MTE 322 PROJECT 2

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Motor selection

The input speed of the thrust motor on the pinion is $\eta_{P1} = 1{,}720rpm$.

Calculating the power required of the motor is:

$$P_{out} = 14{,}914N * 10\frac{m}{s} = 149{,}140\frac{Nm}{s} = 149{,}140W = 149.14kW$$

Since there is no loss in power throughout the system, the output power is the same as the input power and countershaft power throughout the entire system, therefore:

$$P_{out} = P_{countershaft} = P_{in} = 149.14kW$$

$$149.14kW * 1.341 = 199.99674 \approx 200hp$$

Therefore, selecting a motor with 200hp provides a suitable rating for this application. At the given power, a speed of 1800 rpm was selected based on the required 1,720 rpm.

Out of the options given, the cheapest [Marathon E631A] AC induction motor was chosen.

Product images are for reference only. Please review product specifications for the most accurate and detailed information.

New

Marathon E631A

Marathon

200HP 1790 445T 460V SEVERE DUTY MOTORS

Catalog Number: E631A
Part Number: 445TTFCD6538
Model Number: 445TTFCD6538BB

HP	200
RPM	1800
VOLTAGE	460V
FRAME	445T
PHASE	3
ENCLOSURE	TEFC
MATERIAL	Cast Iron
MOUNTING	Rigid

Figure 1 Selected motor for input shaft

Bearing Selection

From Project 1:

$$W_{rG1} = W_{xP1} = 2.28\ kN$$

$$W_{xG1} = W_{rP1} = 3.65\ kN$$

$$W_{tG1} = W_{tP1} = 11.8kN$$

Below is the 3D FBD for the input shaft which is split into the x-z and y-z planes for two 2D FBDs:

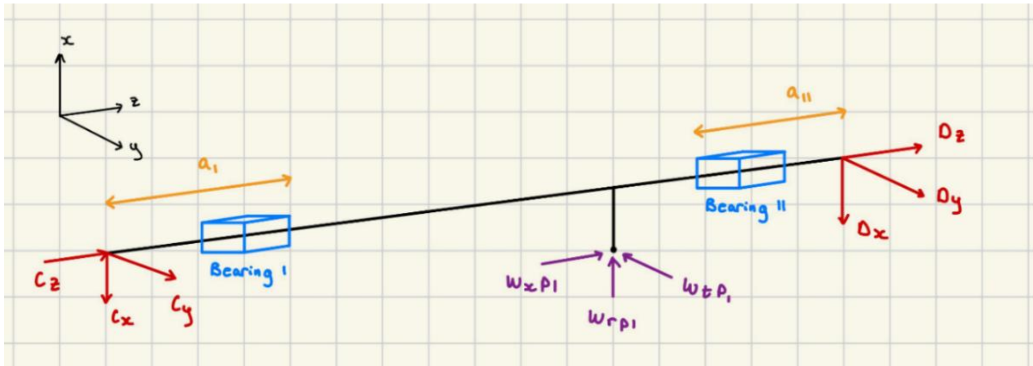


Figure 2 Input shaft 3D FBD for B2B configurations

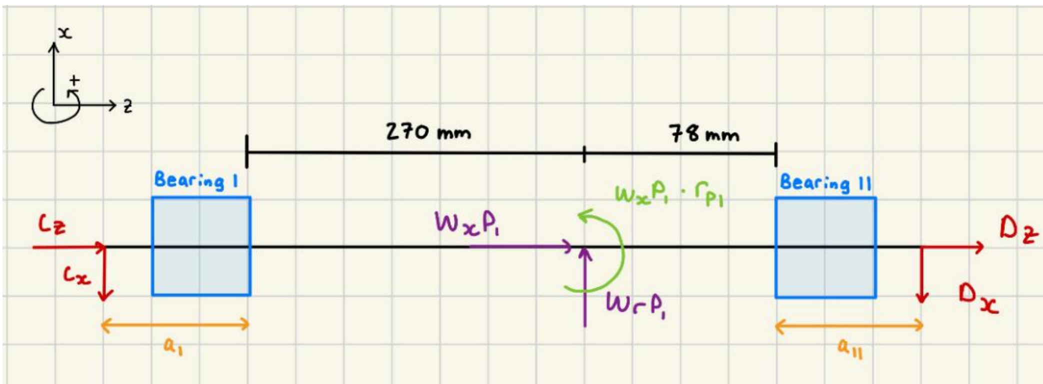


Figure 3 Input shaft x-z plane FBD for B2B configurations

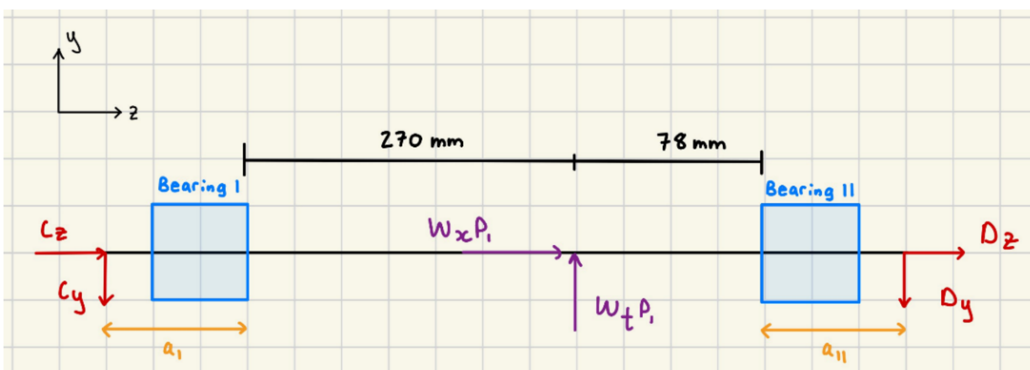


Figure 4 Input shaft y-z plane FBD for B2B configurations

The drawings above are shown for a B2B configuration, but the calculations shown below will be for the generic case where l_C is the distance to the load center of Bearing C and l_D is the distance to the load center of Bearing D. For the B2B drawings above:

$$l_C = 270 + a_I, \qquad l_D = 78 + a_{II}$$

For F2F, these equations include the bearing outer ring thickness as well and subtract a instead:

$$l_C = 270 + C_I - a_I, \qquad l_D = 78 + C_{II} - a_{II}$$

Using the moment equations in the x-z plane

$$\sum M_D = 0 = -W_{rP1}(l_D) + C_x(l_C + l_D) + W_{xP1}(r_{P1})$$

$$C_x = \frac{W_{rP1}(l_D) - W_{xP1}(r_{P1})}{(l_C + l_D)} = \frac{3650(l_D) - 2280(70)}{(l_C + l_D)}$$

$$\sum M_C = 0 = W_{rP1}(l_C) - D_x(l_C + l_D) + W_{xP1}(r_{P1})$$

$$D_x = \frac{W_{rP1}(l_C) + W_{xP1}(r_{P1})}{(l_C + l_D)} = \frac{3650(l_C) + 2280(70)}{(l_C + l_D)}$$

