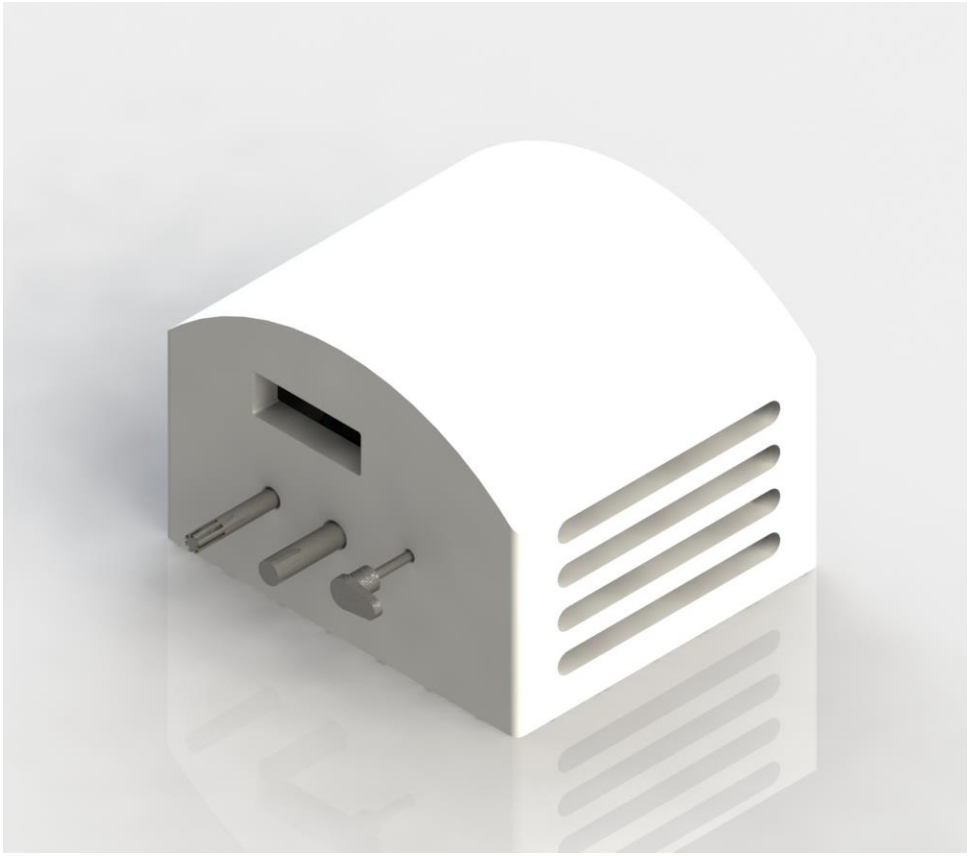
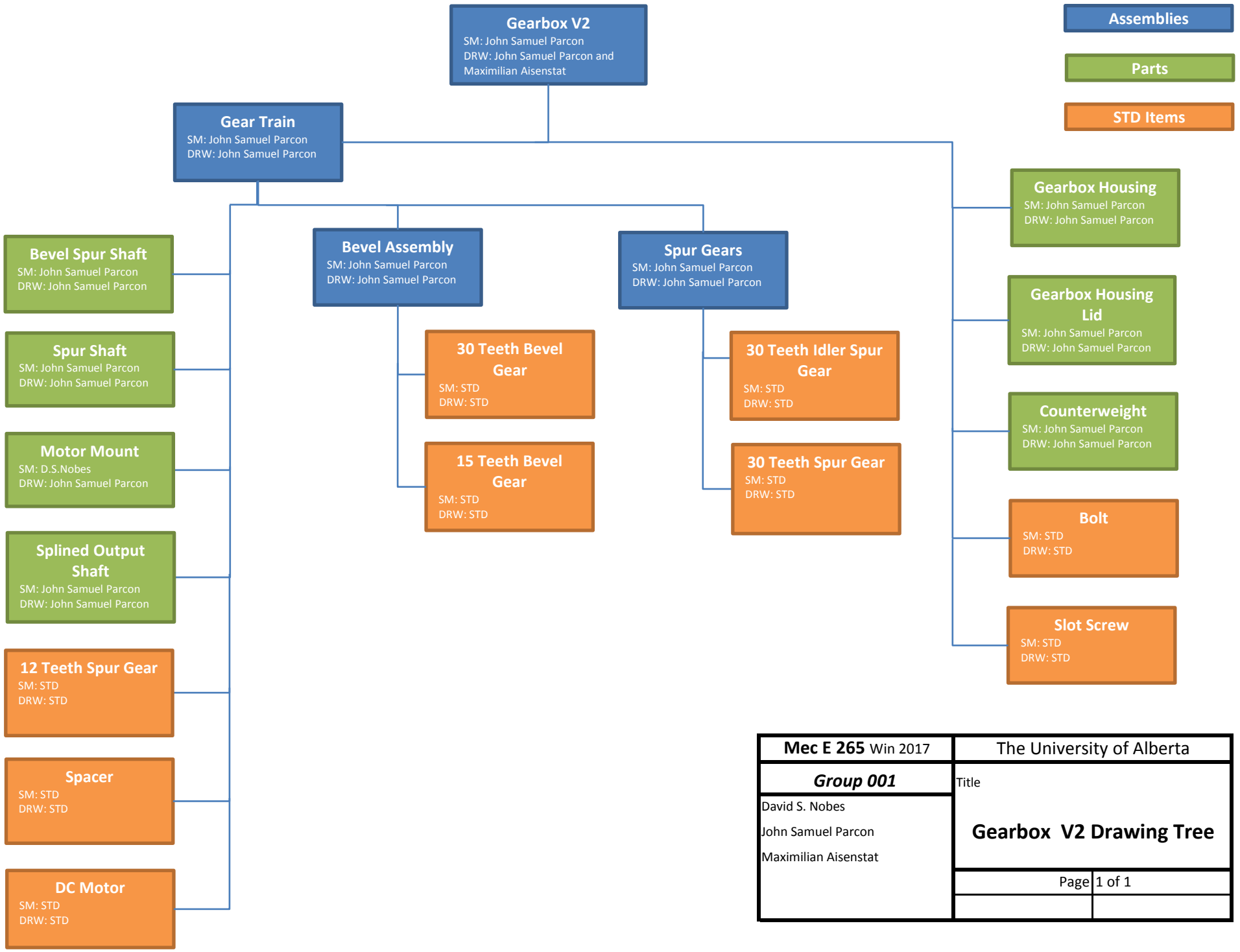
# Mec E 265
# Engineering Graphics and CAD

## *Overall Gearbox V2*

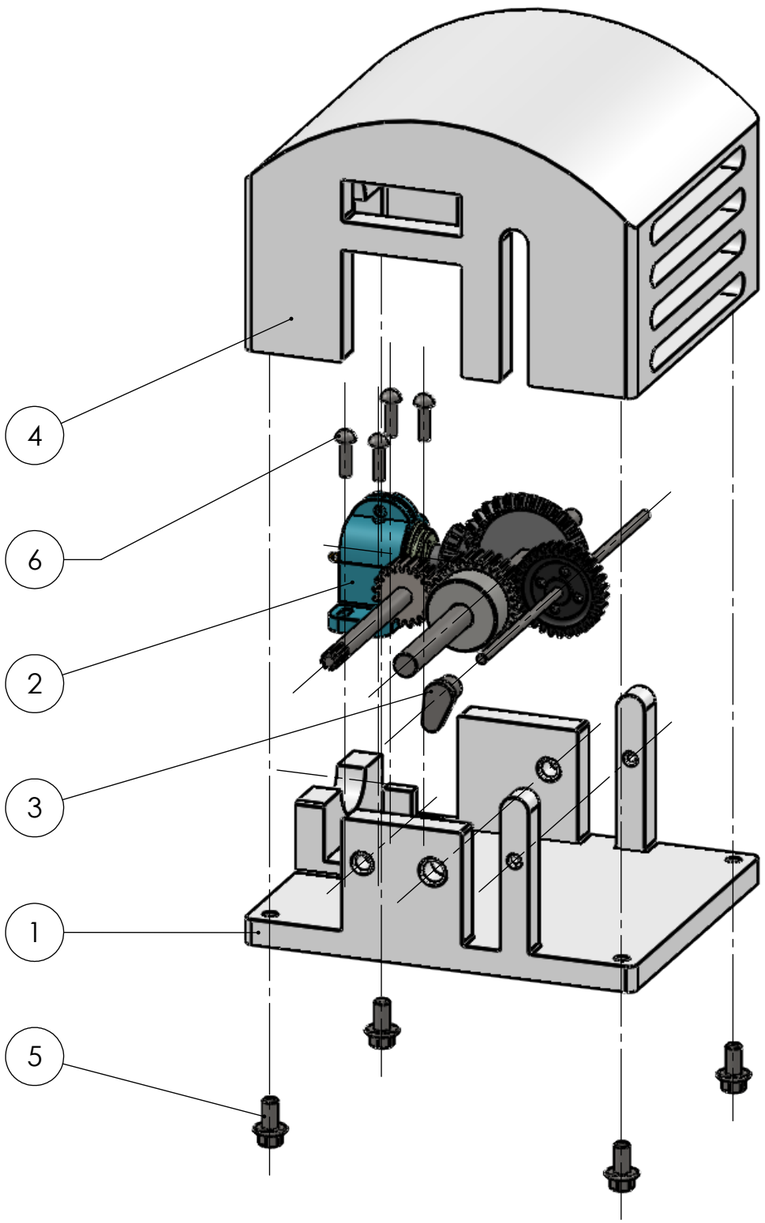


FALL 2017

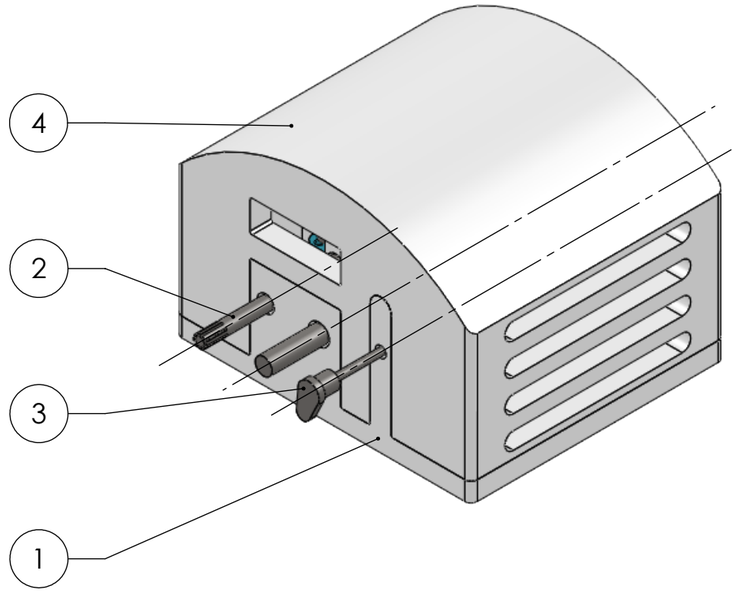
Dr. David S. Nobes




| Mec E 265 Win 2017 | The University of Alberta |
|---|---|
| ***Group 001*** | Title |
| David S. Nobes<br>John Samuel Parcon<br>Maximilian Aisenstat | **Gearbox V2 Drawing Tree** |
| | Page 1 of 1 |




| ITEM NO. | SW-Author(Author) | SW-Title(Title) | Material | QTY. |
|---|---|---|---|---|
| 1 | John Samuel Parcon | Gearbox Base | ABS | 1 |
| 2 | John Samuel Parcon | Gear Train and Shafts | Multiple | 1 |
| 3 | John Samuel Parcon | Counterweight | Cast Stainless Steel | 1 |
| 4 | John Samuel Parcon | Gearbox Lid | ABS | 1 |
| 5 | John Samuel Parcon | Bolt ISO 4162 - M5 x 10 x 10-N | Cast Alloy Steel | 4 |
| 6 | David S. Nobes | 6-32 UNC Slot Screw 0.5in | Cast Alloy Steel | 4 |




