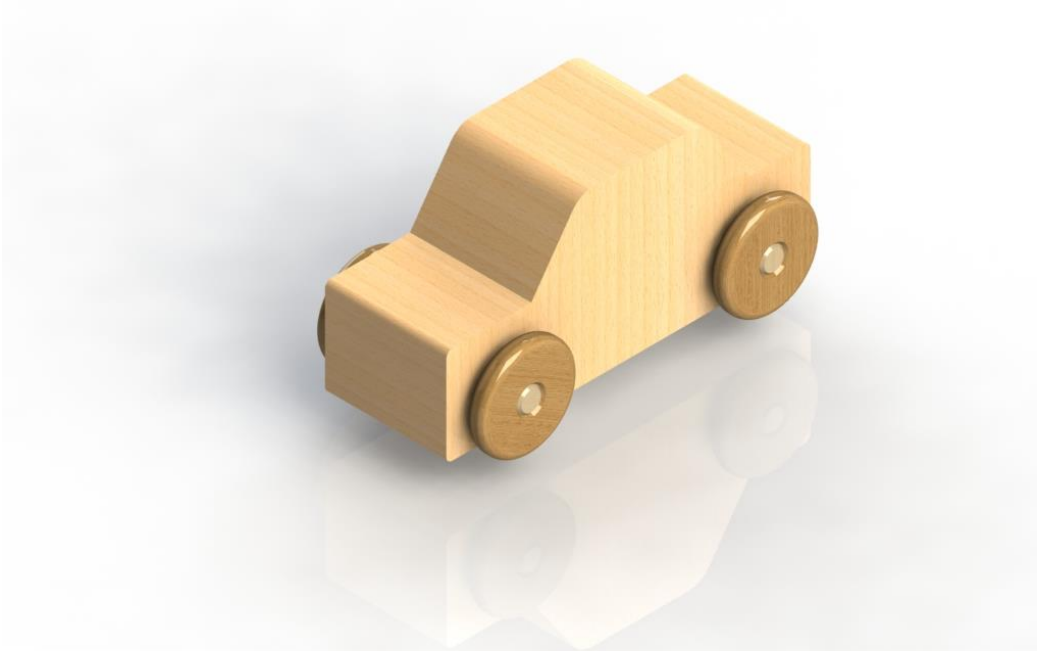
Mec E 265
Engineering Graphics and CAD

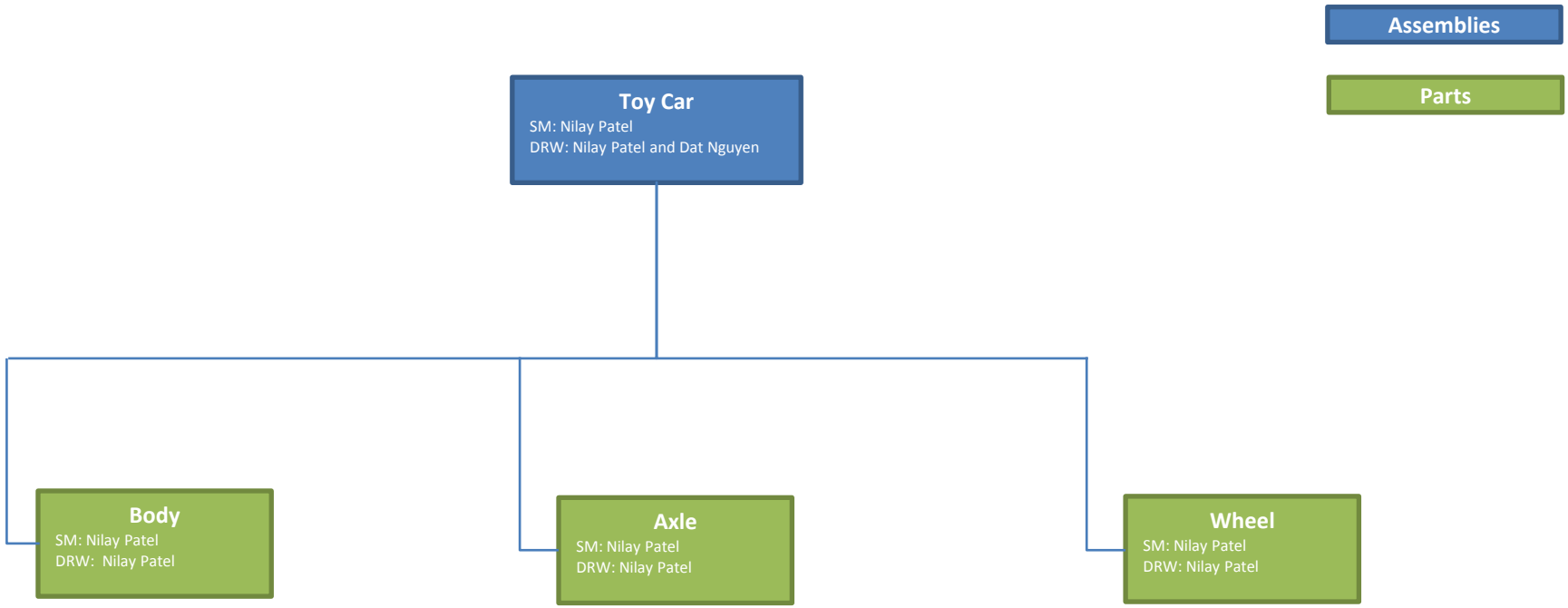
An Example Drawing Package:

The Toy Car



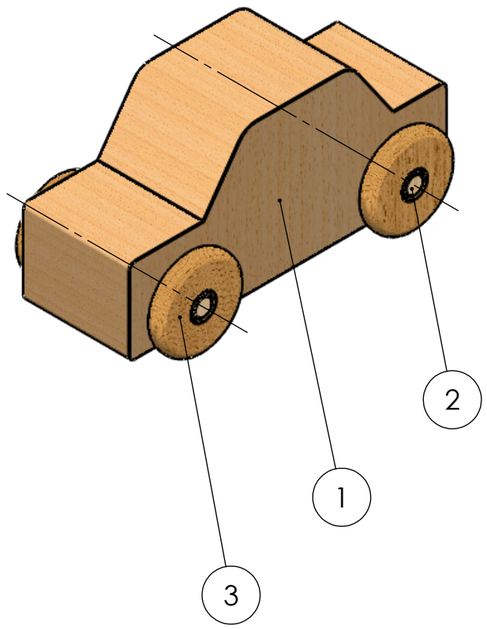
WINTER 2017

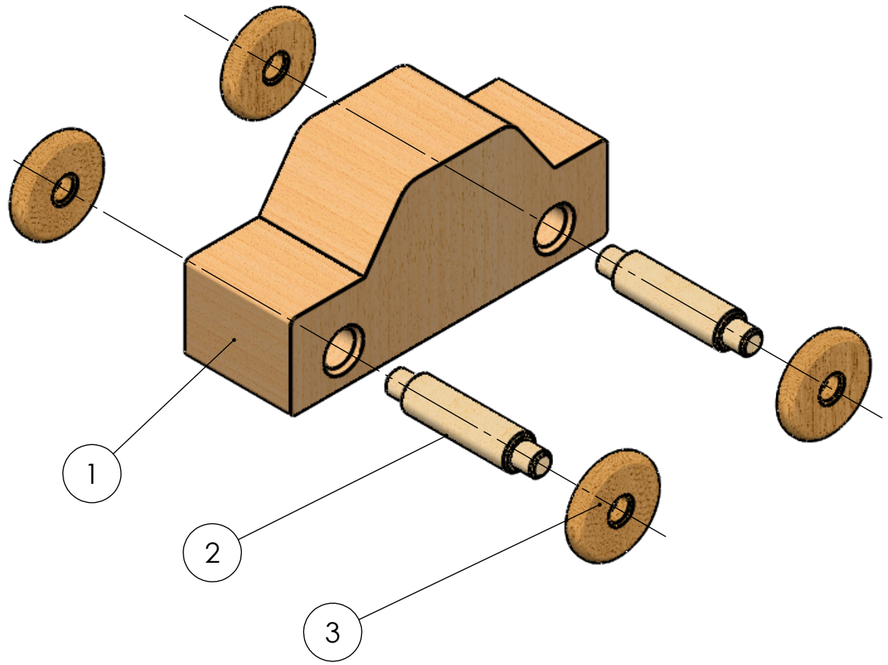
Dr. David S. Nobes



Mec E 265 Win 2017	The University of Alberta
Group 002	Title
David Nobes Nilay Patel Andrew Archibald Dat Nguyen	**Toy Car Drawing Tree**
	Page 1 of 1

ITEM NO.	SW-Author(Author)	SW-Title(Title)	Material	Mass	QTY.
1	Nilay Patel	Toy Car Body	Balsa	60.99	1
2	Nilay Patel	Toy Car Axle	Pine	3.51	2
3	Nilay Patel	Toy Car Wheel	Oak	4.67	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 0.6 µm

DO NOT SCALE DRAWING

DRAWN BY:
Nilay Patel

Lab Day	ALL
SM By	**Nilay Patel**
TA Initials	DSN

melab_user
Friday, June 16, 2017 10:29:10 AM
Thursday, June 16, 2016 10:07:01 AM

MATERIAL:
Material <not specified>

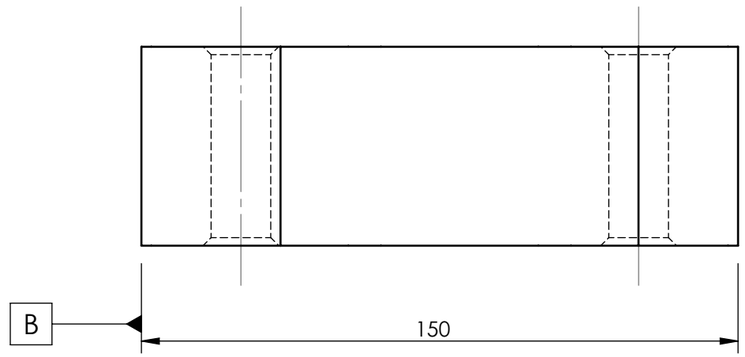
FILE NAME:
Toy_Car

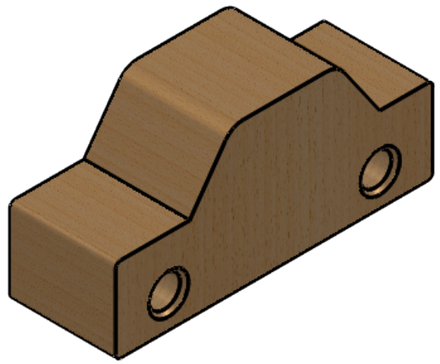
The Department of Mechanical Engineering
UNIVERSITY OF ALBERTA