Using the moment equations in the y-z plane:

$$\sum M_D = 0 = -W_{tP1}(78 + a_{II}) + C_y(a_I + 348 + a_{II})$$

$$C_y = \frac{W_{tP1}(l_D)}{(l_C + l_D)} = \frac{11800(l_D)}{(l_C + l_D)}$$

$$\sum M_C = 0 = W_{tP1}(l_C) - D_y(a_{II} + 348 + a_I)$$

$$D_y = \frac{W_{tP1}(l_C)}{(l_C + l_D)} = \frac{11800(l_C)}{(l_C + l_D)}$$

These can be combined to find the total radial force equation for each bearing:

$$F_{rI} = C_r = \sqrt{\left(\frac{3650(l_D) - 2280(70)}{(l_C + l_D)}\right)^2 + \left(\frac{11800(l_D)}{(l_C + l_D)}\right)^2}$$

$$F_{rII} = D_r = \sqrt{\left(\frac{3650(l_C) + 2280(70)}{(l_C + l_D)}\right)^2 + \left(\frac{11800(l_C)}{(l_C + l_D)}\right)^2}$$

Starting with these bearing radial forces, we can compute the resultant L_{10} and f_s for each bearing to see if these parameters match the given requirements for the project. A Python program (Appendix A) was written to brute force all combinations of 55mm-80mm inner diameter bearings that fit the shaft diameter on either side. Both B2B and F2F configurations were tested separately and a total of 292 out of 5625 possible combinations were found that could support the pinion forces. Some extra size restrictions were added on top of the required L_{10} and f_s specifications. These conditions were as follows:

1) The OD of Bearing D must be under the maximum housing width of 150mm
2) The C thickness of Bearing D must be less than the hole width of 40mm
3) The d_{amin} of Bearing D must be less than or equal to the shaft diameter of 86mm
4) The OD of Bearing C must be under the maximum housing width of 120mm
5) The C thickness of Bearing C must be less than the maximum hole width of 37mm
6) The d_{amin} of Bearing C must be less than or equal to the shaft diameter of 66mm

After these extra conditions, three F2F combinations were found that fit all the constraints:

Bearing_I	ID_I	OD_I	T_I	C_I	da_min_I	Bearing_II	ID_II	OD_II	T_II	C_II	da_min_II	Fr_I	Fr_II	Fa_I	Fa_II	P_I	P_II	P0_I	P0_II
HR 32011 XJ	55	90	23	17.5	66	HR 32313 J	65	140	51	39	86	2828.417	9594.743	0	3413.367	2828.417	9640.621	2828.417	9594.743
HR 33011 J	55	90	27	21	66	HR 32313 J	65	140	51	39	86	2796.529	9625.998	1115.411	0	3237.893	9625.998	2796.529	9625.998
HR 33111 J	55	95	30	23	66	HR 32313 J	65	140	51	39	86	2806.02	9616.696	1112.128	0	2901.813	9616.696	2806.02	9616.696

Figure 5 Final working combinations of bearings given project requirements

Out of these three, the smallest possible bearings, given in row 1, were picked: **HR32011XJ** as Bearing C (I) and **HR32313J** as Bearing D (II). Example calculations from the program for this bearing combinations given below.

Calculating radial forces given the equivalent load centers of $a_I = 19.7mm$ and $a_{II} = 34mm$:

$$F_{rI} = \sqrt{\left(\frac{3650(78+39-34)-2280(70)}{(83+267.8)}\right)^2 + \left(\frac{11800(78+39-34)}{(83+267.8)}\right)^2} = 2828.417\ N$$

$$F_{rII} = \sqrt{\left(\frac{3650(270+17.5-19.7)+2280(70)}{(83+267.8)}\right)^2 + \left(\frac{11800(270+17.5-19.7)}{(83+267.8)}\right)^2} = 9594.743\ N$$

For dynamic equivalent loads, we are assuming that the axial load is not negligible compared to e and therefore $Y \neq 0$. Following from this, $X = 0.4$ and $Y = Y_1$ for tapered roller bearings where Y_1 is the axial load factor of each taper roller bearing in the catalogue.

Next, solve for F_{aI} & F_{aII} based on whichever F2F inequality is true:

$$F_{ae} + \frac{0.6}{Y_I}F_{rI} \geq \frac{0.6}{Y_{1II}}F_{rII} \rightarrow \ F_{aII} = F_{ae} + \frac{0.6}{Y_{1I}}F_{rI} \quad \& \quad F_{aI} = 0$$

$$F_{ae} + \frac{0.6}{Y_{1I}}F_{rI} < \frac{0.6}{Y_{1II}}F_{rII} \rightarrow \ F_{aII} = 0 \quad \& \quad F_{aI} = \frac{0.6}{Y_{1II}}F_{rII} - F_{ae}$$

Since we chose bearings HR32011XJ and HR32313J, $Y_{1I} = 1.5$ and $Y_{1II} = 1.7$. W_{xP1} is also considered the external axial force and therefore is equal to F_{ae}.

$$F_{aI} = 0N$$

$$F_{aII} = 3413.37N$$

Now that we have the axial and radial forces of both bearings ($I\ and\ II$), as well as the load factors, we can compute the dynamic equivalent loads, $P_I\ and\ P_{II}$.