Note:
-Only top level parts of the overall assembly were listed in the BOM
-GearTrain subassembly is to be assembled in place

**MecE 265**
Instructor:
Dr. D.S.Nobes
Win 2017
Comments:

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN MM
TOLERANCES:
ANGULAR: ± 0.5°
LINEAR
X = ± 0.5
X.X = ± 0.1
X.XX = ± 0.025
SURFACE FINISH 0.6 µm
DO NOT SCALE DRAWING

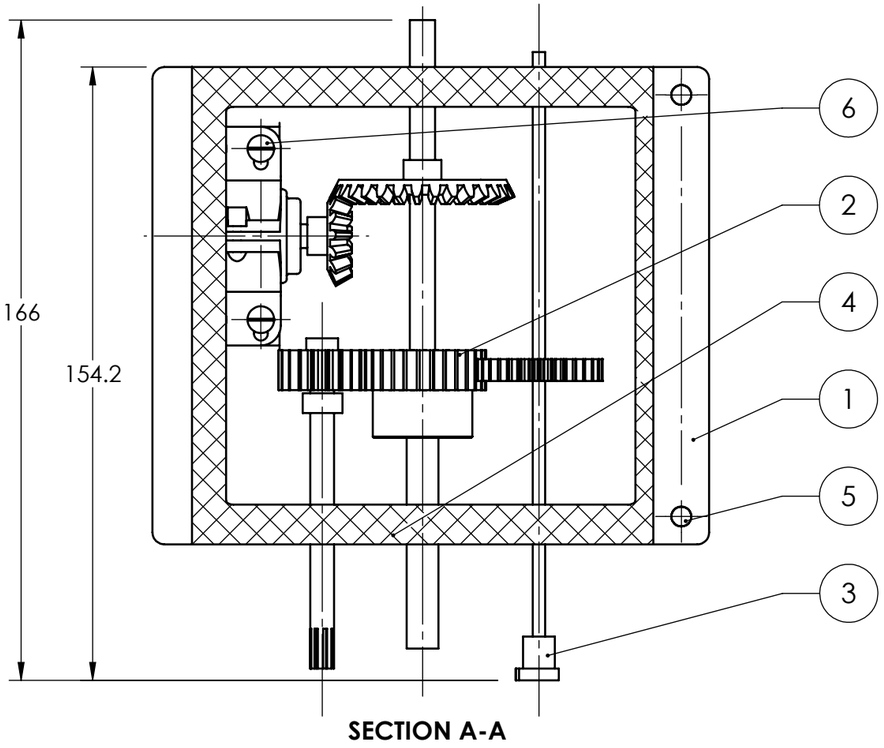
DRAWN BY:
**John Samuel Parcon**
Lab Day: ALL
SM By: **John Samuel Parcon**
TA Initials: DSN/MA
melab_user
Wednesday, June 14, 2017 11:57:46 AM
Thursday, June 23, 2016 3:00:59 PM

MATERIAL:
Multiple
FILE NAME:
Overall Gearbox V2

The Department of Mechanical Engineering
UNIVERSITY OF ALBERTA

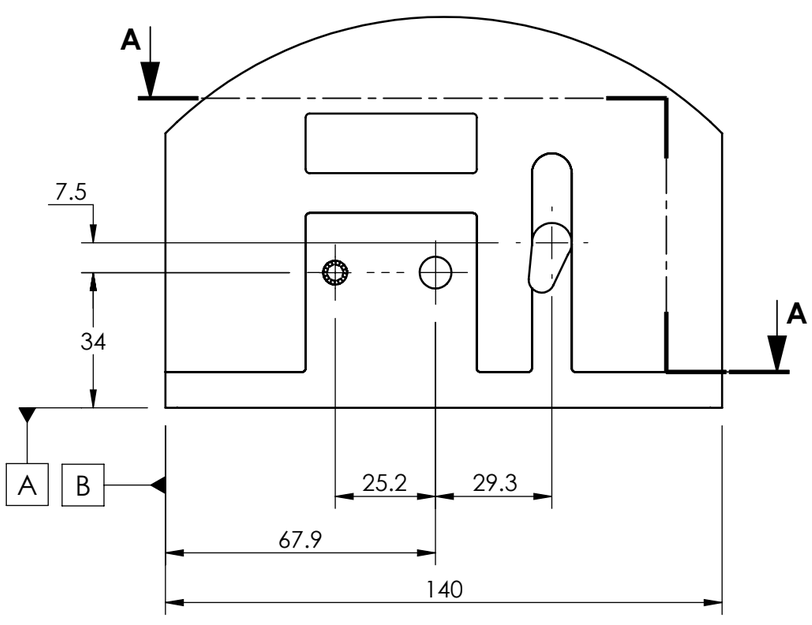
TITLE:
# Exploded View of the Gearbox Assembly

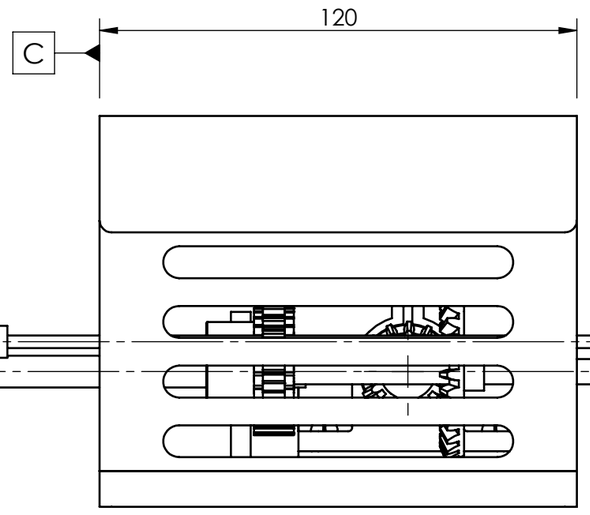
SIZE **B** | Assignment Number ALL | REV **2**
SCALE: 1:2 | Mass: 731.36 | SHEET 1 OF 9




**SECTION A-A**

| ITEM NO. | SW-Author(Author) | SW-Title(Title) | Material | QTY. |
|---|---|---|---|---|
| 1 | John Samuel Parcon | Gearbox Base | ABS | 1 |
| 2 | John Samuel Parcon | Gear Train and Shafts | Multiple | 1 |
| 3 | John Samuel Parcon | Counterweight | Cast Stainless Steel | 1 |
| 4 | John Samuel Parcon | Gearbox Lid | ABS | 1 |
| 5 | John Samuel Parcon | Bolt ISO 4162 - M5 x 10 x 10-N | Cast Alloy Steel | 4 |
| 6 | David S. Nobes | 6-32 UNC Slot Screw 0.5in | Cast Alloy Steel | 4 |




**MecE 265**

Instructor:
Dr. D.S.Nobes
Win 2017

Comments:

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN MM
TOLERANCES:
ANGULAR: ± 0.5°
LINEAR
X = ± 0.5
X.X = ± 0.1
X.XX = ± 0.025

SURFACE FINISH µm 0.6

DO NOT SCALE DRAWING

MATERIAL:
Multiple

FILE NAME:
Overall Gearbox V2

DRAWN BY:
**John Samuel Parcon**

| | |
|---|---|
| Lab Day | ALL |
| SM By | **John Samuel Parcon** |
| TA Initials | DSN/MA |

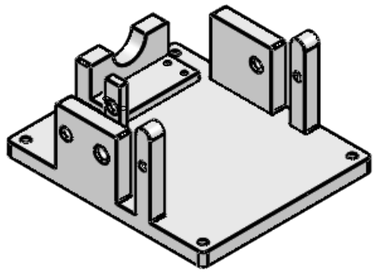
melab_user
Wednesday, June 14, 2017 11:57:46 AM
Thursday, June 23, 2016 3:00:59 PM

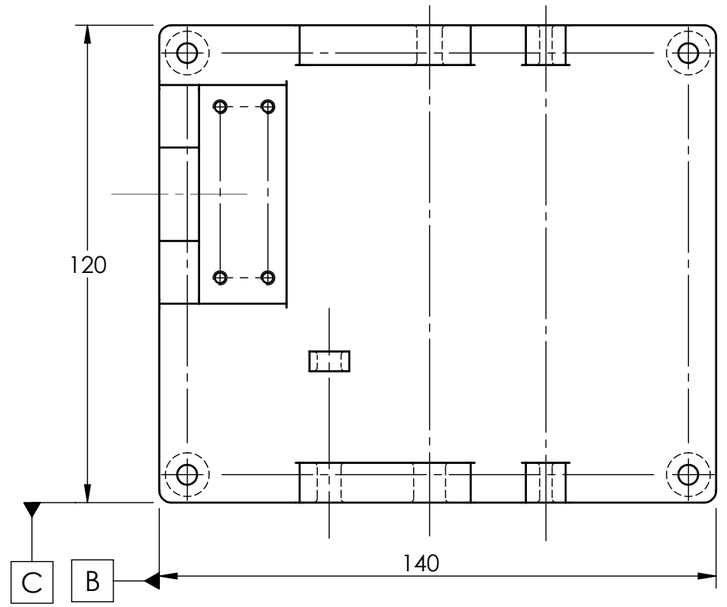
The Department of Mechanical Engineering
UNIVERSITY OF ALBERTA

