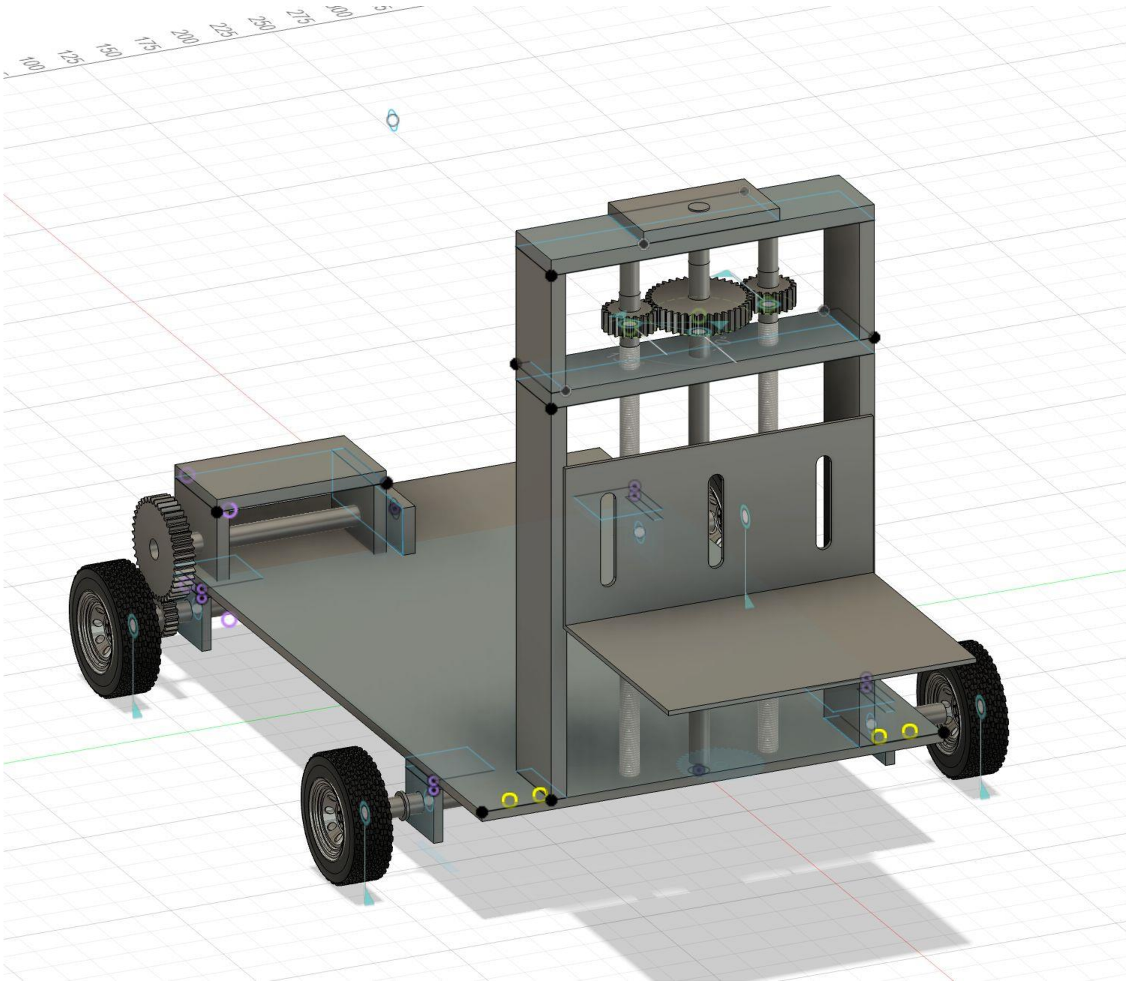
Subhankar Sutradhar 2301042

**Guide - Mr. Rahul**

**Tutor - Mr.**

**Course Instructor – Prof. Arvind Kumar**

# ISOMETRIC DRAWING



# INDEX


| Serial No. | Content | Page No. |
|---|---|---|
| 1 | Introduction | |
| 2 | Acknowledgement | |
| 3 | Abstract | |
| 4 | Motivation | |
| 5 | Isometric Drawing | |
| 6 | Parts List | |
| 7 | Motor Sizing | |
| 8 | Cost Estimation | |
| 9 | Log Sheets | |
| | | |
| | | |

# INTRODUCTION

The mechanical fork lifter using a spur gear mechanism is a small-scale model designed to lift and move light materials easily and efficiently. In industries and workshops, heavy materials often need to be moved from one place to another. Usually, this is done by large hydraulic forklifts which are expensive and difficult to maintain. Our project aims to create a simpler and more affordable version that can be used in small setups.

This fork lifter uses two motors—one for moving the lifter forward and backward, and the other for lifting the forks vertically. The lifting is done using spur gears, which help in converting the motor's rotation into vertical motion. The frame is made of mild steel, which gives it strength and stability.

The main goal of this project is to understand and apply basic mechanical concepts like gears, torque, and structure. We also learned how to combine motors with mechanical parts to create a working system. This project not only helps us learn practically but also shows how simple ideas can solve real-life problems.

# ACKNOWLEDGEMENT

We sincerely express our gratitude to Mr. Rahul Sir for his expert guidance, continuous support, and invaluable feedback during the development of our Mechanical Fork Lifter project under TA212. His profound knowledge, patience, and motivation were instrumental in helping us overcome challenges and refine our design.

We are also thankful to Indian Institute of Technology Kanpur (IITK) for providing the necessary resources, workshop facilities, and a conducive learning environment to execute this project. Our sincere appreciation goes to the lab instructors and technical staff for their assistance during fabrication and testing. This project was a collective effort, and we acknowledge the hard work and dedication of all team members who contributed to its success.

**Group 19**
**TA212, Mechanical Engineering**
**IIT Kanpur**

# ABSTRACT

This paper presents the design and implementation of a motorized mechanical forklift system developed for material handling applications. The prototype utilizes a dual-motor configuration, with one motor enabling wheeled mobility and another driving a spur gear mechanism for vertical lifting operations. The lifting mechanism converts rotational motion into linear displacement through an efficient spur gear arrangement, demonstrating effective power transmission with minimal backlash.