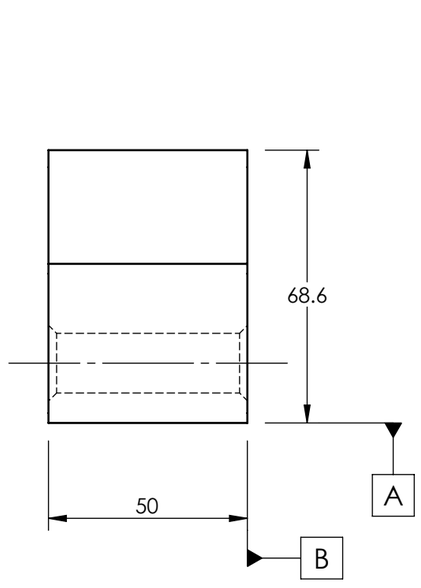
TITLE:
Toy Car Assembly

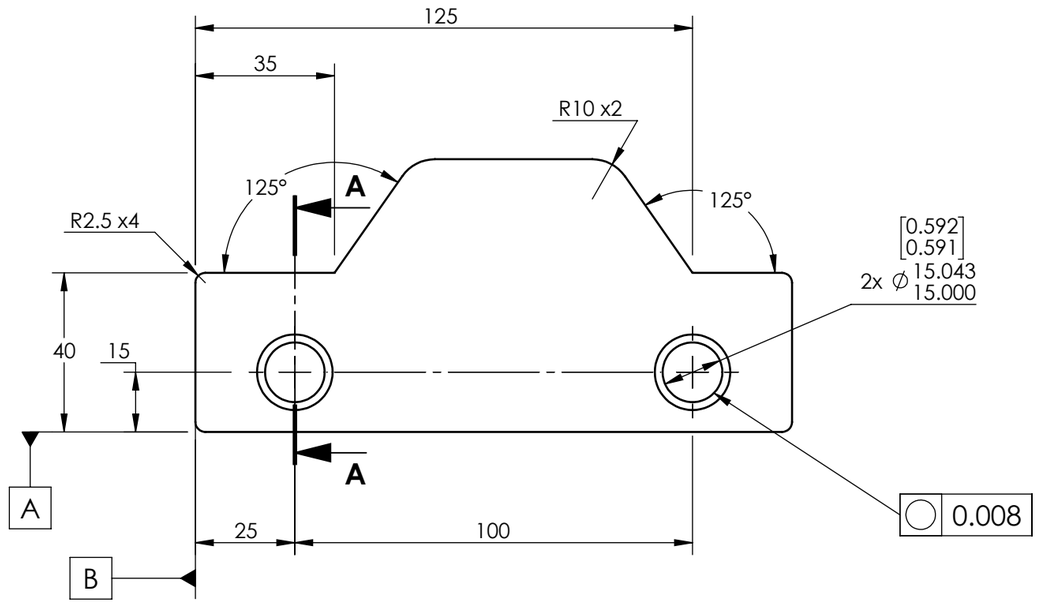
SIZE	Assignment Number	REV
B	ALL	1

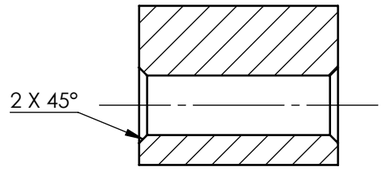
SCALE: 1:2 | Mass: 86.68 | SHEET 1 OF 4





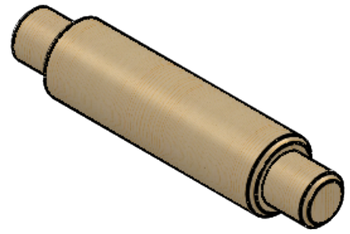


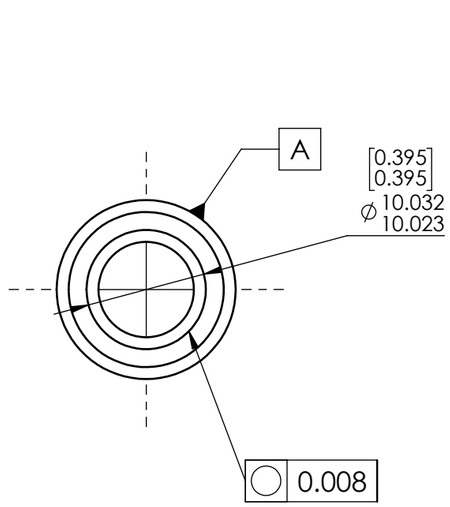


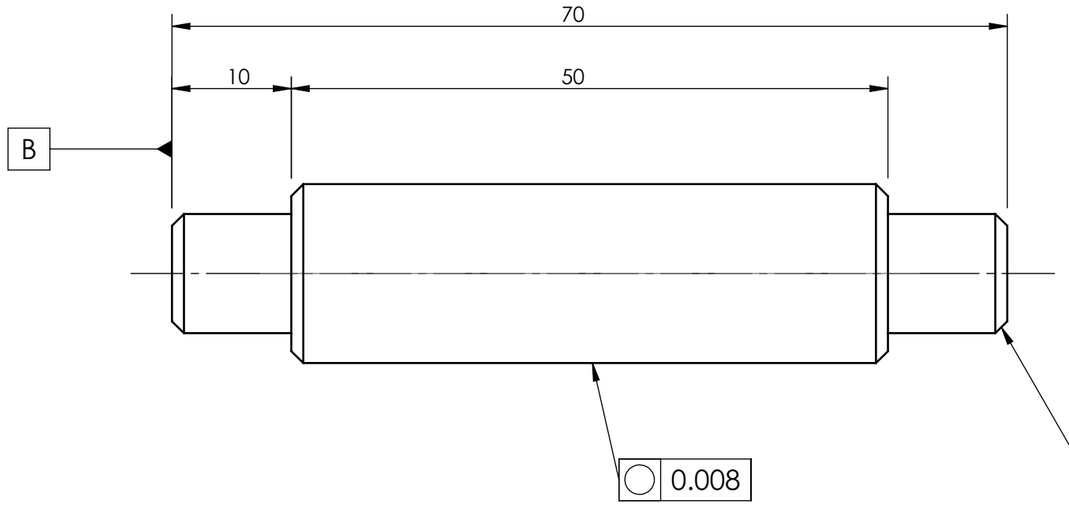


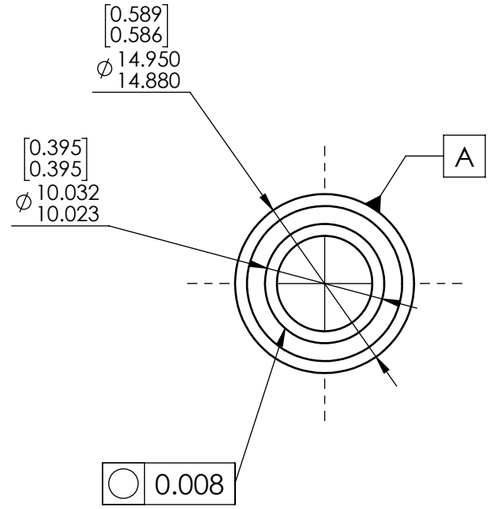
SECTION A-A

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	DRAWN BY: **Nilay Patel** Lab Day: ALL SM By: **Nilay Patel** TA Initials: DSN melab_user Tuesday, May 30, 2017 3:50:38 PM Wednesday, June 08, 2016 9:56:21 AM	The Department of Mechanical Engineering UNIVERSITY OF ALBERTA TITLE: Toy Car Body
MATERIAL: Balsa FILE NAME: Toy_Car-Body			SIZE B · Assignment Number ALL · REV 1 SCALE: 2:3 · Mass: 60.99 · SHEET 2 OF 4