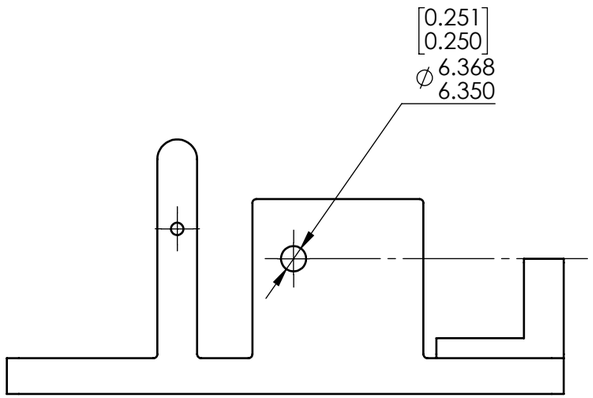
TITLE:
# Gearbox Assembly

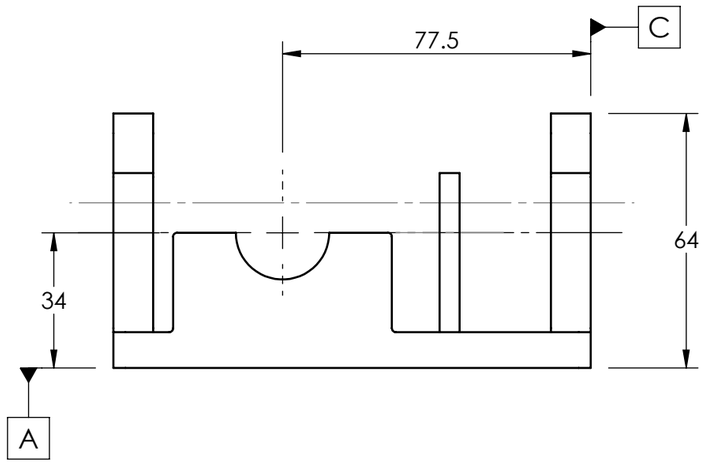
| SIZE | Assignment Number | REV |
|---|---|---|
| **B** | ALL | **2** |

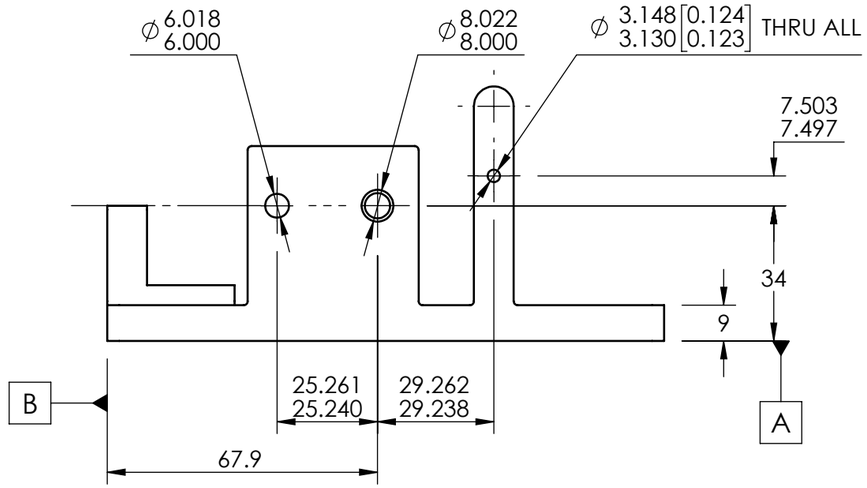
SCALE: 2:3 | Mass: 731.36 | SHEET 2 OF 9



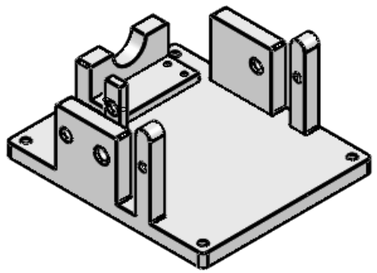


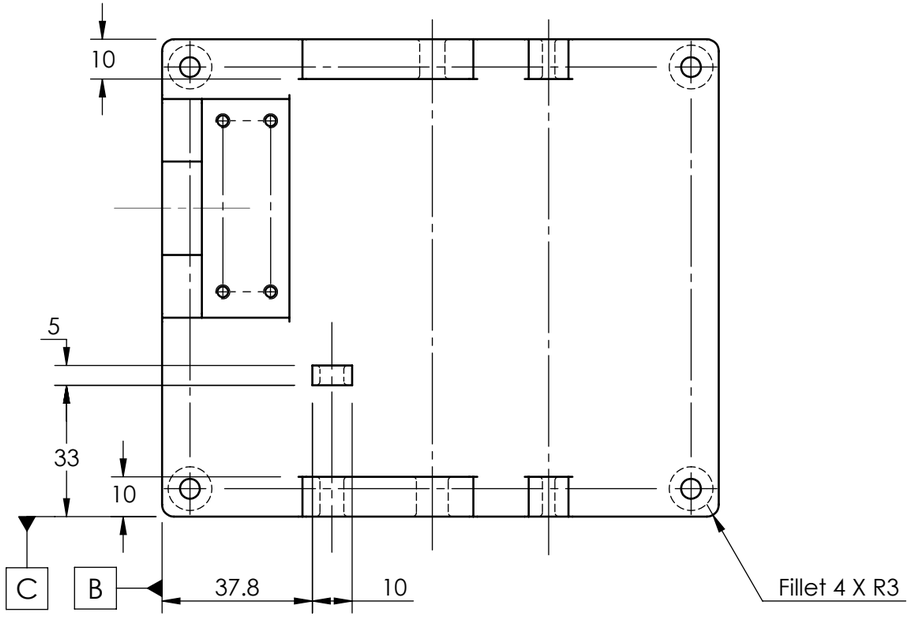




| | | | |
|---|---|---|---|
| **MecE 265**<br>Instructor: Dr. D.S.Nobes Win 2017<br>Comments: | UNLESS OTHERWISE SPECIFIED:<br>DIMENSIONS ARE IN MM<br>TOLERANCES:<br>ANGULAR: ± 0.5°<br>LINEAR<br>X = ± 0.5<br>X.X = ± 0.1<br>X.XX = ± 0.025<br>SURFACE FINISH µm 0.6<br>DO NOT SCALE DRAWING | DRAWN BY: **John Samuel Parcon**<br>Lab Day: ALL<br>SM By: **John Samuel Parcon**<br>TA Initials: DSN/MA<br>melab_user<br>Wednesday, June 14, 2017 11:57:46 AM<br>Tuesday, June 21, 2016 9:38:15 AM | The Department of Mechanical Engineering<br>UNIVERSITY OF ALBERTA<br>TITLE:<br>Overall and Functional Dimensions for Gearbox base |
| MATERIAL: ABS<br>FILE NAME: Gearbox housing V2 | | | SIZE B · Assignment Number ALL · REV 2<br>SCALE: 2:3 · Mass: 215.92 · SHEET 3 OF 9 |