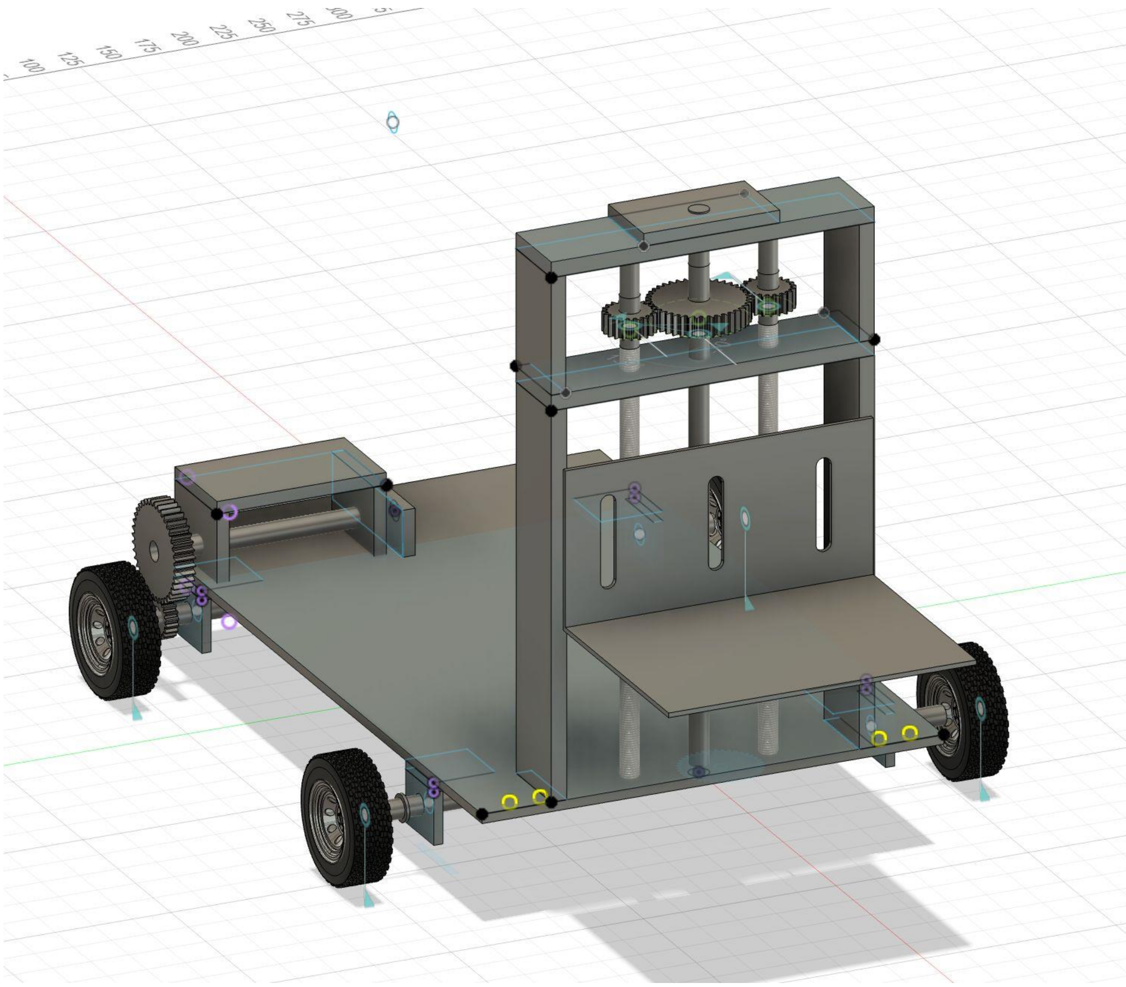
Constructed primarily from mild steel, the forklift's structural design emphasizes stability and load-bearing capacity. The system successfully demonstrates fundamental principles of mechanical power transmission and gear kinematics. Key design considerations included torque requirements, gear ratio optimization, and structural integrity under load.

The project provides practical insights into integrating electrical and mechanical systems for material handling applications. Results indicate reliable performance in lifting and transporting loads within the designed capacity. This work serves as a valuable case study in applied mechanical design and could be extended through automation or enhanced control systems in future iterations.