We know that $P = XF_r + YF_a$ only under the condition that $F_a > 0$. Therefore,

$$F_{aI} = 0 \rightarrow P_I = F_{rII} = 2828.42N$$

$$F_{aII} > 0 \rightarrow P_{II} = 0.4(F_{rII}) + 1.7(F_{aII}) = 9640.63N$$

Next, using the values of Y_0, we can calculate the static equivalent loads, P_{0I} and P_{0II}:

$$Y_{0I} = 0.81$$

$$Y_{0II} = 0.96$$

$$P_0 = \begin{cases} F_r, & F_r > 0.5F_r + Y_0F_a \\ 0.5F_r + Y_0F_a, & F_r \leq 0.5F_r + Y_0F_a \end{cases}$$

$$0.5F_{rI} + Y_{0I}F_{aI} = 0.5(2828.417\ ) + 0.81(0) = 1414.2085 < F_{rI}$$

$$P_{0I} = 2828.417$$

$$0.5F_{rII} + Y_{0II}F_{aII} = 0.5(9594.743) + 0.96(3413.37) = 8074.2067 < F_{rII}$$

$$P_{0II} = 9594.743$$

Next, check if the L_{10} and f_s requirements are met for both bearings. Referring back to the NSK catalogue the basic load ratings for both bearings are as follows:

$$C_{0I} = 117{,}000\ N$$

$$C_{0II} = 340{,}000\ N$$

Safety factor requirements for Bearing C (I) and Bearing D (II):

$$f_{sI} = \frac{C_{0I}}{P_{0I}} = \frac{117000}{2828.417} = 41.37$$

$$f_{sII} = \frac{C_{0II}}{P_{0II}} = \frac{340000}{9594.743} = 35.44$$

$$f_s < f_{sII} < f_{sI}$$

$$20 < 35.44 < 41.37$$

Therefore, both Bearings C and D abide by the requirements as the necessary safety factor against static failure for the selected bearings should be a minimum of 20.

Lifetime requirements for Bearing C (I) and Bearing D (II):

$$C_I = 81{,}500\ N$$

$$C_{II} = 267{,}000\ N$$

$$C_I \geq P_I(L_{10})^{\frac{3}{10}}$$

$$L_{10_I} \leq \left[\frac{C_I}{P_I}\right]^{\frac{10}{3}} = \left[\frac{81500}{2828.42N}\right]^{\frac{10}{3}} = 73{,}346$$

$$C_{II} \geq P_{II}(L_{10})^{\frac{3}{10}}$$

$$L_{10_{II}} \leq \left[\frac{C_{II}}{P_{II}}\right]^{\frac{10}{3}} = \left[\frac{267{,}000}{9640.63}\right]^{\frac{10}{3}} = 64{,}271$$

$$L_{10} < L_{10_{II}} < L_{10_I}$$

$$50{,}000 < 64{,}271 < 73{,}346$$

As the requirements state, both bearings must have a minimum L_{10} life equal to 50,000. According to the calculations shown above, bearings HR32011XJ as Bearing C (I) and HR32313J as Bearing D (II) both have a L_{10} life greater than 50,000.

Modelling

To constrain Bearing C, steps were cut into the shaft and the housing. The shaft diameter was cut down from $66mm$ to $60mm$ to account for the bearing inner diameter. The hole in the housing was made larger from $80mm$ to $90mm$ to account for the outer diameter. This housing extruded cut was made $17.5mm$ deep, so that the inner face of the bearing sits flush with the housing wall.

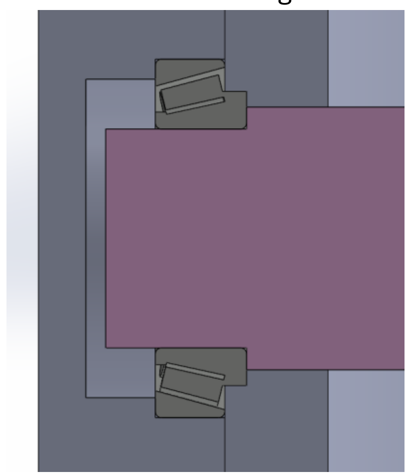


Figure 6 Bearing C installed into the housing

Since $d_{amin} = 66mm$, the shaft itself is enough to meet the abutment requirements for the inner ring. For the outer ring, the abutment diameter of $D_a = 80mm$ fits with the confines of $D_{amin} = 80mm$ and $D_{amax} = 81mm$. Therefore, the bearing is properly constrained on load bearing corners.

For Bearing D on the right side, the shaft was cut down from $86mm$ to $65mm$ to fit the inner diameter and create a constraining step in the shaft. Since the pinion diameter is approximately $150mm$, the hole in the housing must be big enough to be able to fit the pinion and consequently also bigger than the $140mm$ outer diameter of the bearing. To support and constrain the bearing, the housing cover will be designed to fit between the housing opening and its outer ring. This cover will also provide a constraining step for the outer ring in much the same way the step in the housing was used with Bearing C. This bearing is also made to sit flush with the inner face of the housing.

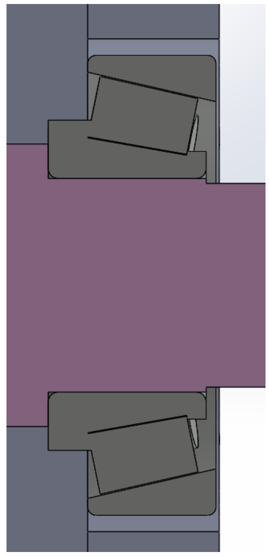


Figure 7 Bearing D fitted onto the shaft

Again, the shaft itself is enough to meet the inner ring abutment requirement of $d_{amin} = 86mm$ and no external restraining rings are needed. The housing cover will be designed to meet the outer ring abutment requirements of being between $D_{amin} = 116mm$ and $D_{amax} = 128mm$.

Before designing the housing cover, an appropriate lip seal must be selected to be placed after Bearing D on the shaft. Since the tolerancing of the lip seal should be different from the tolerancing of the bearing, another step must be cut here so that the lip seal sits on a different part of the shaft with a smaller diameter. The far end of the shaft, attached to the motor, has a diameter of $60mm$ and shouldn't be cut down so a lip seal with a diameter of between $60mm$ and $65mm$ (ID of Bearing D) can be picked. For this application, we went with the SKF 62x90x10 HMSA10 V seal and its placing can be seen in Figure 8 below:

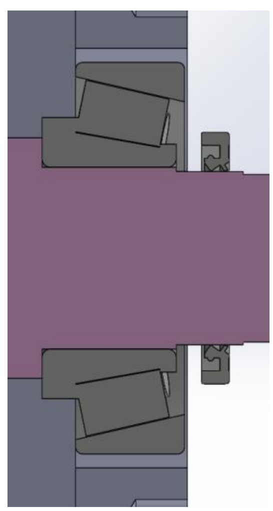


Figure 8 Lip seal fitted onto the shaft

Following this, the housing cover can be designed will all the bearing and lip seal constraints in mind. The $90mm$ OD of the lip seal should be able to fit snug within the cover, and the cover outer diameter should be big enough so that it's able to be screwed into the existing holes in the housing. With regards to the bearing, D_a was chosen to be $120mm$ thus fitting into the outer ring abutment requirements mentioned earlier. The cover was also designed to leave an S_a gap of $6mm$, which is above the required $S_{amin} = 4mm$. The final design is shown in Figure 9, after all sharp corners were chamfered by $5mm$.