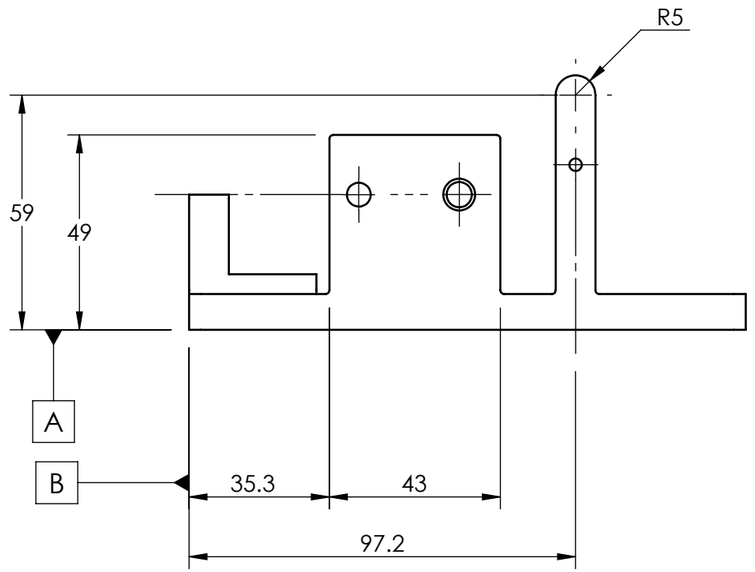


Note:
-Fillets are 1 mm if not specified

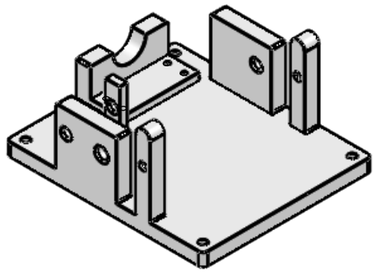


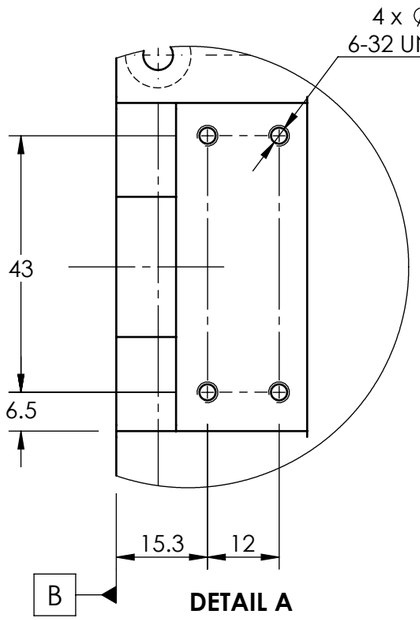




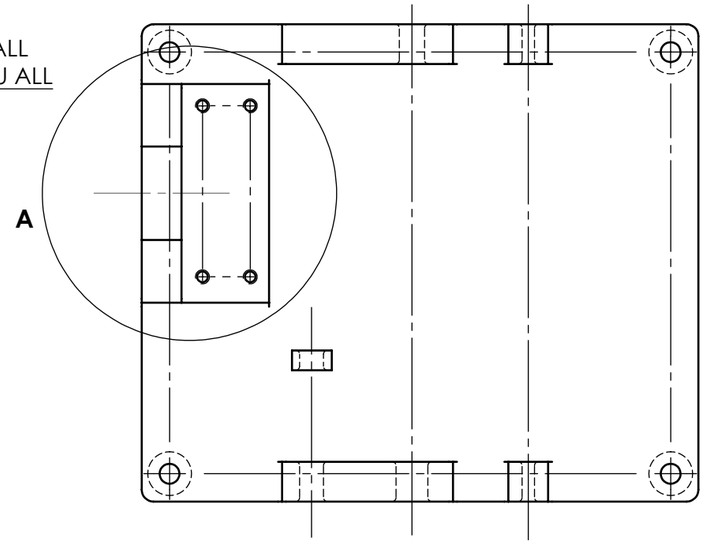


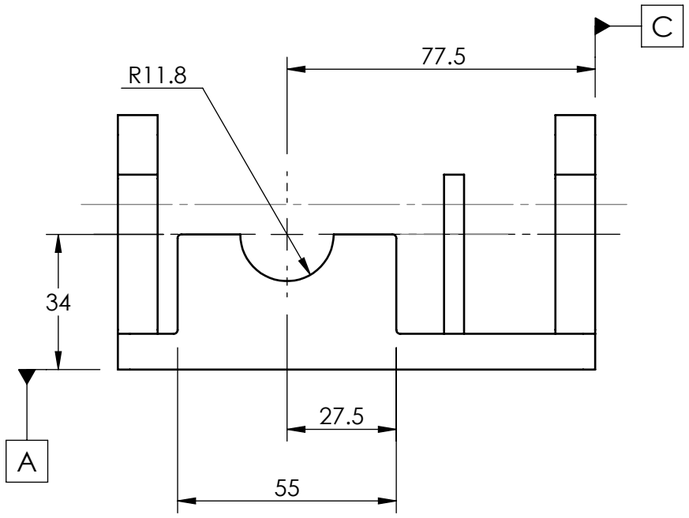

| | | | |
|---|---|---|---|
| **MecE 265**<br>Instructor:<br>Dr. D.S.Nobes<br>Win 2017<br>Comments: | UNLESS OTHERWISE SPECIFIED:<br>DIMENSIONS ARE IN MM<br>TOLERANCES:<br>ANGULAR: ± 0.5°<br>LINEAR<br>X = ± 0.5<br>X.X = ± 0.1<br>X.XX = ± 0.025<br>SURFACE FINISH µm 0.6<br>DO NOT SCALE DRAWING | DRAWN BY:<br>**John Samuel Parcon**<br>Lab Day: ALL<br>SM By: **John Samuel Parcon**<br>TA Initials: DSN/MA<br>melab_user<br>Wednesday, June 14, 2017 11:57:46 AM<br>Tuesday, June 21, 2016 9:38:15 AM | The Department of Mechanical Engineering<br>UNIVERSITY OF ALBERTA<br>TITLE:<br>Feature Dimensions on Gearbox base |
| MATERIAL:<br>ABS | | | SIZE B \| Assignment Number: ALL \| REV: 2 |
| FILE NAME:<br>Gearbox housing V2 | | | SCALE: 2:3 \| Mass: 215.92 \| SHEET 4 OF 9 |

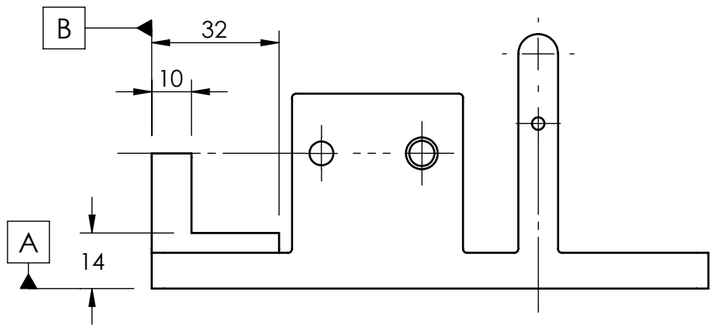




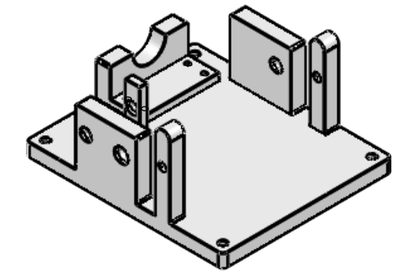

**DETAIL A**
**SCALE 1 : 1**

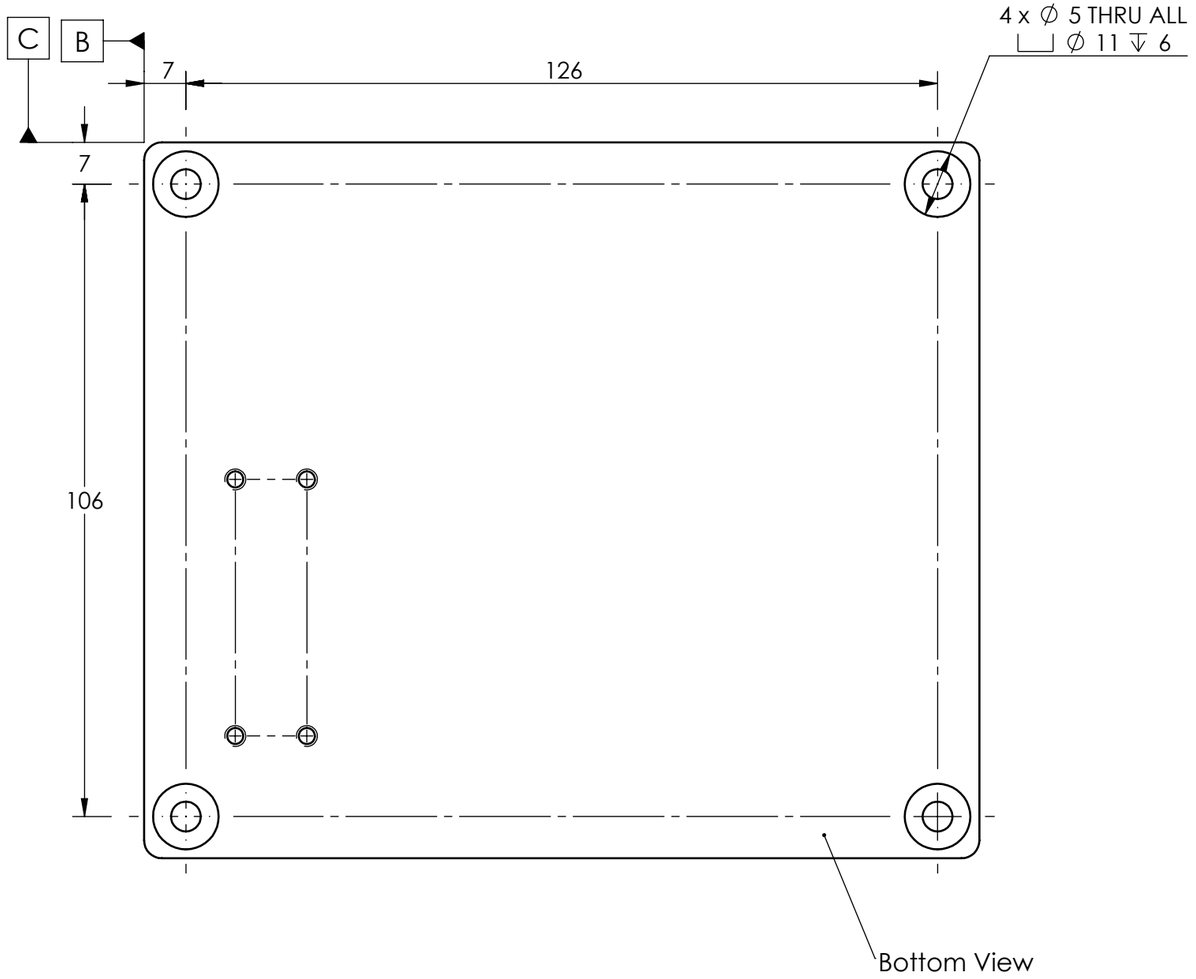


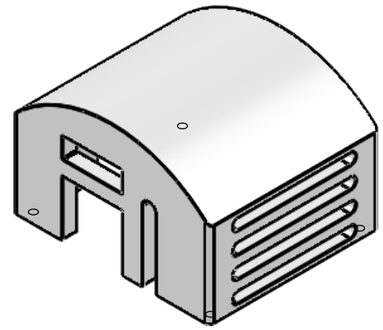



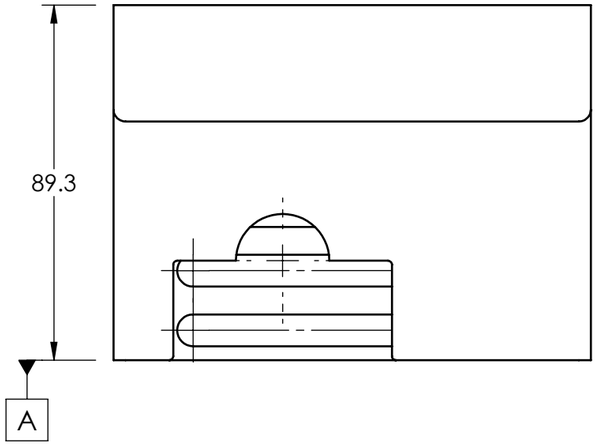

| | | | |
|---|---|---|---|
| **MecE 265** | UNLESS OTHERWISE SPECIFIED: | DRAWN BY: **John Samuel Parcon** | The Department of Mechanical Engineering, UNIVERSITY OF ALBERTA |
| Instructor: Dr. D.S.Nobes Win 2017 | DIMENSIONS ARE IN MM<br>TOLERANCES:<br>ANGULAR: ± 0.5°<br>LINEAR<br>X = ± 0.5<br>X.X = ± 0.1<br>X.XX = ± 0.025 | Lab Day: ALL | TITLE: Motor Mount Stand Detail |
| Comments: | SURFACE FINISH µm 0.6 | SM By: **John Samuel Parcon** | |
| | DO NOT SCALE DRAWING | TA Initials: DSN/MA | |
| MATERIAL: ABS | | melab_user<br>Wednesday, June 14, 2017 11:57:46 AM<br>Tuesday, June 21, 2016 9:38:15 AM | SIZE: **B** · Assignment Number: ALL · REV: **2** |
| FILE NAME: Gearbox housing V2 | | | SCALE: 2:3 · Mass: 215.92 · SHEET 5 OF 9 |