# MOTIVATION

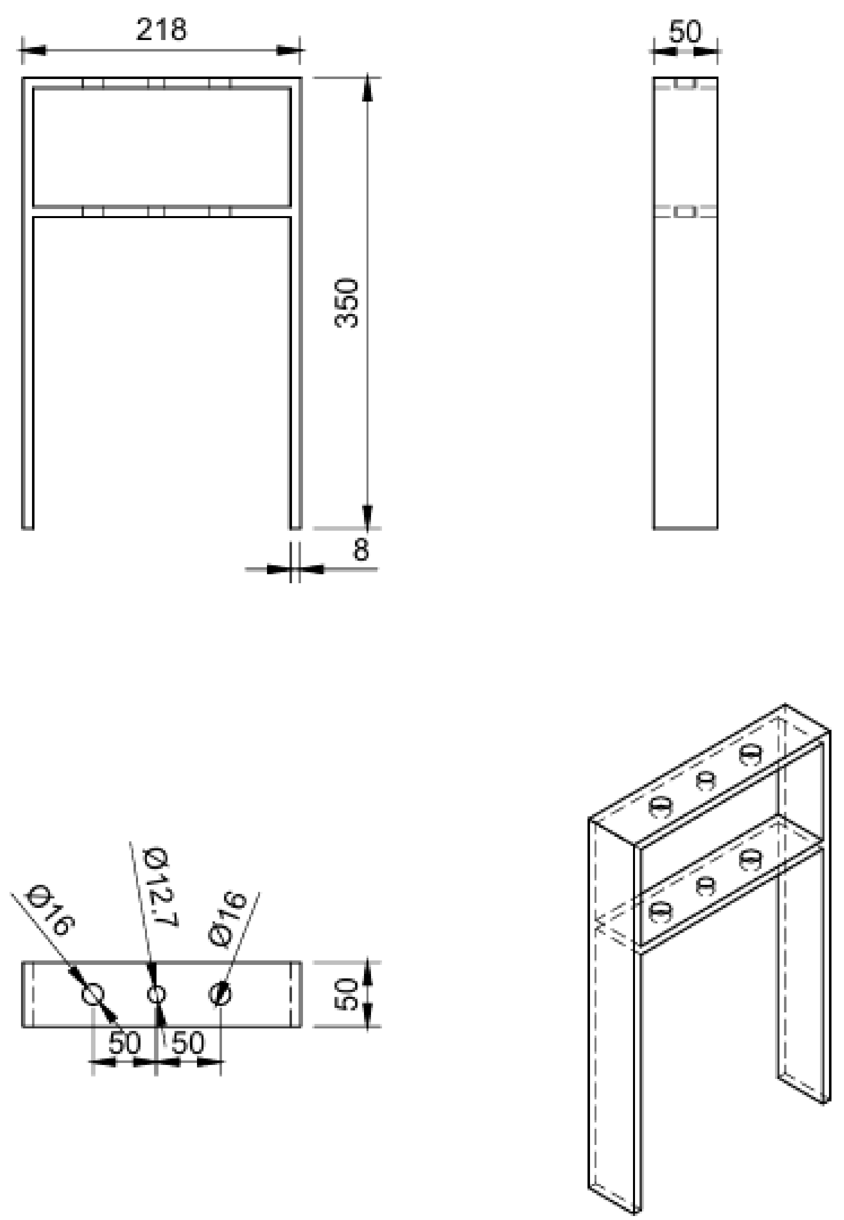
The motivation behind developing this motorized forklift stemmed from observing real-world material handling challenges in small industries and workshops. Traditional manual lifting methods prove labor-intensive and inefficient, while conventional hydraulic forklifts remain cost-prohibitive for many small-scale operations. This project sought to bridge this gap by designing an affordable, electrically-powered alternative using fundamental mechanical principles. The spur gear mechanism was specifically chosen for its reliability, efficiency, and ease of maintenance compared to hydraulic systems. Beyond creating a practical solution, this project served as an invaluable hands-on learning experience in mechanical design, power transmission, and system integration - core competencies for engineering students. By optimizing gear ratios and motor selection, we demonstrated how simple machine elements can be combined to create effective automation solutions, making material handling safer and more efficient. The project also emphasized sustainable design through energy-efficient operation and the use of readily available components, showcasing how engineering innovation can address practical problems while developing crucial technical skills.

# ISOMETRIC DRAWING

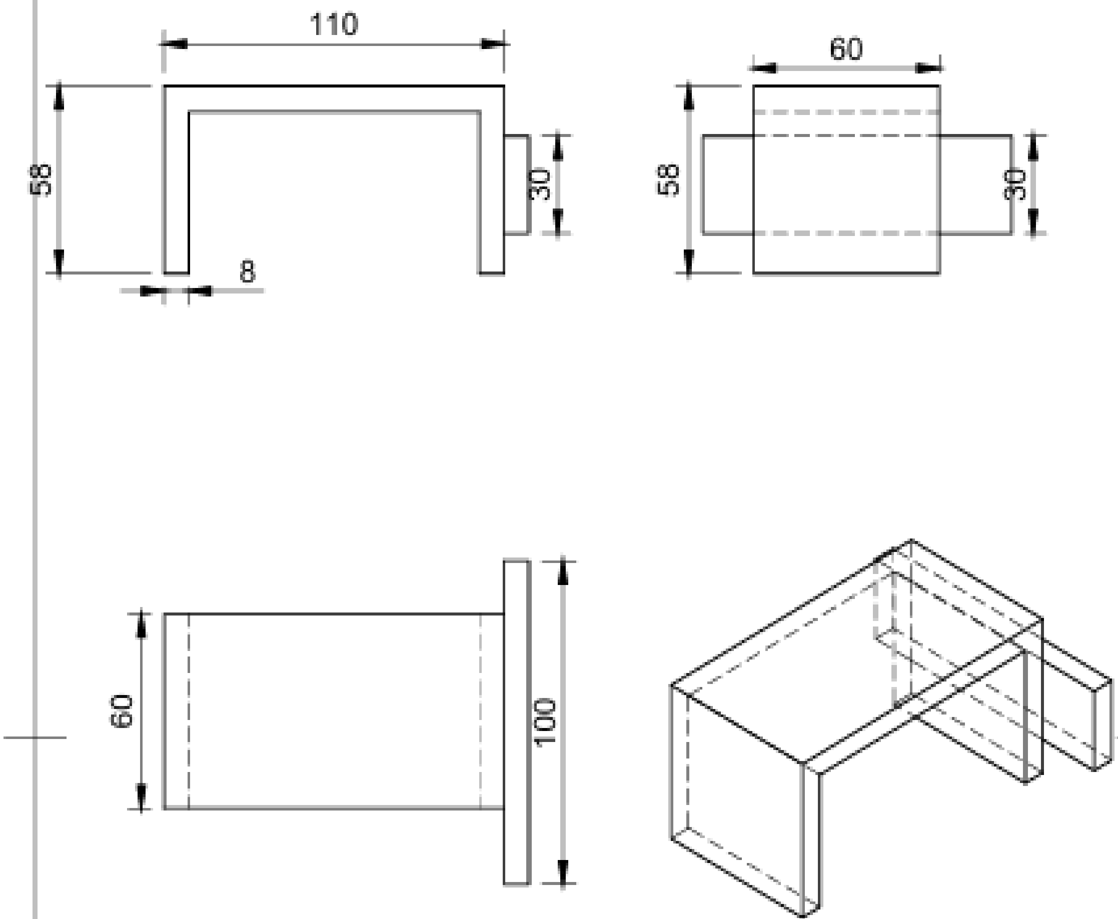


# PARTS LIST

| Part No. | Part Name | Quantity | Dimensions (in mm) |
|---|---|---|---|
| 1 | Frame | 1 | |
| 2 | Motor Support Back | 1 | |
| 3 | Forkplate | 1 | |
| 4 | L- Clamp shaft | | 50*50*7 |
| 5 | Wheel collar | 4 | |
| 6 | L- Clamp Support | | 40*40*7 |
| 7 | Wheel shaft | 2 | |
| 8 | Base Plate | 1 | 490*300*2 |
| 9 | Gear Threaded Shaft | 2 | |
| 10 | Gear Central Shaft | 1 | |
| 11 | Lifting Spur Gear | 2+1 | |
| 12 | Motor Details | | |