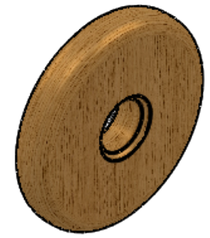


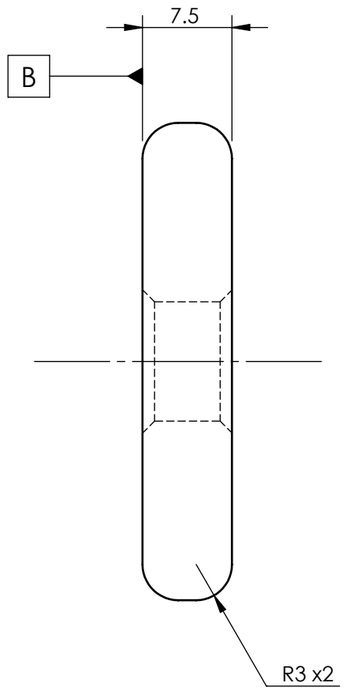


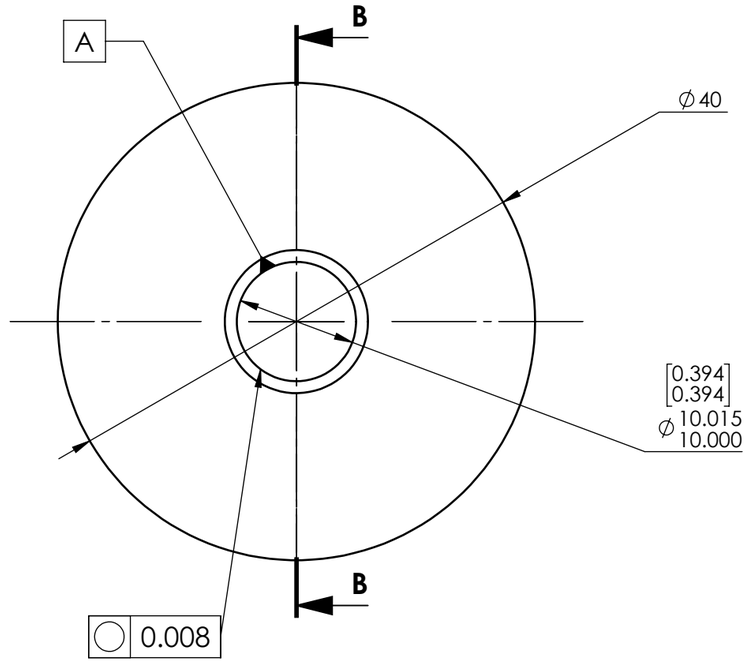


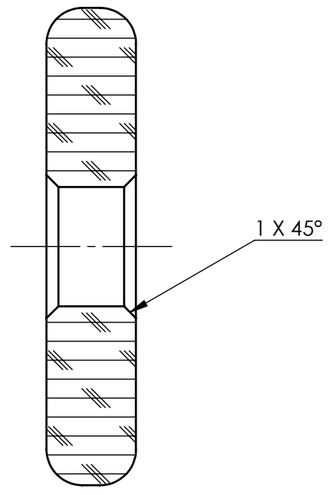


MecE 265	UNLESS OTHERWISE SPECIFIED:	DRAWN BY: **Nilay Patel**	The Department of Mechanical Engineering, UNIVERSITY OF ALBERTA
Instructor: Dr. D.S.Nobes Win 2017	DIMENSIONS ARE IN MM TOLERANCES: ANGULAR: ± 0.5° LINEAR X = ± 0.5 X.X = ± 0.1 X.XX = ± 0.025	Lab Day: ALL	TITLE: Toy Car Axle
Comments:	SURFACE FINISH µm 0.6	SM By: **Nilay Patel**	
	DO NOT SCALE DRAWING	TA Initials: DSN	
		melab_user Tuesday, May 30, 2017 3:51:02 PM Wednesday, June 08, 2016 10:46:36 AM	SIZE B · Assignment Number ALL · REV 1
MATERIAL: Pine			