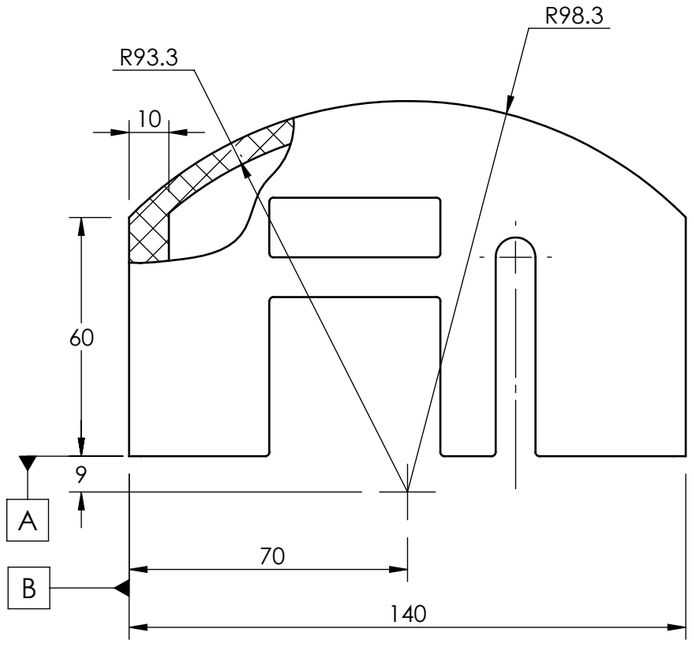


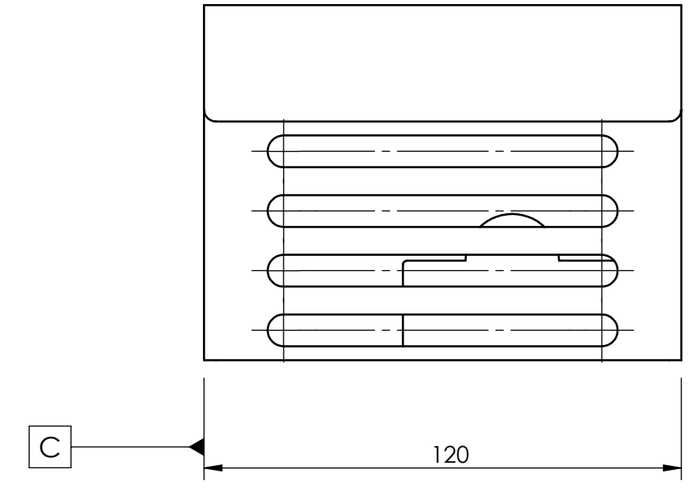



| | | | |
|---|---|---|---|
| **MecE 265**<br>Instructor: Dr. D.S.Nobes Win 2017<br>Comments: | UNLESS OTHERWISE SPECIFIED:<br>DIMENSIONS ARE IN MM<br>TOLERANCES:<br>ANGULAR: ± 0.5°<br>LINEAR<br>X = ± 0.5<br>X.X = ± 0.1<br>X.XX = ± 0.025<br>SURFACE FINISH µm 0.6<br>DO NOT SCALE DRAWING | DRAWN BY:<br>**John Samuel Parcon**<br>Lab Day: ALL<br>SM By: **John Samuel Parcon**<br>TA Initials: DSN/MA<br>melab_user<br>Wednesday, June 14, 2017 11:57:46 AM<br>Tuesday, June 21, 2016 9:38:15 AM | The Department of Mechanical Engineering<br>UNIVERSITY OF ALBERTA<br>TITLE:<br>Bolt holes at the bottom of the Gearbox base |
| MATERIAL: ABS<br>FILE NAME: Gearbox housing V2 | | | SIZE B; Assignment Number ALL; REV 2<br>SCALE: 1:1; Mass: 215.92; SHEET 6 OF 9 |



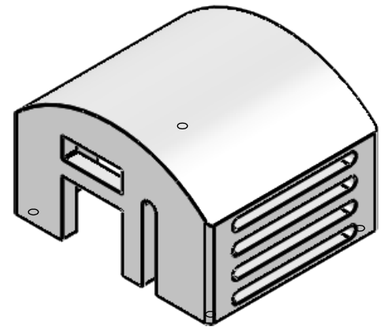


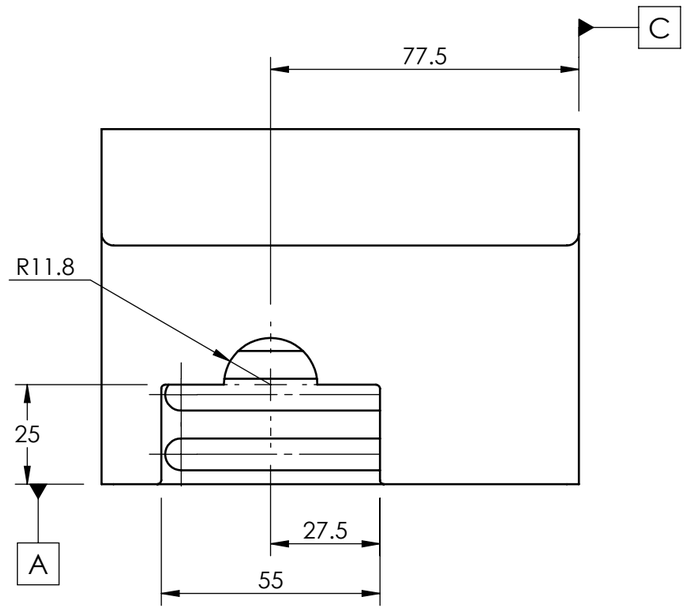



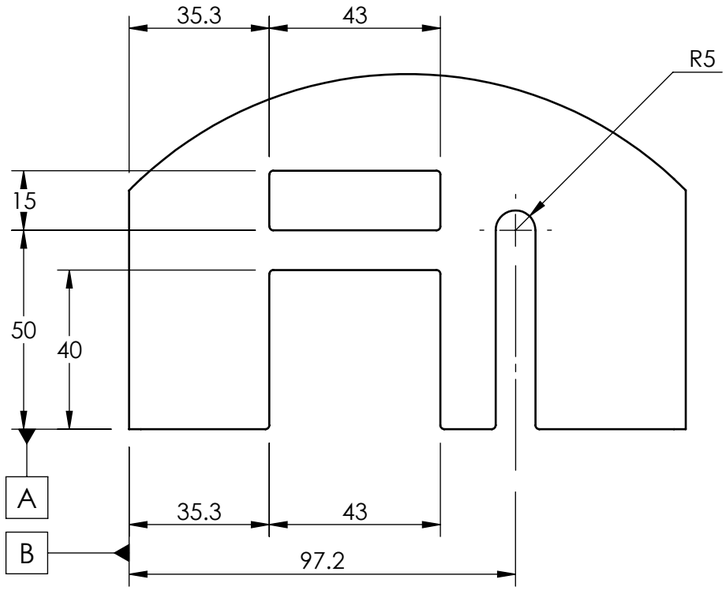



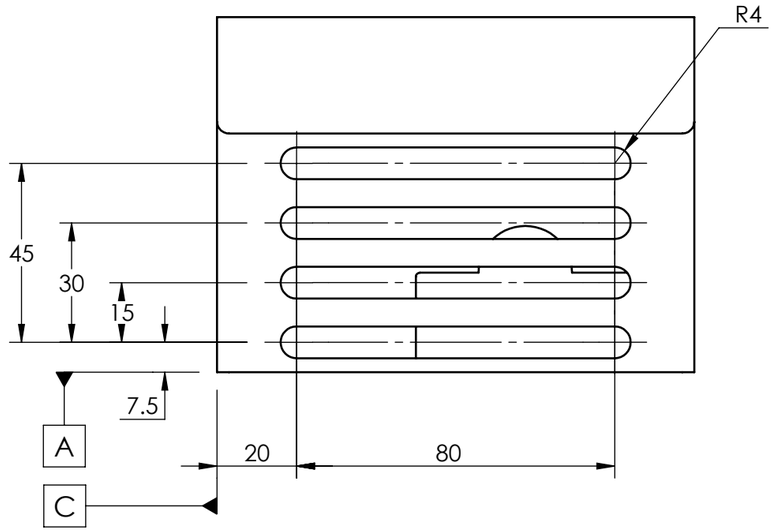

Note:
-Fillets are 1mm if not specified

| | | | |
|---|---|---|---|
| **MecE 265**<br>Instructor: Dr. D.S.Nobes Win 2017<br>Comments: | UNLESS OTHERWISE SPECIFIED:<br>DIMENSIONS ARE IN MM<br>TOLERANCES:<br>ANGULAR: ± 0.5°<br>LINEAR<br>X = ± 0.5<br>X.X = ± 0.1<br>X.XX = ± 0.025<br>SURFACE FINISH µm 0.6<br>DO NOT SCALE DRAWING | DRAWN BY: **John Samuel Parcon**<br>Lab Day: ALL<br>SM By: **John Samuel Parcon**<br>TA Initials: DSN/MA<br>melab_user<br>Tuesday, June 06, 2017 3:50:05 PM<br>Thursday, June 23, 2016 3:46:00 PM | The Department of Mechanical Engineering<br>UNIVERSITY OF ALBERTA<br>TITLE: Gearbox Lid<br>SIZE **B** \| Assignment Number ALL \| REV **2**<br>SCALE: 2:3 \| Mass: 329.06 \| SHEET 7 OF 9 |
| MATERIAL: ABS<br>FILE NAME: Lid | | | |