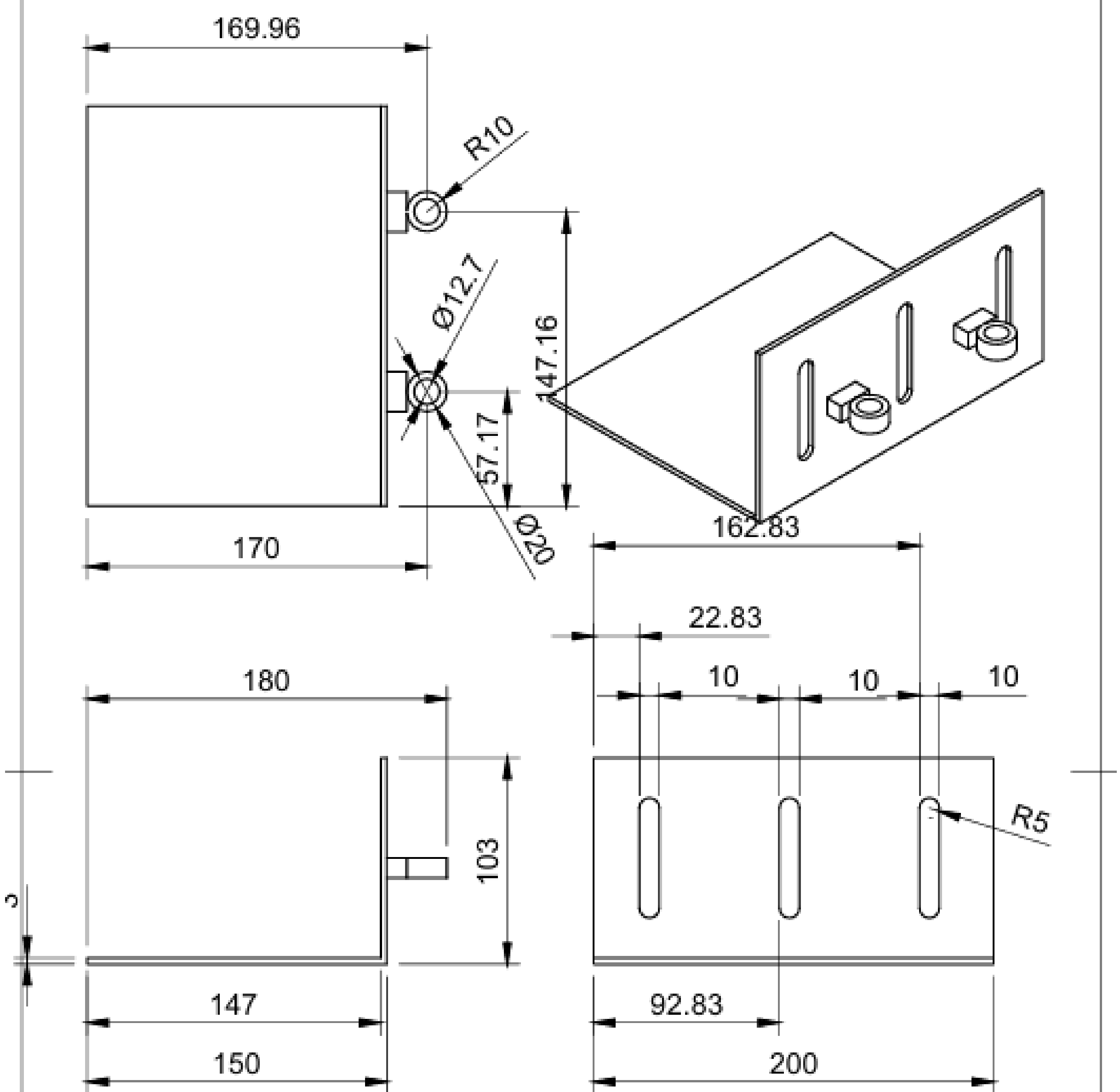

| | | | |
|---|---|---|---|
| Dept. | Technical reference | Created by<br>SUSHANT KUMAR 16/04/25 | Approved by |
| | | Document type | Document status |
| | | Title<br>frame | DWG No. |
| | | | Rev. / Date of issue / Sheet<br>1/1 |