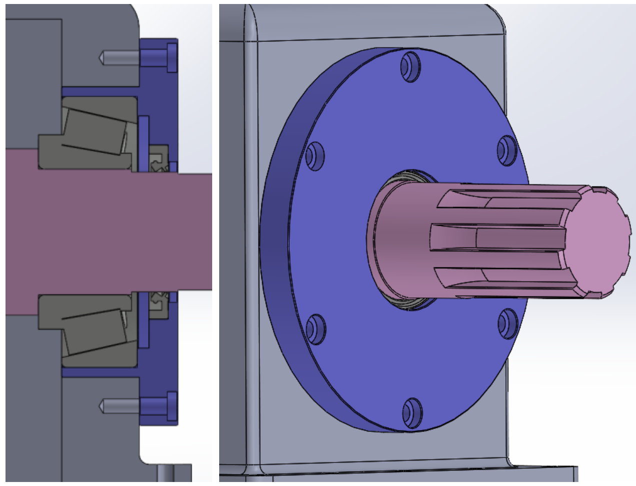


Figure 9 Final design for housing cover

Tolerancing

Since the inner ring along with the inner ring load are rotating and the outer ring along with the outer ring load must be stationary, the inner ring is made to be tight fit while the outer ring is kept loose fit.

To determine the tolerancing for Bearing C (I), the load conditions must be determined by finding the ratio between the capacity of the bearing and the actual load the bearing is experiencing.

For bearing HR 32011 XJ, $C_I = 81{,}500\ N$ and $P_I = 2828.42\ N$

$$Load\ Condition = \frac{P_I}{C_I} = \frac{2828.42}{81500} = 0.0347 = 3.47\%$$

This indicates that Bearing C is experiencing a “Light Load or Variable Load” (less than 6% of the C_r) as categorized in A84/85 of the NSK catalogue. Since the diameter of the shaft (66mm) is between 40-100mm, the suggested tolerancing is k6. The same calculation for Bearing D (II) is shown below:

For bearing HR 32313J, $C_{II} = 267{,}000\ N$ and $P_{II} = 9640.63\ N$

$$Load\ Condition = \frac{P_{II}}{C_{II}} = \frac{9640.63}{267000} = 0.0361 = 3.61\%$$

Similarly to Bearing C, Bearing C is experiencing a “Light Load or Variable Load” and as the shaft diameter (86mm) is again between 40-100mm the tolerancing used is k6 for this bearing as well.

The housing tolerances must be determined next. Comparing the load conditions of the system with the conditions given in A85 of the NSK catalogue we recognize that both bearings used must have a rotating inner ring. In addition, both solid and split housing are useful for disassembly and consistent maintenance which would be vital for this marine propulsion system after a certain number of cycles have been reached. Both the bearings that were chosen should also be able to support loads of all kinds. Therefore, based on these categories we can ascertain the tolerances for the housing bores as H7. Thus, this results in both bearings having an H7/k6 tolerance.

According to SKF, the lip seal that chosen for our design has a nominal H8/h11tolerance. The tolerancing for all other new parts mated with the housing, such as the housing cover, follows a H7/g6 scheme. Lastly, if the step on the shaft and the step on the housing are too close together then the bearing won't fit properly. Therefore, we will take the nominal tolerances and remove the most material condition for each step depth. This would mean that in the worst case, there is some extra space for the bearing but never not enough.

Assembly

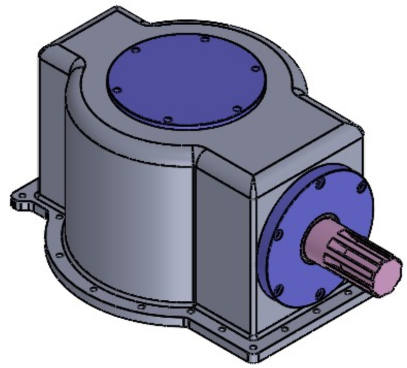
1) Since the pinion (P6) is to be placed in the middle of the shaft (P2) with a strong interference fit, it should be pushed first before the bearings (P8 and P9) and lip seal (P10). Force should be applied till it reaches the widest part of the shaft and contacts the narrow step.
2) The inner rings of the bearings (P8 and P9) should be tightly fit to the shaft (P2) next. Both bearings must be pushed onto the shaft with a sizeable force till they're successfully made to be flush with their appropriate steps
    a. Both bearings should be inserted with the side that has the inner ring sticking out made to be facing the pinion (P6) to ensure an F2F configuration
    b. Bearing C (P8) is to be pushed in from the side farther from the pinion till its inner ring contacts the $66mm$ step
    c. Bearing D (P9) is to be pushed in from the side closer behind the pinion till its inner ring contacts the $86mm$ step
3) Similarly, the lip seal (P10) should be pushed in tightly behind Bearing D (P9) till its inner face is at a distance of $9mm$ from the inner ring of the bearing
4) The shaft (P2) can then be pulled through the housing side cover (P7) till the cover contacts both the lip seal (P10) and Bearing D (P9). The cover should fit around the outer ring of Bearing D.
5) This full assembly can then be inserted into the housing (P1) from the $150mm$ hole in the side, with the Bearing C (P8) side going in first. The outer ring of Bearing C should contact the back of the housing, and the housing side cover (P7) should be flush with the side wall of the housing.
6) The housing cover (P7) should then be screwed into the housing (P1) using the counterbored and threaded holes on the cover and housing body respectively to fully secure the assembly.