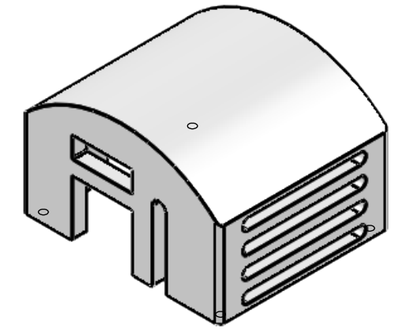


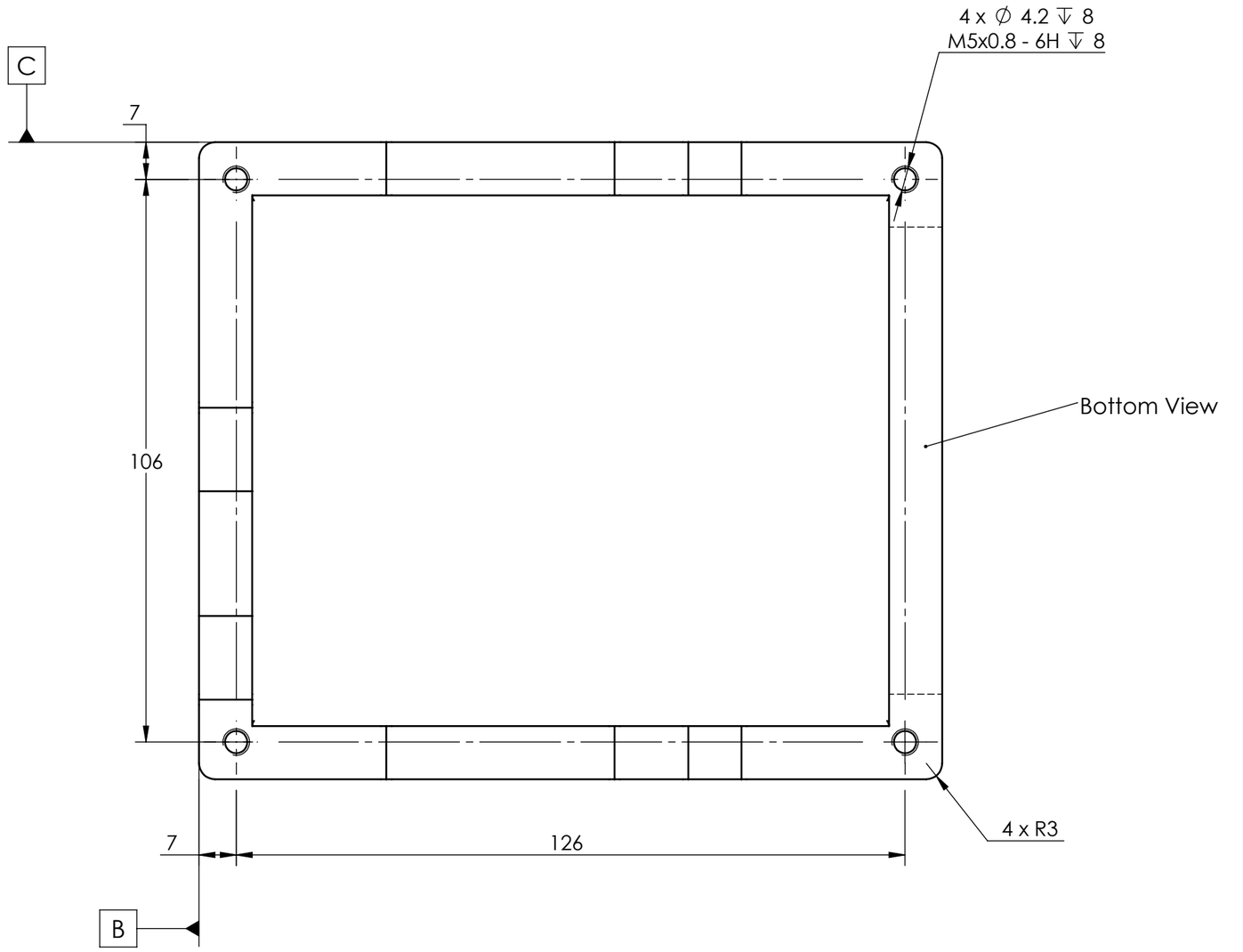



| | | | |
|---|---|---|---|
| **MecE 265**<br>Instructor: Dr. D.S.Nobes Win 2017<br>Comments: | UNLESS OTHERWISE SPECIFIED:<br>DIMENSIONS ARE IN MM<br>TOLERANCES:<br>ANGULAR: ± 0.5°<br>LINEAR<br>X = ± 0.5<br>X.X = ± 0.1<br>X.XX = ± 0.025<br>SURFACE FINISH µm 0.6<br>DO NOT SCALE DRAWING | DRAWN BY: **John Samuel Parcon**<br>Lab Day: ALL<br>SM By: **John Samuel Parcon**<br>TA Initials: DSN/MA<br>melab_user<br>Tuesday, June 06, 2017 3:50:05 PM<br>Thursday, June 23, 2016 3:46:00 PM | The Department of Mechanical Engineering<br>UNIVERSITY OF ALBERTA<br>TITLE: Gearbox Lid |
| MATERIAL: ABS<br>FILE NAME: Lid | | | SIZE **B** · Assignment Number ALL · REV **2**<br>SCALE: 2:3 · Mass: 329.06 · SHEET 8 OF 9 |





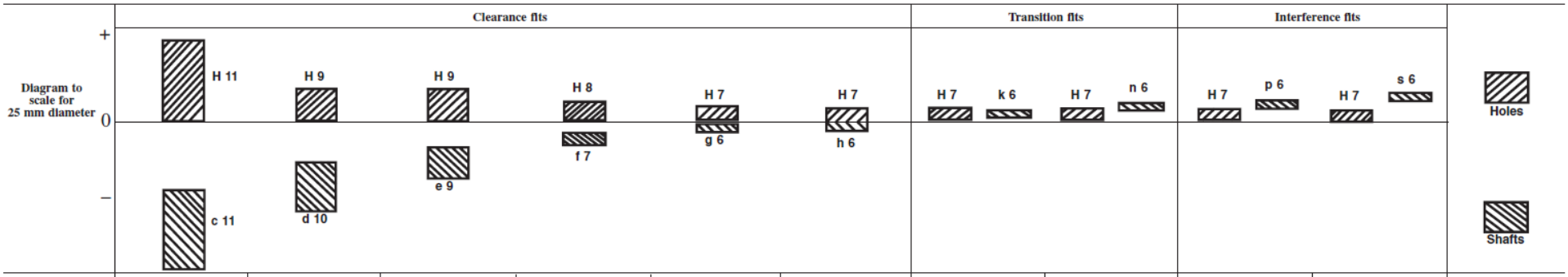

| | | | |
|---|---|---|---|
| **MecE 265** | UNLESS OTHERWISE SPECIFIED: | DRAWN BY: **John Samuel Parcon** | The Department of Mechanical Engineering, UNIVERSITY OF ALBERTA |
| Instructor: Dr. D.S.Nobes Win 2017 | DIMENSIONS ARE IN MM<br>TOLERANCES:<br>ANGULAR: ± 0.5°<br>LINEAR<br>X = ± 0.5<br>X.X = ± 0.1<br>X.XX = ± 0.025 | Lab Day: ALL<br>SM By: **John Samuel Parcon**<br>TA Initials: DSN/MA | TITLE: **Bolt Holes on the Gearbox Lid** |
| Comments: | SURFACE FINISH µm 0.6<br>DO NOT SCALE DRAWING | melab_user<br>Tuesday, June 06, 2017 3:50:05 PM<br>Thursday, June 23, 2016 3:46:00 PM | SIZE **B** · Assignment Number ALL · REV **2** |
| MATERIAL: ABS | | | SCALE: 1:1 · Mass: 329.06 · SHEET 9 OF 9 |
| FILE NAME: Lid | | | |

# TOLERANCE CALCULATIONS

| Action | Splined output shaft in 6mm Gearbox bore | Bevel-Spur shaft in 8mm Gearbox bore | Spur-spur-shaft in 3.13mm Gearbox bore | Bevel-Spur shaft in 6.35mm Gearbox bore |
|---|---|---|---|---|
| 1. Determine the type of fit using table 12.1 (below) | A close running fit | A close running fit | A close running fit | A close running fit |
| 2. Fit Basis | Hole Basis | Hole Basis | Hole Basis | Hole Basis |
| 3. Selection of the ISO symbol for | H8/f7 | H8/f7 | H8/f7 | H8/f7 |
| 4. Define the nominal sizes | 6mm | 8mm | 3.13mm | 6.35mm |
| 5. From table 12.2, get the tolerance ranges | H8 → [0 +18]<br>f7 → [-10 -28] | H8 → [0 +22]<br>f7 → [-13 -28] | H8 → [0 +18]<br>f7 → [-10 -28] | H8 → [0 +22]<br>f7 → [-13 -28] |
| 6. Calculate the tolerance dimensions | Bore [6.000 6.018]<br>Shaft [5.972 5.990] | Bore [8.000 8.022]<br>Shaft [7.972 7.983] | Bore [3.130 3.148]<br>Shaft [3.108 3.120] | Bore [6.350 6.372]<br>Shaft [6.322 6.337] |

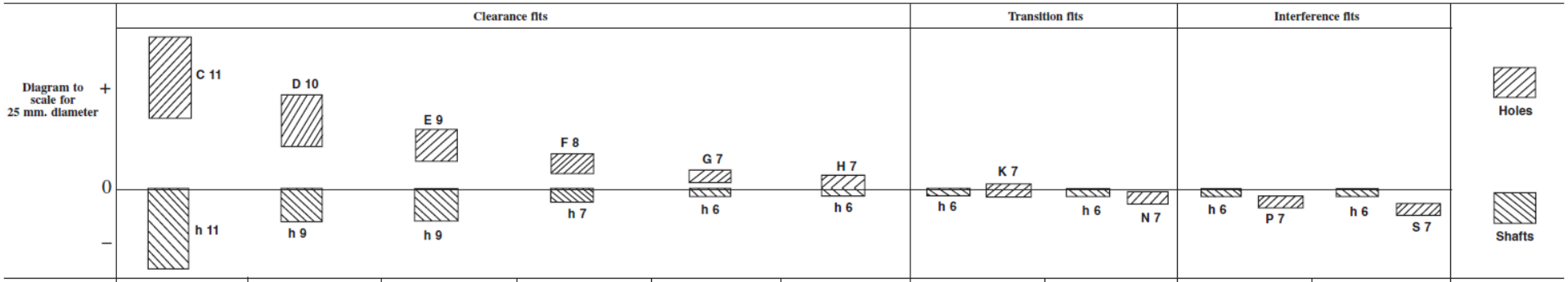
**Table 12.1 Description of fits for circular objects**

| Fit | ISO Symbol | | Description |
|---|---|---|---|
| | Hole Basis | Shaft Basis | |
| Clearance Fits | H11/c11 | C11/h11 | Loose fit. Wide tolerance |
| | H9/d9 | D9/h9 | Free running. Not when accuracy is important. |
| | H8/f7 | F8/h7 | Close running fit. |
| | H7/g6 | G7/h6 | Sliding fit. Not meant for the two parts running against each other but suitable for sliding adjustments. |
| Transition Fits | H7/h6 | H7/h6 | Snug fit but easy assembly |
| | H7/k6 | K7/h6 | Accurate location with some interference |
| | H7/n6 | N7/h6 | Use when larger interference is permissible |
| Interference Fits | H7/p6 | P7/h6 | For rigidity and correct alignment but not for power transmission |
| | H7/s6 | S7/h6 | Medium drive fit for ordinary steel parts. The tightest fit for cast iron parts |
| | H7/u6 | U7/h6 | High interference.<br>Shrink fit recommended. Force fit for heavy parts only |