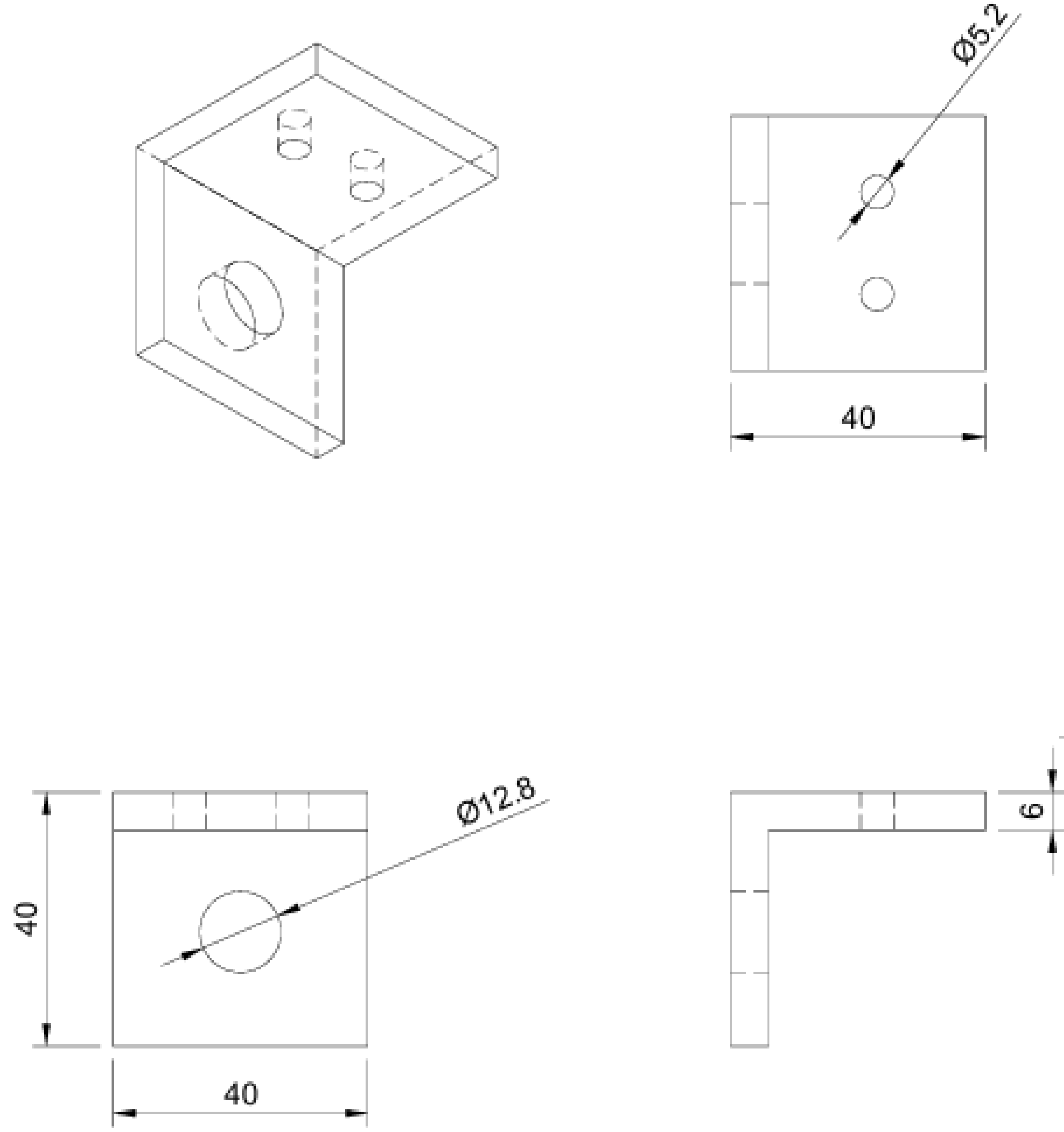

| Dept. | Technical reference | Created by | Approved by |
|---|---|---|---|
| | | SUSHANT KUMAR 16/04/25 | |

| | Document type | Document status |
|---|---|---|
| | | |
| | Title | DWG No. |
| | motor support | |

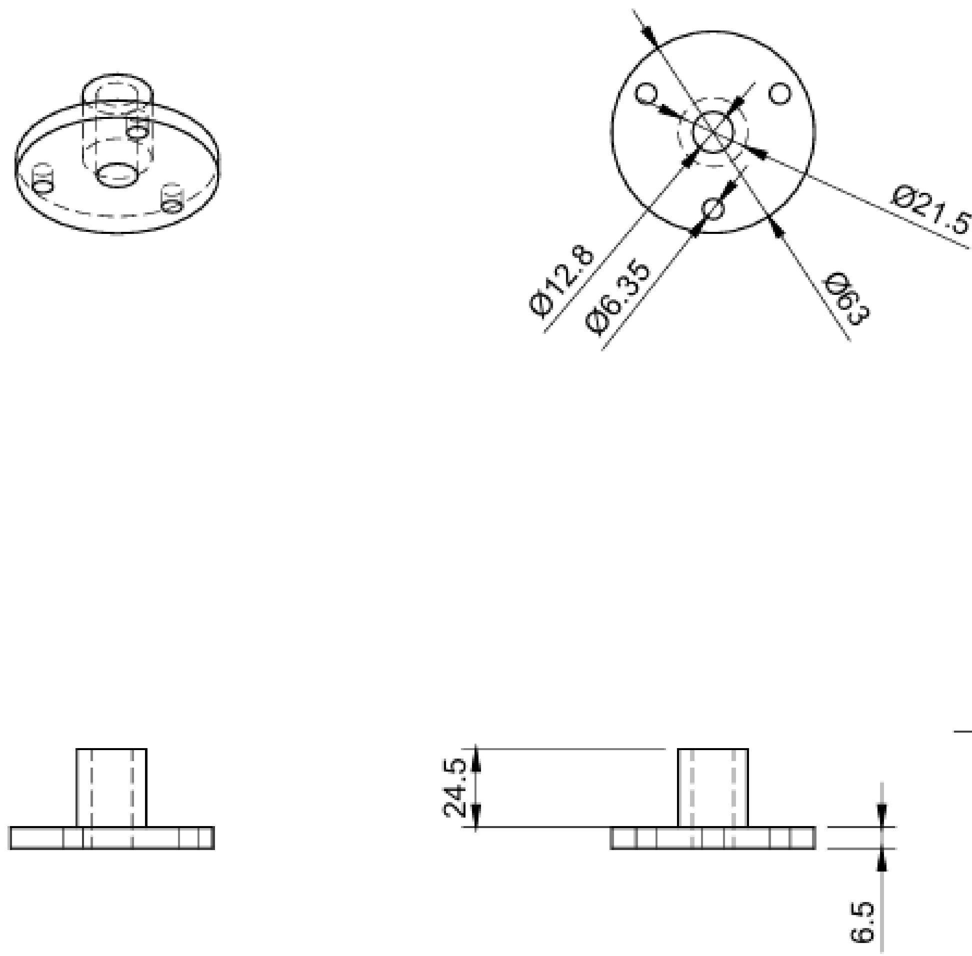
| Rev. | Date of issue | Sheet |
|---|---|---|
| | | 1/1 |