Appendix A:

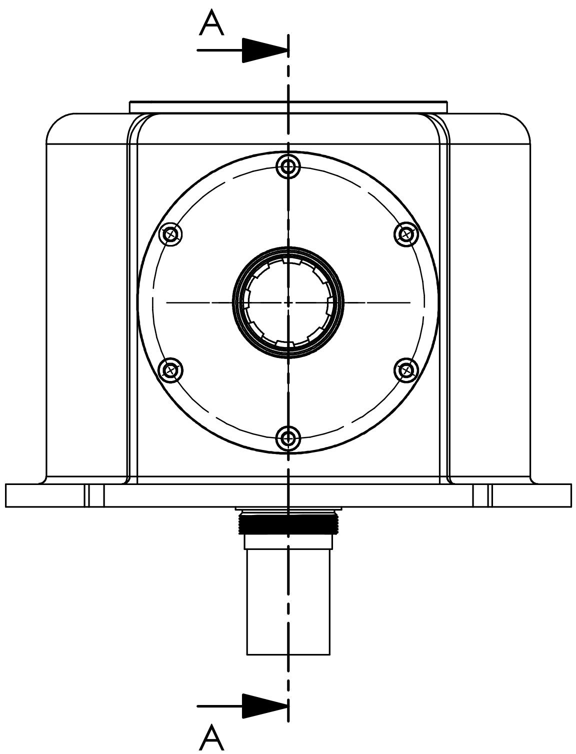
```python
import pandas as pd
from math import sqrt

df = pd.read_csv('nsk.csv')
left_diameter = 66
right_diameter = 86
WxP1 = 2282
WrP1 = 3651
WtP1 = 11829
dI = 270
dII = 78
rP1 = 70
L10 = 50000
fs = 20
f2f = True

# List to store results
results = []
count = 0

for index_C, bC in df.iterrows():
    for index_D, bD in df.iterrows():
        if bC['d'] < left_diameter and bD['d'] < right_diameter and bC['damin'] <= left_diameter and bD['damin'] <= right_diameter:
            CIr = bC['Cr']
            CI0r = bC['C0r']
            CIIr = bD['Cr']
            CII0r = bD['C0r']

            if f2f == True:
                lC = dI - bC['a'] + bC['C']
                lD = dII - bD['a'] + bD['C']
            else:
                lC = dI + bC['a']
                lD = dII + bD['a']

            Cx = ((WrP1*lD)-(WxP1*rP1)) / (lC+lD)
            Cy = (WtP1*lD) / (lC+lD)
            Dx = ((WrP1*lC)+(WxP1*rP1)) / (lC+lD)
            Dy = (WtP1*(lC)) / (lC+lD)

            FrI = sqrt(Cx*Cx + Cy*Cy)
            FrII = sqrt(Dx*Dx + Dy*Dy)

            FaI = 0
            FaII = 0
            if f2f == True:
                if ((WxP1 + (0.6 * FrI / bC['Y1'])) >= (0.6 * FrII / bD['Y1'])):
                    FaII = WxP1 + (0.6 * FrI / bC['Y1'])
                else:
                    FaI = (0.6 * FrII / bD['Y1']) - WxP1
            else:
                if ((WxP1 + (0.6 * FrII / bD['Y1'])) >= (0.6 * FrI / bC['Y1'])):
                    FaI = WxP1 + (0.6 * FrII / bD['Y1'])
                else:
                    FaII = (0.6 * FrI / bC['Y1']) - WxP1

            PI = (0.4*FrI + bC['Y1']*FaI) if FaI > 0 else FrI
            PII = (0.4*FrII + bD['Y1']*FaII) if FaII > 0 else FrII

            P0I = 0.5*FrI + bC['Y0']*FaI
            P0II = 0.5*FrII + bD['Y0']*FaII
```

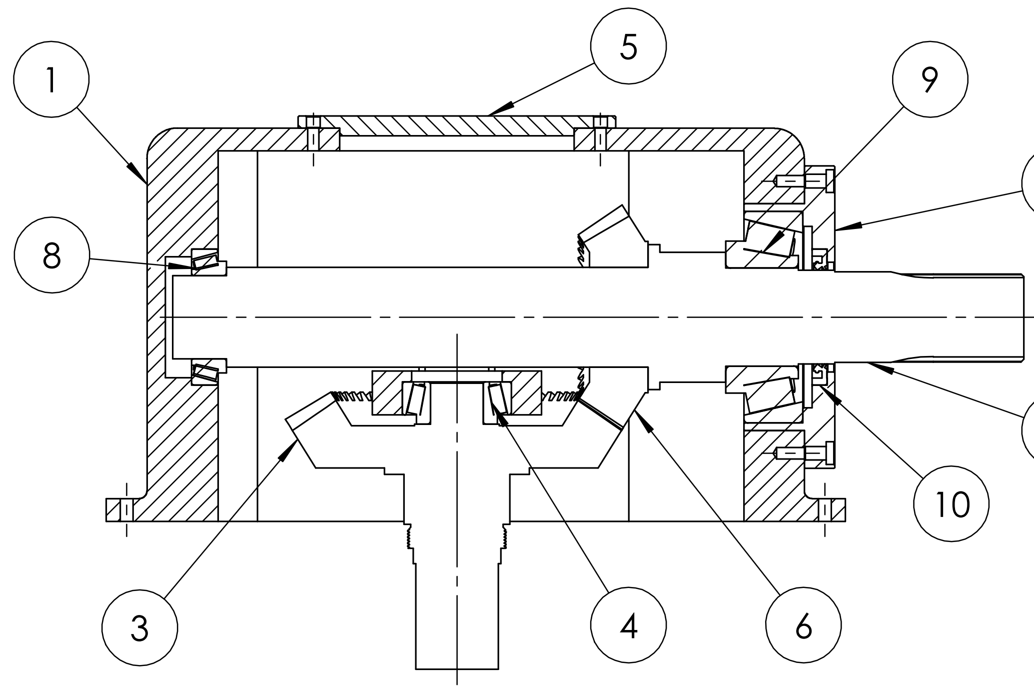
```
            if FrI > P0I:
                P0I = FrI
            if FrII > P0II:
                P0II = FrII

            CIreq = PI * (L10 ** (3/10))
            CI0req = fs * P0I
            CIIreq = PII * (L10 ** (3/10))
            CII0req = fs * P0II

            if CIreq < CIr and CI0req < CI0r and CIIreq < CIIr and CII0req < CII0r:
                print(bC['Bearing'], bD['Bearing'])
                # Store all data in a dictionary
                result_row = {
                    'Bearing_I': bC['Bearing'],
                    'ID_I' : bC['d'],
                    'OD_I' : bC['D'],
                    'T_I' : bC['T'],
                    'C_I' : bC['C'],
                    'da_min_I' : bC['damin'],
                    'Bearing_II': bD['Bearing'],
                    'ID_II' : bD['d'],
                    'OD_II' : bD['D'],
                    'T_II' : bD['T'],
                    'C_II' : bD['C'],
                    'da_min_II' : bD['damin'],
                    'Fr_I' : FrI,
                    'Fr_II' : FrII,
                    'Fa_I' : FaI,
                    'Fa_II' : FaII,
                    'P_I' : PI,
                    'P_II' : PII,
                    'P0_I' : P0I,
                    'P0_II' : P0II,
                }
                results.append(result_row)
        count += 1

print(f"\n{count} combinations checked")
if results:
    results_df = pd.DataFrame(results)
    results_df.to_csv('bearing_results.csv', index=False)
    print(f"Saved {len(results)} results to bearing_results.csv")
else:
    print("No results found matching the criteria.")
```