| Nominal sizes | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Nominal sizes | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Over | To | H11 | c11 | H9 | d10 | H9 | e9 | H8 | f7 | H7 | g6 | H7 | h6 | H7 | k6 | H7 | n6 | H7 | p6 | H7 | s6 | Over | To |
| mm | mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | mm | mm |
| — | 3 | + 60<br>0 | – 60<br>– 120 | + 25<br>0 | – 20<br>– 60 | + 25<br>0 | – 14<br>– 39 | + 14<br>0 | – 6<br>– 16 | + 10<br>0 | – 2<br>– 8 | + 10<br>0 | – 6<br>0 | + 10<br>0 | + 6<br>+ 0 | + 10<br>0 | + 10<br>+ 4 | + 10<br>0 | + 12<br>+ 6 | + 10<br>0 | + 20<br>+ 14 | — | 3 |
| 3 | 6 | + 75<br>0 | – 70<br>– 145 | + 30<br>0 | – 30<br>– 78 | + 30<br>0 | – 20<br>– 50 | + 18<br>0 | – 10<br>– 28 | + 12<br>0 | – 4<br>– 12 | + 12<br>0 | – 8<br>0 | + 12<br>0 | + 9<br>+ 1 | + 12<br>0 | + 16<br>+ 8 | + 12<br>0 | + 20<br>+ 12 | + 12<br>0 | + 27<br>+ 19 | 3 | 6 |
| 6 | 10 | + 90<br>0 | – 80<br>– 170 | + 36<br>0 | – 40<br>– 98 | + 36<br>0 | – 25<br>– 61 | + 22<br>0 | – 13<br>– 28 | + 15<br>0 | – 5<br>– 14 | + 15<br>0 | – 9<br>0 | + 15<br>0 | + 10<br>+ 1 | + 15<br>0 | + 19<br>+ 10 | + 15<br>0 | + 24<br>+ 15 | + 15<br>0 | + 32<br>+ 23 | 6 | 10 |
| 10 | 18 | + 110<br>0 | – 95<br>– 205 | + 43<br>0 | – 50<br>– 120 | + 43<br>0 | – 32<br>– 75 | + 27<br>0 | – 16<br>– 34 | + 18<br>0 | – 6<br>– 17 | + 18<br>0 | – 11<br>0 | + 18<br>0 | + 12<br>+ 1 | + 18<br>0 | + 23<br>+ 12 | + 18<br>0 | + 29<br>+ 18 | + 18<br>0 | + 39<br>+ 28 | 10 | 18 |
| 18 | 30 | + 130<br>0 | – 110<br>– 240 | + 52<br>0 | – 65<br>– 149 | + 52<br>0 | – 40<br>– 92 | + 33<br>0 | – 20<br>– 41 | + 21<br>0 | – 7<br>– 20 | + 21<br>0 | – 13<br>0 | + 21<br>0 | + 15<br>+ 2 | + 21<br>0 | + 28<br>+ 15 | + 21<br>0 | + 35<br>+ 22 | + 21<br>0 | + 48<br>+ 35 | 18 | 30 |
| 30 | 40 | + 160<br>0 | – 120<br>– 280 | + 62 | – 80 | + 62 | – 50 | + 39 | – 25 | + 25 | – 9 | + 25 | – 16 | + 25 | + 18 | + 25 | + 33 | + 25 | + 42 | + 25 | + 59 | 30 | 40 |
| 40 | 50 | + 160<br>0 | – 130<br>– 290 | 0 | – 180 | 0 | – 112 | 0 | – 50 | 0 | – 25 | 0 | 0 | 0 | + 2 | 0 | + 17 | 0 | + 26 | 0 | + 43 | 40 | 50 |
| 50 | 65 | + 190<br>0 | – 140<br>– 330 | + 74 | – 100 | – 74 | – 60 | + 46 | – 30 | + 30 | – 10 | + 30 | – 19 | + 30 | + 21 | + 30 | + 39 | + 30 | + 51 | + 30<br>0 | + 72<br>+ 53 | 50 | 65 |
| 65 | 80 | + 190<br>0 | – 150<br>– 340 | 0 | – 220 | 0 | – 134 | 0 | – 60 | 0 | – 29 | 0 | 0 | 0 | + 2 | 0 | + 20 | 0 | + 32 | + 30<br>0 | + 78<br>+ 59 | 65 | 80 |
| 80 | 100 | + 220<br>0 | – 170<br>– 390 | + 87 | – 120 | – 87 | – 72 | + 54 | – 36 | + 35 | – 12 | + 35 | – 22 | + 35 | + 25 | + 35 | + 45 | + 35 | + 59 | + 35<br>0 | + 93<br>+ 71 | 80 | 100 |
| 100 | 120 | + 220<br>0 | – 180<br>– 400 | + 0 | – 260 | – 0 | – 159 | 0 | – 71 | 0 | – 34 | 0 | 0 | 0 | + 3 | 0 | + 23 | 0 | + 37 | + 35<br>+ 0 | + 101<br>+ 79 | 100 | 120 |
| 120 | 140 | + 250<br>0 | – 200<br>– 450 | | | | | | | | | | | | | | | | | + 40<br>0 | + 117<br>+ 92 | 120 | 140 |
| 140 | 160 | + 250<br>0 | – 210<br>– 460 | + 100<br>0 | 145<br>305 | + 100<br>0 | – 84<br>– 185 | + 63<br>0 | – 43<br>– 83 | – 40<br>0 | – 14<br>– 39 | + 40<br>0 | – 25<br>0 | + 40<br>0 | + 28<br>+ 3 | + 40<br>0 | + 52<br>+ 27 | – 40<br>0 | + 68<br>+ 43 | + 40<br>0 | + 125<br>+ 100 | 140 | 160 |
| 160 | 180 | + 250<br>0 | – 230<br>– 480 | | | | | | | | | | | | | | | | | + 40<br>0 | + 133<br>+ 108 | 160 | 180 |
| 180 | 200 | + 290<br>0 | – 240<br>530 | | | | | | | | | | | | | | | | | + 46<br>0 | + 151<br>+ 122 | 180 | 200 |
| 200 | 225 | + 290<br>0 | 260<br>550 | + 115<br>0 | – 170<br>– 355 | + 115<br>0 | – 100<br>– 215 | + 72<br>0 | – 50<br>– 96 | + 46<br>0 | – 15<br>– 44 | + 46<br>0 | – 29<br>0 | + 46<br>0 | + 33<br>+ 4 | + 46<br>0 | + 60<br>+ 31 | + 46<br>0 | + 79<br>+ 50 | + 46<br>0 | + 159<br>+ 130 | 200 | 225 |
| 225 | 250 | + 290<br>0 | 280<br>570 | | | | | | | | | | | | | | | | | + 46<br>0 | + 169<br>+ 140 | 225 | 250 |
| 250 | 280 | + 320<br>0 | 300<br>620 | + 130 | – 190 | + 130 | – 110 | + 81 | – 56 | + 52 | – 17 | + 52 | + 32 | + 52 | – 36 | + 52 | + 66 | + 52 | + 88 | + 52<br>0 | + 190<br>+ 158 | 250 | 280 |
| 280 | 315 | + 320<br>0 | 330<br>650 | 0 | – 400 | 0 | – 240 | 0 | – 108 | 0 | – 49 | 0 | 0 | 0 | + 4 | 0 | + 34 | 0 | + 56 | + 52<br>0 | + 202<br>+ 170 | 280 | 315 |
| 315 | 355 | + 360<br>0 | 360<br>– 720 | + 140 | – 210 | + 140 | – 125 | + 89 | – 62 | + 57 | – 18 | + 57 | – 36 | + 57 | + 40 | + 57 | + 73 | + 57 | + 98 | + 57<br>0 | + 226<br>+ 190 | 315 | 355 |
| 355 | 400 | + 360<br>0 | 400<br>760 | 0 | – 440 | 0 | – 265 | 0 | – 119 | 0 | – 54 | 0 | 0 | 0 | + 4 | 0 | + 37 | 0 | + 62 | +57<br>0 | + 244<br>+ 208 | 355 | 400 |
| 400 | 450 | + 400<br>0 | 440<br>840 | + 155 | – 230 | + 155 | – 135 | + 97 | – 68 | + 63 | – 20 | + 63 | – 40 | + 63 | + 45 | + 63 | + 80 | + 63 | + 108 | + 63<br>0 | + 272<br>+ 232 | 400 | 450 |
| 450 | 500 | + 400<br>0 | 480<br>880 | 0 | – 480 | 0 | – 290 | 0 | – 131 | 0 | – 60 | 0 | 0 | 0 | + 5 | 0 | + 40 | 0 | + 68 | + 63<br>0 | + 292<br>+ 252 | 450 | 500 |