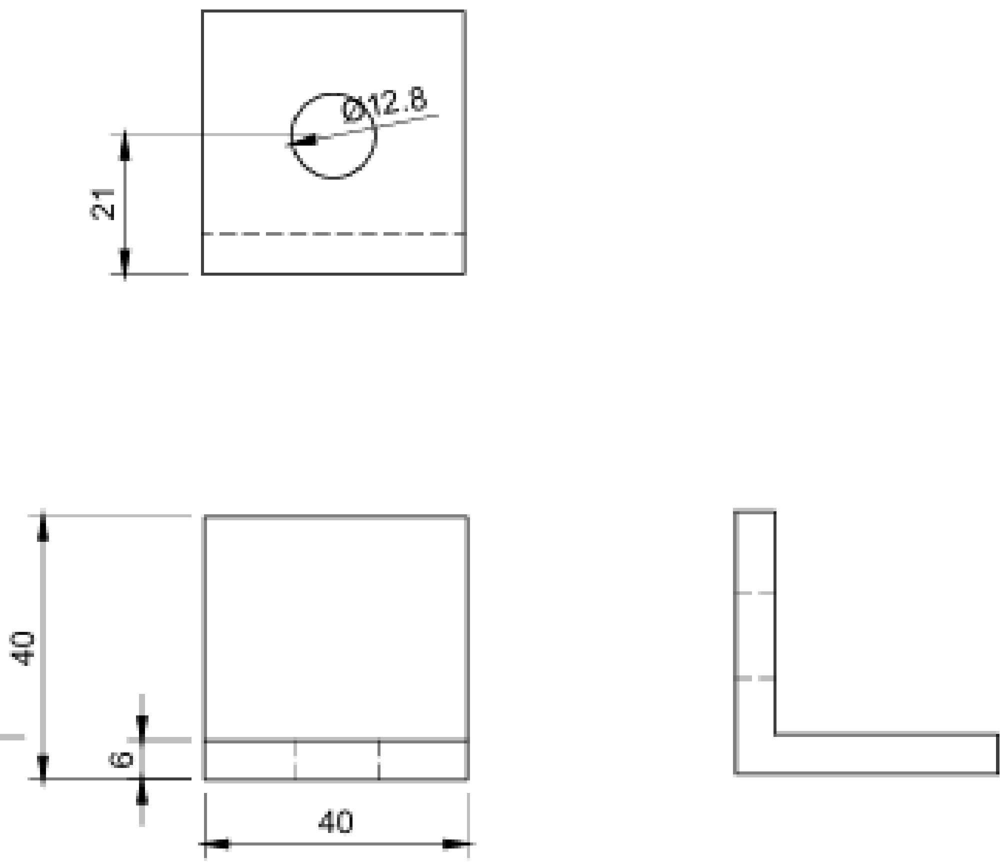

| | | | | |
|---|---|---|---|---|
| Dept. | Technical reference | Created by SUSHANT KUMAR 11/02/25 | Approved by | |
| | | Document type | Document status | |
| | | Title wheel_gears[1] | DWG No. | |
| | | | Rev. | Date of issue | Sheet 1/1 |



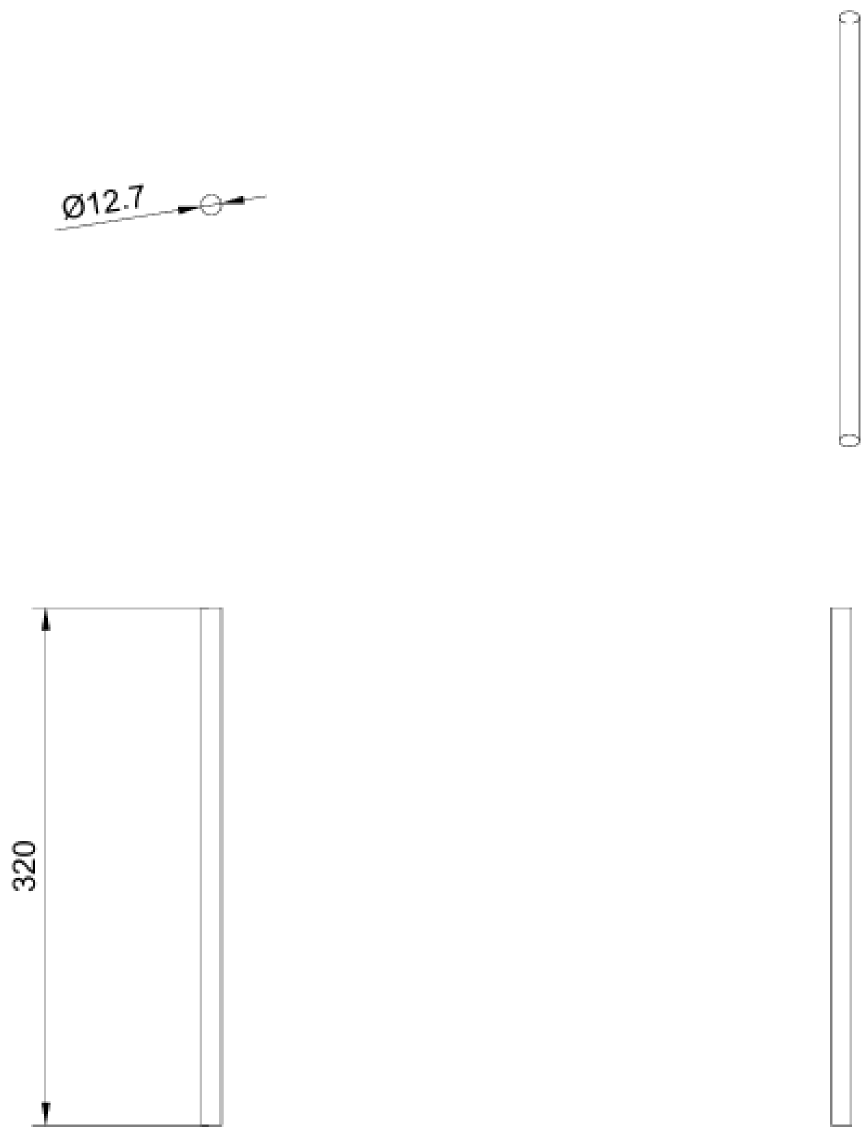

| | | | | |
|---|---|---|---|---|
| Dept. | Technical reference | Created by<br>Tushar Dua 12-02-2025 | Approved by | |
| | | Document type | Document status | |
| | | Title<br>L-Clamp(Shaft) | DWG No. | |
| | | | Rev. | Date of issue | Sheet<br>1/1 |