ITEM NO.	PartNo	DESCRIPTION	QTY.
1	PRT1	Input Shaft Housing	1
2	PRT2	Input Shaft	1
3	PRT3	Input Bevel - Gear	1
4	BRG E & K	NSK HR33207J	1
5	PRT6	Input Housing Top Cover	1
6	PRT4	Input Bevel - Pinion	1
7	PRT7	Input Housing Side Cover	1
8	BRG C	NSK HR32011XJ	1
9	BRG D	NSK HR32313J	1
10	SEAL	SKF 62X90X10 HMSA10 V	1



SCALE 1:10





SECTION A-A, SCALE 1 : 5

University of Waterloo
MTE322

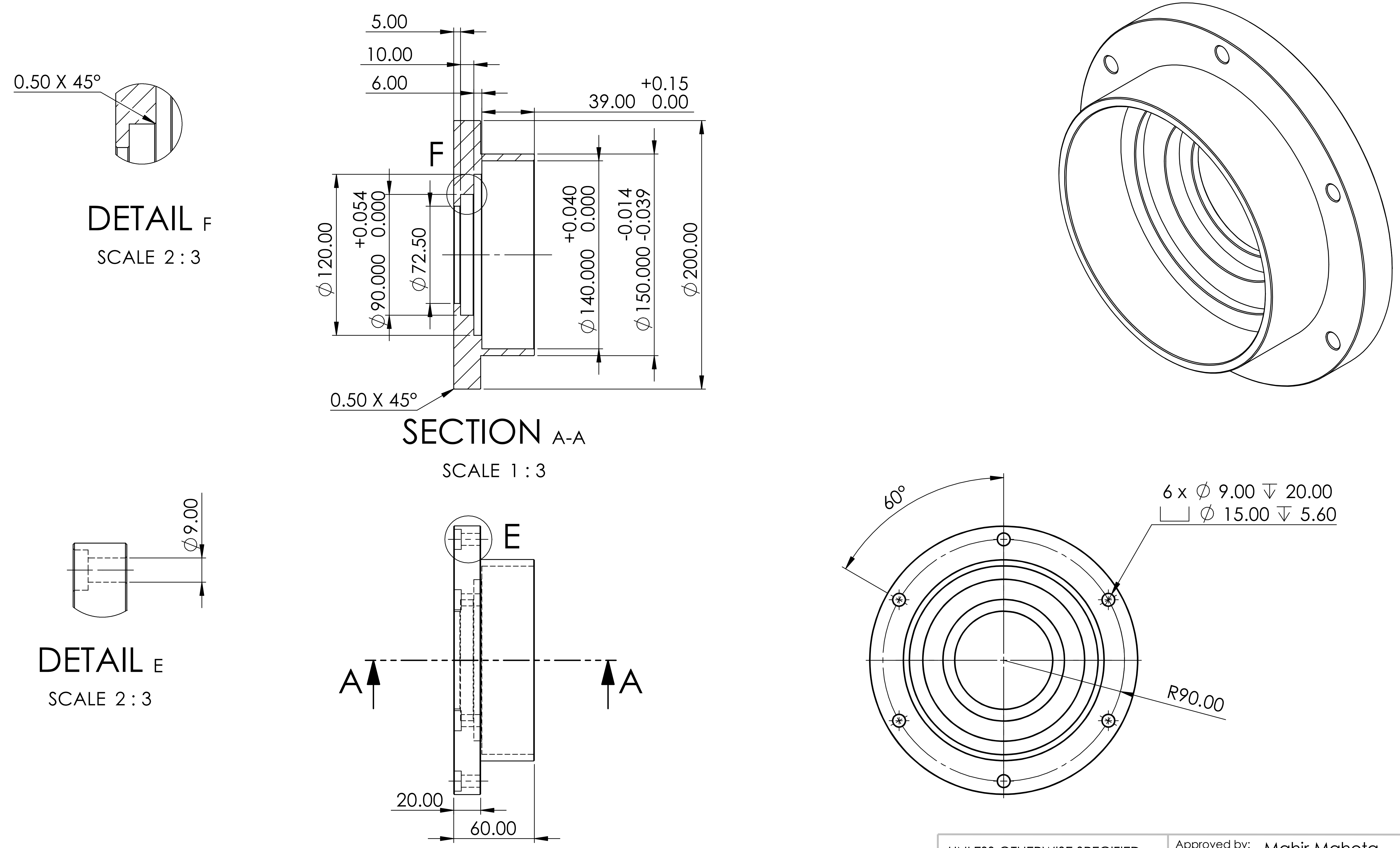
ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED

LINEAR TOLERANCE ± 0.15
ANGULAR TOLERANCE ± 0.1°

Approved by Vinesh Vivekanand
Created by Mahir Mahota
DATE: 28-Nov-25

DO NOT SCALE PRINT
THIRD ANGLE PROJECTION

SIZE LETTER
PART NO Input Shaft Assay
REV
SCALE: 1:5
WEIGHT:
SHEET 1 / 1
Description Input Shaft Assembly