# Table 12.2 Selected ISO Fits : Hole Bases




| Nominal sizes | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Tolerance | | Nominal sizes | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Over | To | h11 | C11 | h9 | D10 | h9 | E9 | h7 | F8 | h6 | G7 | h6 | H7 | h6 | K7 | h6 | N7 | h6 | P7 | h6 | S7 | Over | To |
| mm | mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | 0.001 mm | mm | mm |
| – | 3 | 0<br>– 60 | + 120<br>+ 60 | 0<br>– 25 | + 60<br>+ 20 | 0<br>– 25 | + 39<br>+ 14 | 0<br>– 10 | + 20<br>+ 6 | 0<br>– 6 | + 12<br>+ 2 | 0<br>– 6 | + 10<br>0 | 0<br>– 6 | 0<br>– 10 | 0<br>– 6 | – 4<br>– 14 | 0<br>– 6 | – 6<br>– 16 | 0<br>– 6 | – 14<br>– 24 | – | 3 |
| 3 | 6 | 0<br>– 75 | + 145<br>+ 70 | 0<br>– 30 | + 78<br>+ 30 | 0<br>– 30 | + 50<br>+ 20 | 0<br>– 12 | + 28<br>+ 10 | 0<br>– 8 | + 16<br>+ 4 | 0<br>– 8 | + 12<br>0 | 0<br>– 8 | + 3<br>– 9 | 0<br>– 8 | – 4<br>– 16 | 0<br>– 8 | – 8<br>– 20 | 0<br>– 8 | – 15<br>– 27 | 3 | 6 |
| 6 | 10 | 0<br>– 90 | + 170<br>+ 80 | 0<br>– 36 | + 98<br>+ 40 | 0<br>– 36 | + 61<br>+ 25 | 0<br>– 15 | + 35<br>+ 13 | 0<br>– 9 | + 20<br>+ 5 | 0<br>– 9 | + 15<br>0 | 0<br>– 9 | + 5<br>– 10 | 0<br>– 9 | – 4<br>– 19 | 0<br>– 9 | – 9<br>– 24 | 0<br>– 9 | – 17<br>– 32 | 6 | 10 |
| 10 | 18 | 0<br>– 110 | + 205<br>+ 95 | 0<br>– 43 | + 120<br>+ 50 | 0<br>– 43 | + 75<br>+ 32 | 0<br>– 18 | + 43<br>+ 16 | 0<br>– 11 | + 24<br>+ 6 | 0<br>– 11 | + 18<br>0 | 0<br>– 11 | + 6<br>– 12 | 0<br>– 11 | – 5<br>– 23 | 0<br>– 11 | – 11<br>– 29 | 0<br>– 11 | – 21<br>– 39 | 10 | 18 |
| 18 | 30 | 0<br>– 130 | + 240<br>+ 110 | 0<br>– 52 | + 149<br>+ 65 | 0<br>– 52 | + 92<br>+ 40 | 0<br>– 21 | + 53<br>+ 20 | 0<br>– 13 | + 28<br>+ 7 | 0<br>– 13 | + 21<br>0 | 0<br>– 13 | + 6<br>– 15 | 0<br>– 13 | – 7<br>– 28 | 0<br>– 13 | – 14<br>– 35 | 0<br>– 13 | – 27<br>– 48 | 18 | 30 |
| 30 | 40 | 0<br>– 160 | + 280<br>+ 120 | 0 | + 180 | 0 | + 112 | 0 | + 64 | 0 | + 34 | 0 | + 25 | 0 | + 7 | 0 | – 8 | 0 | – 17 | 0 | – 34 | 30 | 40 |
| 40 | 50 | 0<br>– 160 | + 290<br>+ 130 | – 62 | + 80 | – 62 | + 50 | – 25 | + 25 | – 16 | + 9 | – 16 | 0 | – 16 | – 18 | – 16 | – 33 | – 16 | – 42 | – 16 | – 59 | 40 | 50 |
| 50 | 65 | 0<br>– 190 | + 330<br>+ 140 | 0 | + 220 | 0 | + 134 | 0 | + 76 | 0 | + 40 | 0 | + 30 | 0 | + 9 | 0 | – 9 | 0 | – 21 | 0<br>– 19 | – 42<br>– 72 | 50 | 65 |
| 65 | 80 | 0<br>– 190 | + 340<br>+ 150 | – 74 | + 100 | – 74 | + 60 | – 30 | + 30 | – 19 | + 10 | – 19 | 0 | – 19 | – 21 | – 19 | – 39 | – 19 | – 51 | 0<br>– 19 | – 48<br>– 78 | 65 | 80 |
| 80 | 100 | 0<br>– 220 | + 390<br>+ 170 | 0 | + 260 | 0 | + 159 | 0 | + 90 | 0 | + 47 | 0 | + 35 | 0 | + 10 | 0 | – 10 | 0 | – 24 | 0<br>– 22 | – 58<br>– 93 | 80 | 100 |
| 100 | 120 | 0<br>– 220 | + 400<br>+ 800 | – 87 | + 120 | – 87 | + 72 | – 35 | + 36 | – 22 | + 12 | – 22 | 0 | – 22 | – 25 | – 22 | – 45 | – 22 | – 59 | 0<br>– 22 | – 66<br>– 101 | 100 | 120 |
| 120 | 140 | 0<br>– 250 | + 450<br>+ 200 | | | | | | | | | | | | | | | | | 0<br>– 25 | – 77<br>– 117 | 120 | 140 |
| 140 | 160 | 0<br>– 250 | + 460<br>+ 210 | 0<br>– 100 | + 305<br>+ 145 | 0<br>– 100 | + 185<br>+ 85 | 0<br>– 40 | + 106<br>+ 43 | 0<br>– 25 | + 54<br>+ 14 | 0<br>– 25 | + 40<br>0 | 0<br>– 25 | + 12<br>– 28 | 0<br>– 25 | – 12<br>– 52 | 0<br>– 25 | – 28<br>– 68 | 0<br>– 25 | – 85<br>– 125 | 140 | 160 |
| 160 | 180 | 0<br>– 250 | + 480<br>+ 230 | | | | | | | | | | | | | | | | | 0<br>– 25 | – 93<br>– 133 | 160 | 180 |
| 180 | 200 | 0<br>– 290 | + 530<br>+ 240 | | | | | | | | | | | | | | | | | 0<br>– 29 | – 105<br>– 151 | 180 | 200 |
| 200 | 225 | 0<br>– 290 | + 550<br>– 260 | 0<br>– 115 | + 355<br>+ 170 | 0<br>– 115 | + 215<br>+ 100 | 0<br>– 46 | + 122<br>+ 50 | 0<br>– 29 | + 61<br>+ 15 | 0<br>– 29 | + 46<br>0 | 0<br>– 29 | + 13<br>– 33 | 0<br>– 29 | – 14<br>– 60 | 0<br>– 29 | – 33<br>– 79 | 0<br>– 29 | – 113<br>– 159 | 200 | 225 |
| 225 | 250 | 0<br>– 290 | + 570<br>+ 280 | | | | | | | | | | | | | | | | | 0<br>– 29 | – 123<br>– 169 | 225 | 250 |
| 250 | 280 | 0<br>– 320 | + 620<br>+ 300 | 0 | + 400 | 0 | + 240 | 0 | + 137 | 0 | + 62 | 0 | + 52 | 0 | + 16 | 0 | – 14 | 0 | – 36 | 0<br>– 32 | – 138<br>– 190 | 250 | 280 |
| 280 | 315 | 0<br>– 320 | + 650<br>+ 330 | – 130 | + 190 | – 130 | + 110 | – 52 | + 56 | – 32 | + 17 | – 32 | 0 | – 32 | – 36 | – 32 | – 66 | – 32 | – 88 | 0<br>– 32 | – 150<br>– 202 | 280 | 315 |
| 315 | 355 | 0<br>– 360 | + 720<br>+ 360 | 0 | + 440 | 0 | + 265 | 0 | + 151 | 0 | + 75 | 0 | + 57 | 0 | + 17 | 0 | – 16 | 0 | – 41 | 0<br>– 36 | – 169<br>– 226 | 315 | 355 |
| 355 | 400 | 0<br>– 360 | + 760<br>+ 400 | – 140 | + 210 | – 140 | + 125 | – 57 | + 62 | – 36 | + 18 | – 36 | 0 | – 36 | – 40 | – 36 | – 73 | – 36 | – 98 | 0<br>– 36 | – 187<br>– 244 | 355 | 400 |
| 400 | 450 | 0<br>– 400 | + 840<br>+ 440 | 0 | + 480 | 0 | + 290 | 0 | + 165 | 0 | + 83 | 0 | + 63 | 0 | + 18 | 0 | – 17 | 0 | – 45 | 0<br>– 40 | – 209<br>– 272 | 400 | 450 |
| 450 | 500 | 0<br>– 400 | + 880<br>+ 480 | – 155 | + 230 | – 155 | + 135 | – 63 | + 68 | – 40 | + 20 | – 40 | 0 | – 40 | – 45 | – 40 | – 80 | – 40 | – 108 | 0<br>– 40 | – 229<br>– 292 | 450 | 500 |

# Table 12.3 Selected ISO Fits : Shaft Bases

# Spur Gear Center to Center Tolerance Calculations:

| Action | Drive Spur Gear to Pinion Spur Gear | Drive Spur Gear to Idler Spur Gear | |
|---|---|---|---|
| 1. Selection for the class of Accuracy | Js7 | Js7 | |
| 2. Define the nominal sizes | 25.25mm | 30.20mm | |
| | | Horizontal 29.25mm | Vertical 7.5mm |
| 3. From table below, get the tolerance ranges | [-10.5 +10.5] | [-12.5 +12.5] | |
| | | Horizontal [-12.1 +12.1] | Vertical [-3.1 +3.1] |
| 4. Calculate the tolerance dimensions | [25.240 25.261] | [30.188 30.213] | |
| | | Horizontal [29.238 29.262] | Vertical [7.497 7.503] |

Note: The accuracy class varies according to:
The manufacturing process

- 9 to 12 for gears that undergo a heat treatment after the finish
- 6 to 12 for teeth obtained by milling, hobbing or shaving
- 4 to 6 for grinded teeth

Rotational speed

- 10 to 12 for a circumferential speed of 3 m/sec
- 7 to 10 for a circumferential speed of 3 to 6 m/sec
- 4 to 6 for a circumferential speed of 6 to 20 m/sec
- Tolerance on the centre distance

Seven tolerance fields are applicable: from js 5 to 11. In table 1 you will find the most widely used tolerances: js's 7 to 10.

| Tolerances on the centre distance | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Class of accuracy of centre distance 5 to 6<br>Class of accuracy of centre distance 7 to 9<br>Class of accuracy of centre distance 10 to 12 | | | | | | | |
| a = centre distance in mm | Tolerance zone (deviations in µm) – js | | | | | | | |
| | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| more than 10 tot 18 | ± 4,0 | ± 5,5 | ± 9,0 | ± 13,5 | ± 21,5 | ± 35,0 | ± 55,0 | ± 90,0 |
| more than 18 tot 30 | ± 4,5 | ± 6,5 | ± 10,5 | ± 16,5 | ± 26,0 | ± 42,0 | ± 65,0 | ± 105 |
| more than 30 tot 50 | ± 5,5 | ± 8,0 | ± 12,5 | ± 19,5 | ± 31,0 | ± 50,0 | ± 80,0 | ± 125 |
| more than 50 tot 80 | ± 6,5 | ± 9,5 | ± 15,0 | ± 23,0 | ± 37,0 | ± 60,0 | ± 95,0 | ± 150 |
| more than 80 tot 120 | ± 7,5 | ± 11,0 | ± 17,5 | ± 27,0 | ± 43,5 | ± 70,0 | ± 110 | ± 175 |
| more than 120 tot 180 | ± 9,0 | ± 12,5 | ± 20,0 | ± 31,5 | ± 50,0 | ± 80,0 | ± 125 | ± 200 |
| more than 180 tot 250 | ± 10,0 | ± 14,5 | ± 23,0 | ± 36,0 | ± 57,5 | ± 92,5 | ± 145 | ± 230 |
| more than 250 tot 315 | ± 11,5 | ± 16,0 | ± 26,0 | ± 40,5 | ± 65,0 | ± 105 | ± 160 | ± 260 |
| more than 315 tot 400 | ± 12,5 | ± 18,0 | ± 28,5 | ± 44,5 | ± 70,0 | ± 115 | ± 180 | ± 285 |
| more than 400 tot 500 | ± 13,5 | ± 20,0 | ± 31,5 | ± 48,5 | ± 77,5 | ± 125 | ± 200 | ± 315 |
| more than 500 tot 630 | ± 15,5 | ± 23,0 | ± 35,0 | ± 55,0 | ± 87,0 | ± 140 | ± 218 | ± 350 |
| more than 630 tot 800 | ± 17,0 | ± 25,0 | ± 40,0 | ± 62,0 | ± 100 | ± 160 | ± 250 | ± 395 |
| more than 800 tot 1000 | ± 19,5 | ± 29,0 | ± 45,0 | ± 70,0 | ± 115 | ± 180 | ± 290 | ± 455 |
| more than 1000 tot 1250 | ± 23,0 | ± 33,0 | ± 52,0 | ± 82,0 | ± 130 | ± 210 | ± 330 | ± 525 |
| more than 1250 tot 1600 | ± 27,0 | ± 38,5 | ± 62,0 | ± 97,0 | ± 155 | ± 250 | ± 385 | ± 625 |

http://www.tandwiel.info/en/gears/level-of-accuracy-and-compliance-of-the-teeth/