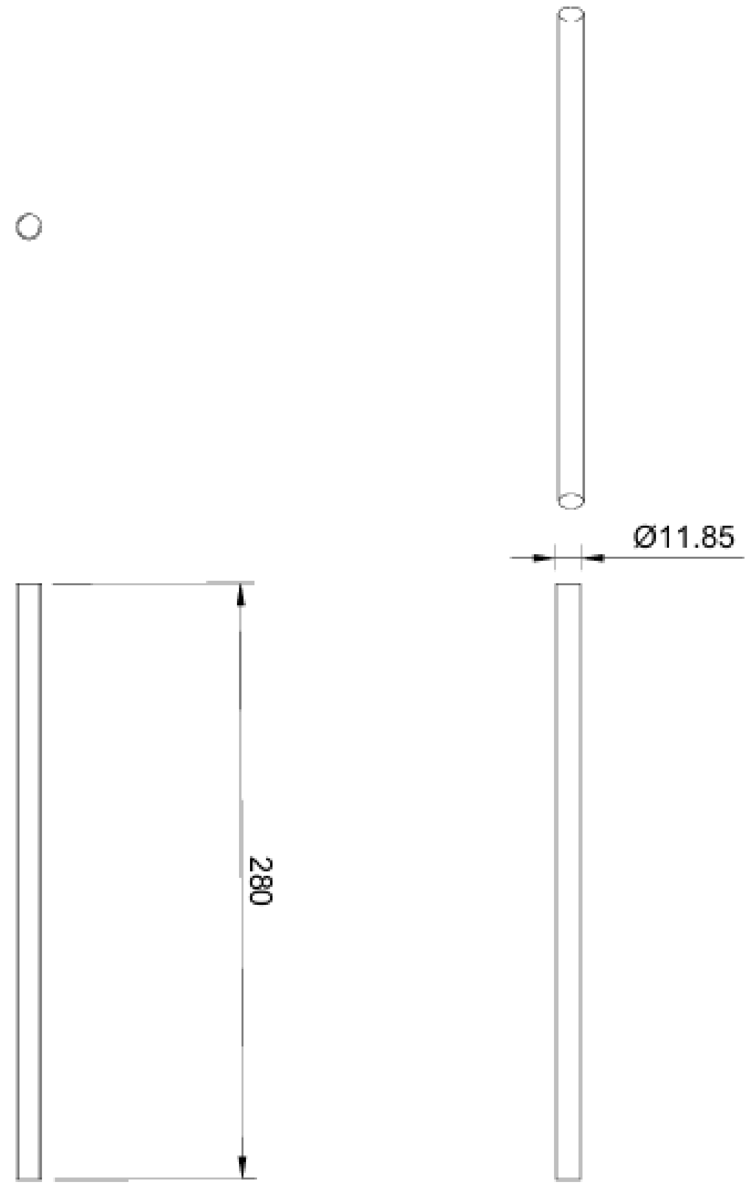

| Dept. | Technical reference | Created by | Approved by |
|---|---|---|---|
| | | Tushar Dua 16-04-2025 | |
| | | Document type | Document status |
| | | Title<br>wheel_collar | DWG No. |
| | | | Rev. / Date of issue / Sheet 1/1 |




| Dept. | Technical reference | Created by SUSHANT KUMAR 10/02/25 | Approved by |
|---|---|---|---|
| | | Document type | Document status |
| | | Title Iclamp | DWG No. |
| | | | Rev. / Date of issue / Sheet 1/1 |