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS

TOLERANCES:
LINEAR: ± 0.15
ANGULAR: ± 0.1°

DO NOT SCALE DRAWING

PROJECTION TYPE:
THIRD ANGLE

Approved by: Mahir Mahota

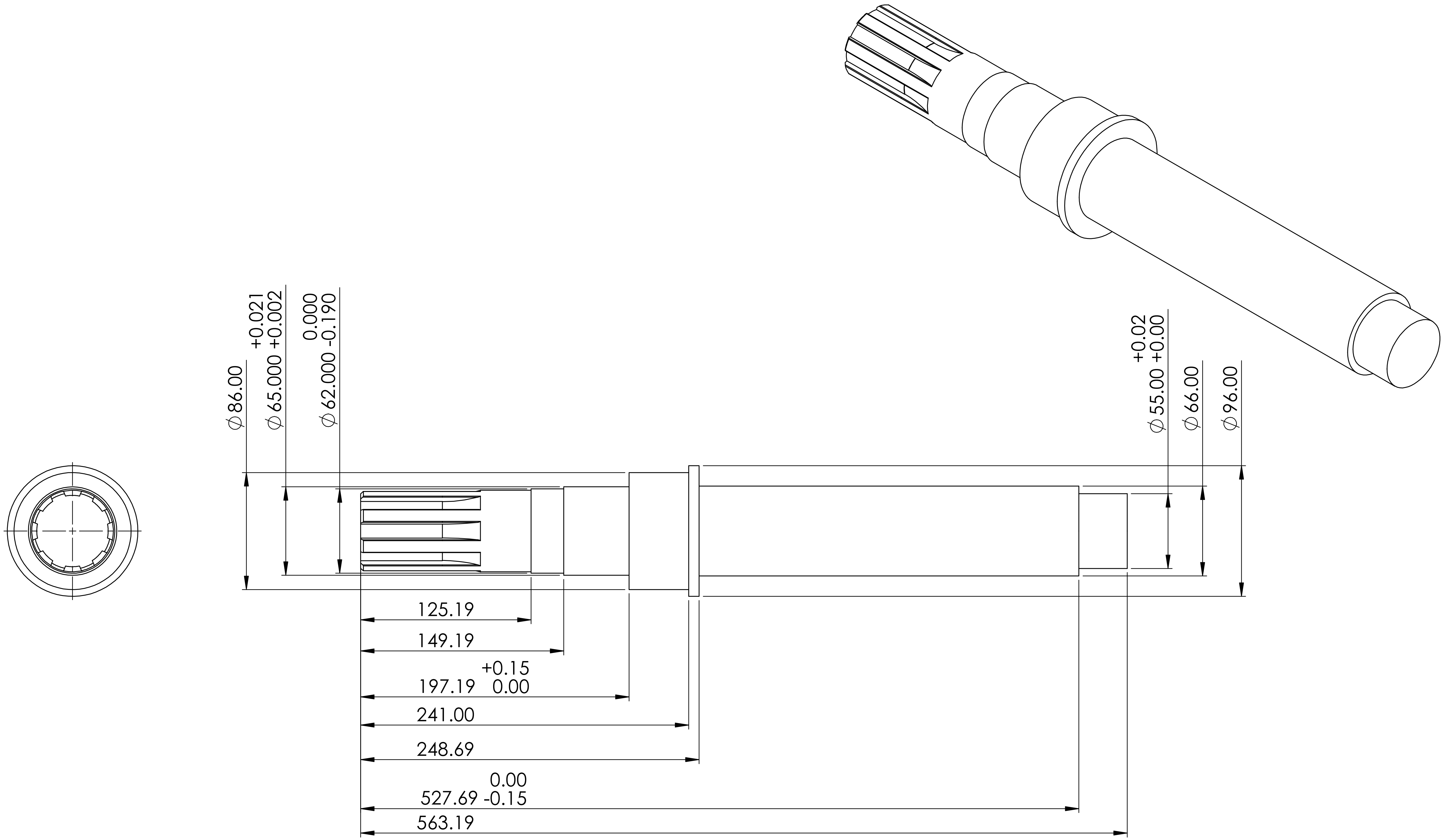
Created by: Vinesh Vivekanand

Student ID: 21000784

University of Waterloo
MTE322

Description: Housing Side Cover

PART NO. PRT7	SHEET FORMAT A3	
DATE: 2025-11-28	SCALE:1:3	SHEET 1 OF 1



UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MILLIMETERS

TOLERANCES:
LINEAR: ± 0.15
ANGULAR: ± 0.1°

Approved by: Mahir Mahota

Created by: Vinesh Vivekanand

Student ID: 21000784

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DO NOT SCALE DRAWING