FILE NAME: Toy_Car-Axle			SCALE: 2:1 · Mass: 3.51 · SHEET 3 OF 4









SECTION B-B

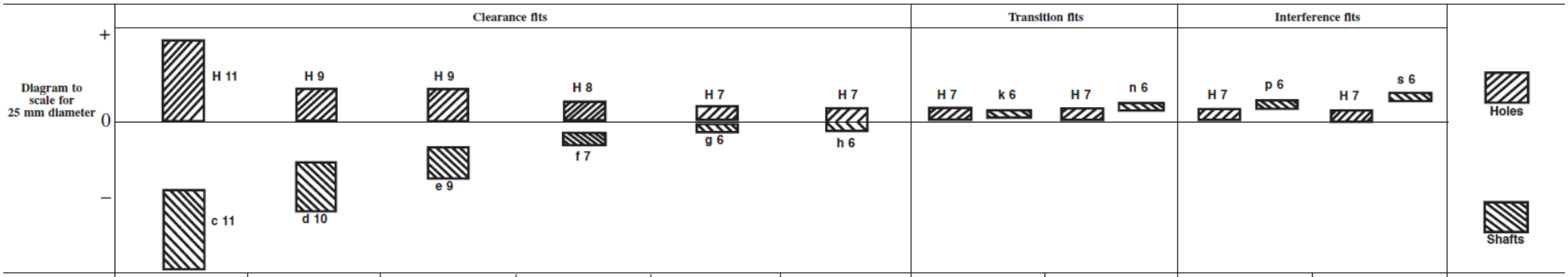
MecE 265 Instructor: Dr. D.S.Nobes Win 2017 Comments:	UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MM TOLERANCES: ANGULAR: ± 0.5° LINEAR X = ± 0.5 X.X = ± 0.1 X.XX = ± 0.025 SURFACE FINISH µm 0.6 DO NOT SCALE DRAWING	DRAWN BY: **Nilay Patel** Lab Day: ALL SM By: **Nilay Patel** TA Initials: DSN melab_user Tuesday, May 30, 2017 3:50:50 PM Wednesday, June 08, 2016 10:50:17 AM	The Department of Mechanical Engineering UNIVERSITY OF ALBERTA TITLE: **Toy Car Wheel**
MATERIAL: Oak FILE NAME: Toy_Car-Wheel			SIZE **B** · Assignment Number ALL · REV 1 SCALE: 2:1 · Mass: 4.67 · SHEET 4 OF 4