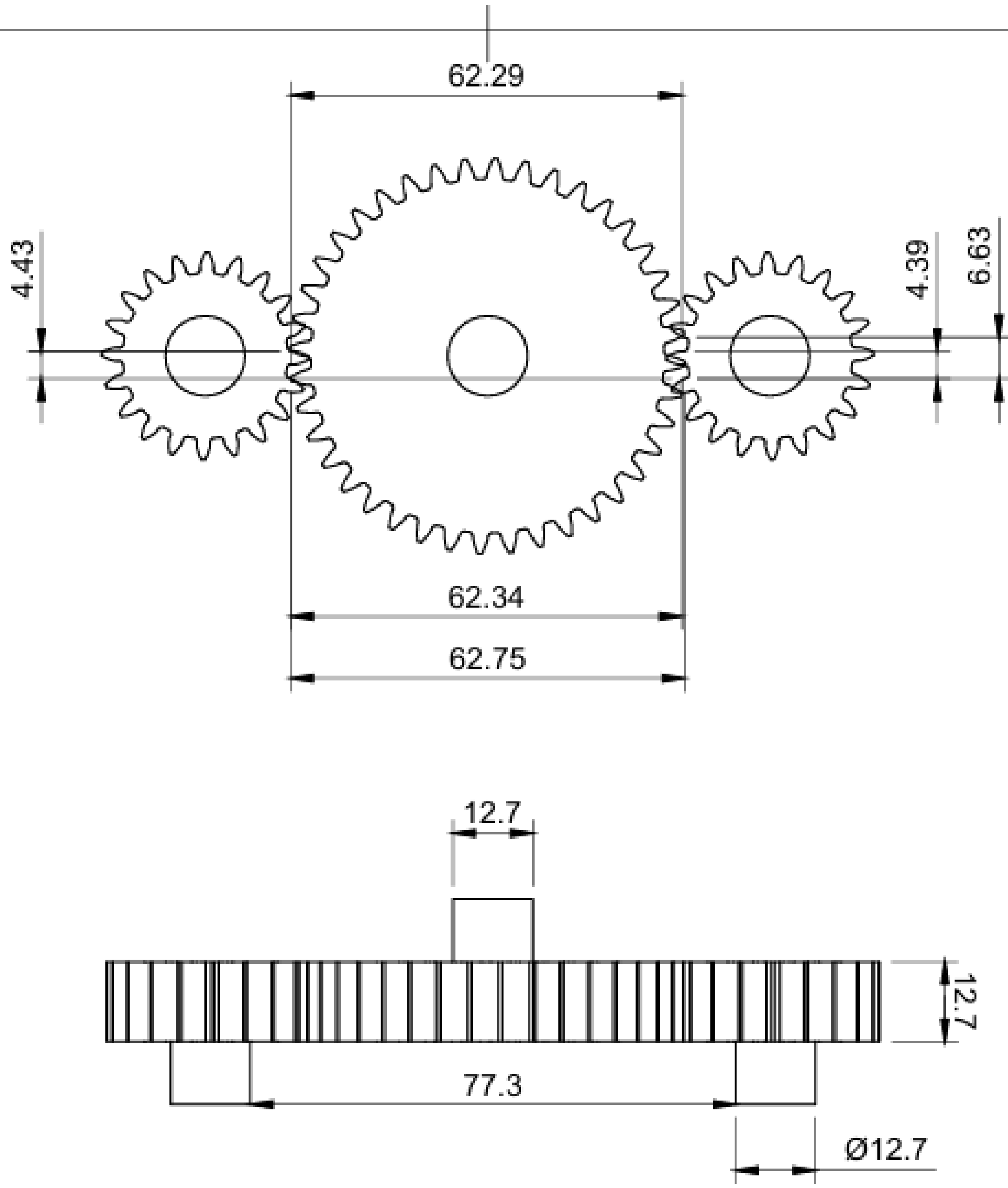



| Dept. | Technical reference | Created by<br>Tushar Dua 12-02-2025 | Approved by | | |
|---|---|---|---|---|---|
| | | Document type | Document status | | |
| | | Title<br>wheel_shaft | DWG No. | | |
| | | | Rev. | Date of issue | Sheet<br>1/1 |




| Dept. | Technical reference | Created by | Approved by |
|---|---|---|---|
| | | Tushar Dua 11-02-2025 | |

| | | |
|---|---|---|
| | Document type | Document status |
| | Title<br>Single_Threaded_Shaft v1 | DWG No. |
| | | Rev. / Date of issue / Sheet 1/1 |




| Dept. | Technical reference | Created by | Approved by |
|---|---|---|---|
| | | SUSHANT KUMAR 10/02/25 | |
| | | Document type | Document status |
| | | Title: spurgear v1 | DWG No. |
| | | | Rev. / Date of issue / Sheet 1/1 |

# GEAR CALCULATION(Side gears *2)

**Given:**

- Number of Teeth (N): 20
- Module (M): 1.5
- Outside Diameter (OD): 33 mm
- Tooth Depth: 3.2 mm
- Taphole: 5.2 mm
- Inner Diameter (ID): 12.7 mm

---

**Gear Dimensions:**

- **Outside Diameter (OD):**
  Given as **33 mm**
- **Tooth Depth:**
  Given as **3.2 mm**
  (Standard formula: Depth = 2.15 × M = 2.15 × 1.5 = 3.225 mm)
- **Pitch Circle Diameter (PCD):**
  PCD = M × N = 1.5 × 20 = **30 mm**
- **Addendum (Height above pitch circle):**
  Addendum = M = **1.5 mm**
- **Dedendum (Height below pitch circle):**
  Dedendum = 1.25 × M = 1.25 × 1.5 = **1.875 mm**

---

**Indexing (Using 40-hole index plate):**

Indexing = 40 / N = 40 / 20 = **2**

→ Move the crank **2 holes per tooth** on any full circle.

---

**M.S. (Mild Steel) Material Requirement:**

- **Gear Blank:** Ø 36 mm × 27 mm (thickness)
- **Shaft/Hub Material:** Ø 25 mm × 25 mm (length)

---

**Drill Hole Details:**

- **Taphole:** Ø 5.2 mm
- **Bore (Inner Diameter):** 12.7 **Gear Calculations**

# • GEAR CALCULATION(Central gear *1)

**Given:**

- Number of Teeth (N): 60
- Module (M): 1.5
- Taphole Diameter: 5.2 mm
- Inner Diameter (ID): 12.7 mm

---

**Gear Dimensions:**

- **Outside Diameter (OD):**
  OD = M × (N + 2) = 1.5 × (60 + 2) = 1.5 × 62 = **93 mm**
- **Tooth Depth:**
  Depth = 2.15 × M = 2.15 × 1.5 = **3.225 mm ≈ 3.2 mm**
- **Pitch Circle Diameter (PCD):**
  PCD = M × N = 1.5 × 60 = **90 mm**
- **Addendum (Height above pitch circle):**
  Addendum = M = **1.5 mm**
- **Dedendum (Height below pitch circle):**
  Dedendum = 1.25 × M = 1.25 × 1.5 = **1.875 mm**

---

**Indexing (Using 40-hole index plate):**

Indexing = 40 / N = 40 / 60 = **2 / 3**

→ Move the crank **2 holes on a 3-hole circle** for each tooth.

---

**M.S. (Mild Steel) Material Requirement:**

- **Gear Blank:** Ø 100 mm × 15 mm (thickness)
- **Shaft/Hub Material:** Ø 25 mm × 25 mm (length)

---

**Drill Hole Details:**

- **Taphole Diameter:** 5.2 mm
- **Bore (Inner Diameter):** 12.7 mm

# MOTOR DETAILS

# (2 * 2knm)