Description: Input Shaft

PROJECTION TYPE: THIRD ANGLE

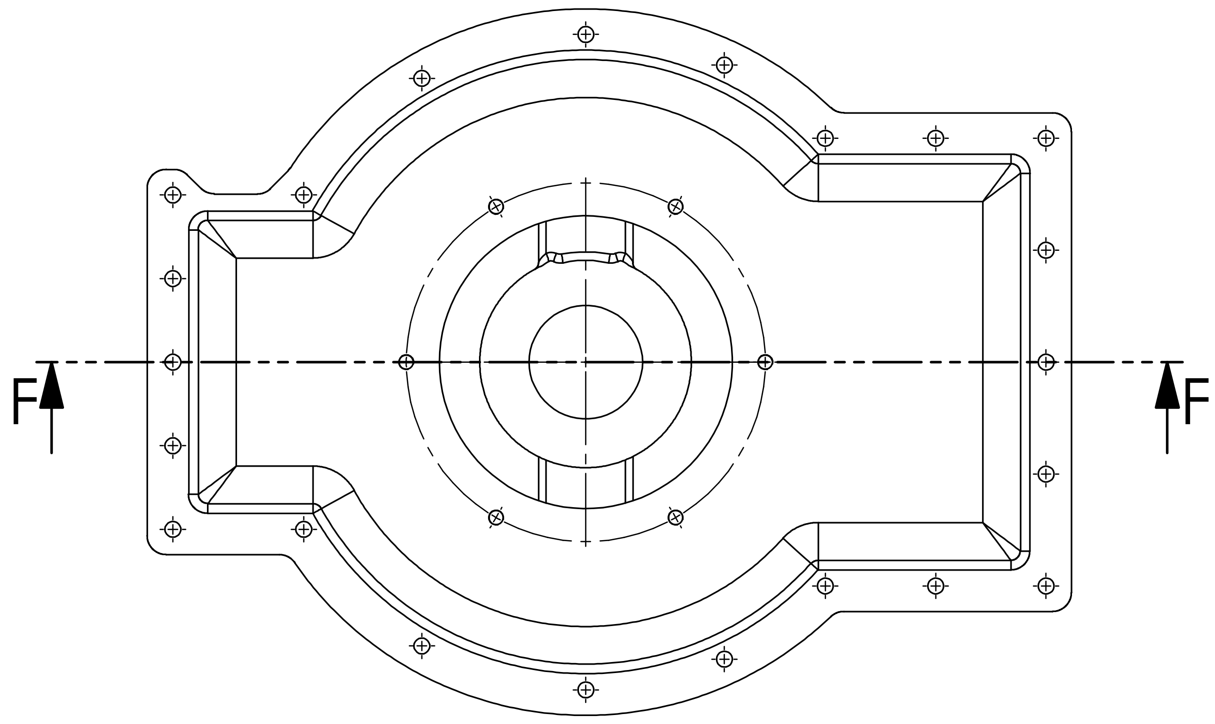
PART NO. PRT2

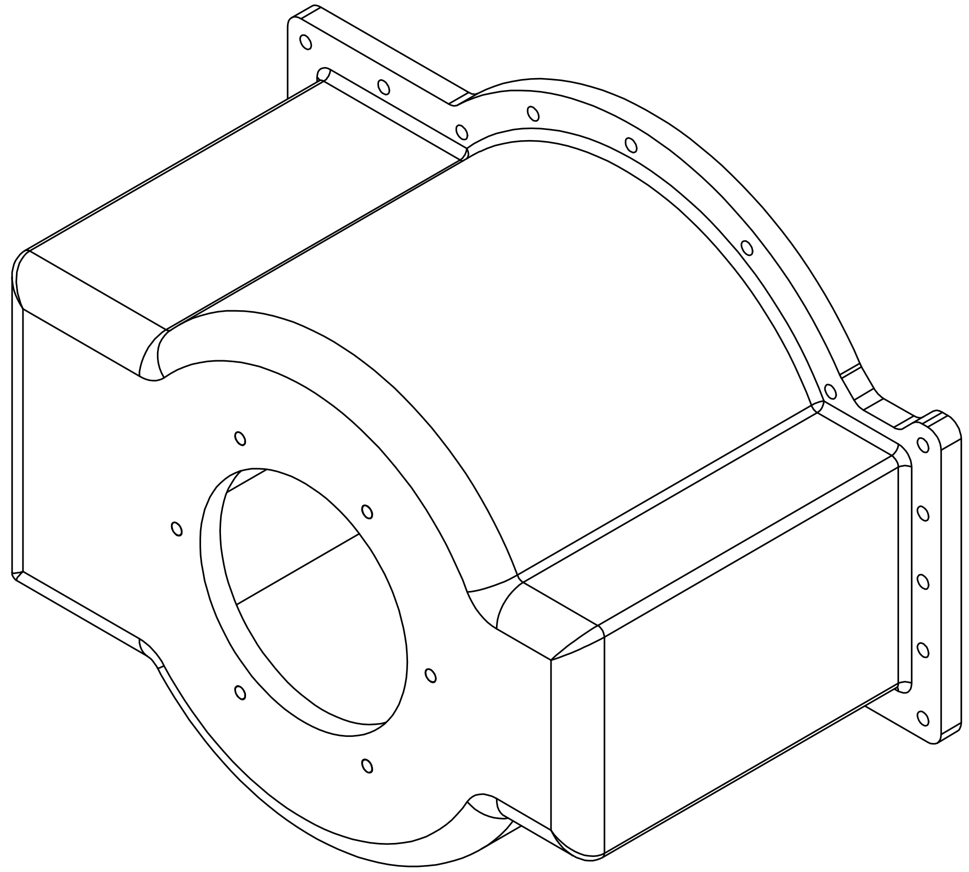
SHEET FORMAT A3

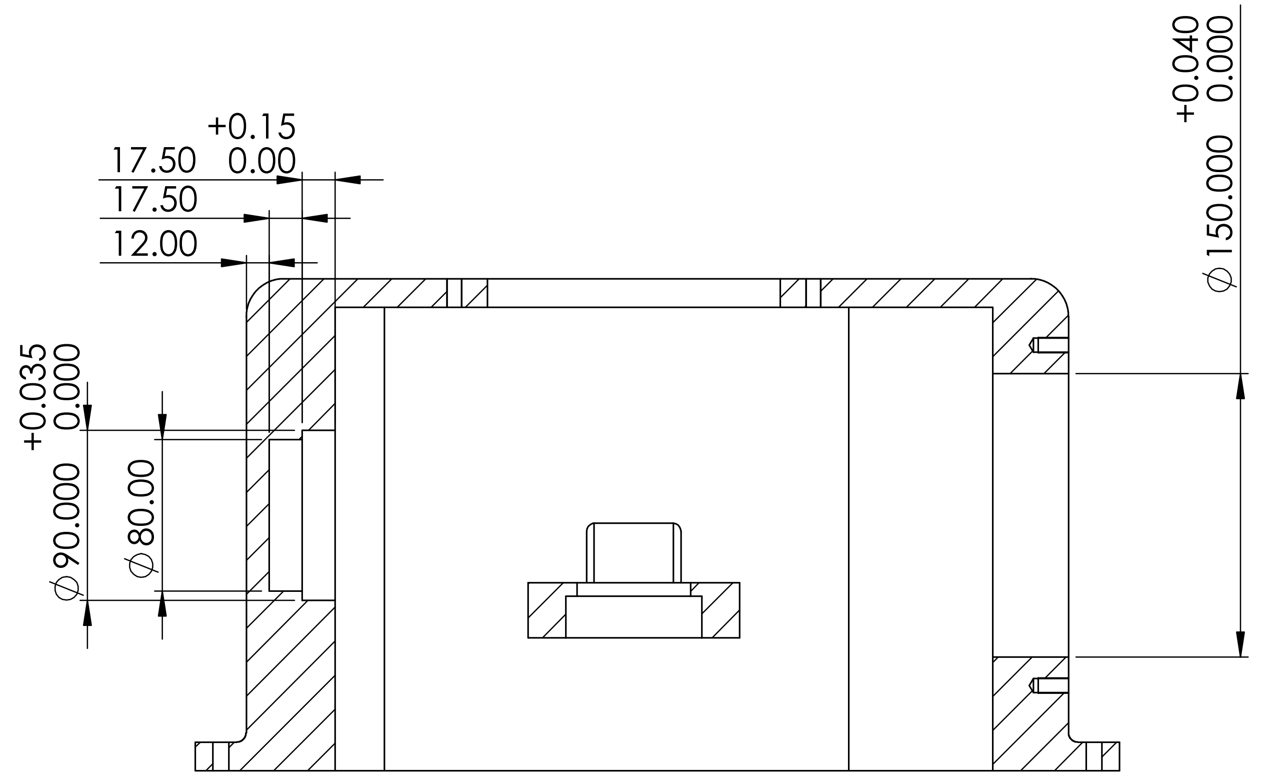
DATE: 2022-11-12

SCALE:1:3

SHEET 1 OF 1







SECTION F-F
SCALE 1 : 4

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS TOLERANCES: LINEAR: ± 0.15 ANGULAR: ± 0.1°	Approved by: Mahir Mahota Created by: Vinesh Vivekanand Student ID: 21000784	University of Waterloo **MTE322**
DO NOT SCALE DRAWING	Description: Input Shaft Housing	
PROJECTION TYPE: THIRD ANGLE	PART NO. PRT1 DATE: 2025-11-28	SHEET FORMAT A3 SCALE:1:4 SHEET 1 OF 1