TOLERANCE CALCULATIONS

Action	Axle in Body	Wheels in Axle
1. Determine the type of fit using table 12.1 (below)	A close running fit	A medium drive \ interference fit
2. Fit Basis	Hole Basis	Hole Basis
3. Selection of the ISO symbol for	H9/d10	H7/s6
4. Define the nominal sizes	15mm	10mm
5. From table 12.2, get the tolerance ranges	H9 → [0 +43] d10→ [-50 -120]	H7 → [0 +15] S6 → [+23 +32]
6. Calculate the tolerance dimensions	Body [15.000 15.043] Axle [14.880 14.950]	Wheel [10.000 10.015] Axle[10.023 10.032]

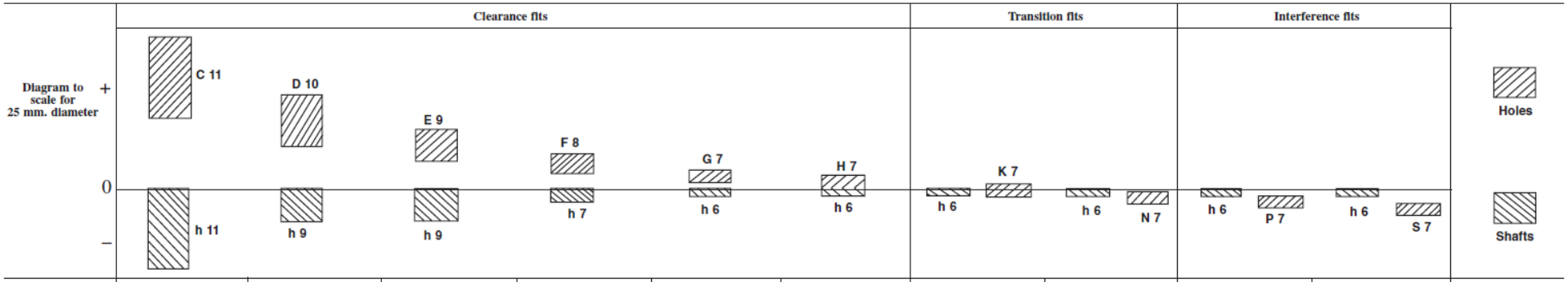
Table 12.1 Description of fits for circular objects

Fit	ISO Symbol		Description
	Hole Basis	Shaft Basis	
Clearance Fits	H11/c11	C11/h11	Loose fit. Wide tolerance
	H9/d10	D10/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. 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 0	– 60 – 120	+ 25 0	– 20 – 60	+ 25 0	– 14 – 39	+ 14 0	– 6 – 16	+ 10 0	– 2 – 8	+ 10 0	– 6 0	+ 10 0	+ 6 + 0	+ 10 0	+ 10 + 4	+ 10 0	+ 12 + 6	+ 10 0	+ 20 + 14	—	3
3	6	+ 75 0	– 70 – 145	+ 30 0	– 30 – 78	+ 30 0	– 20 – 50	+ 18 0	– 10 – 28	+ 12 0	– 4 – 12	+ 12 0	– 8 0	+ 12 0	+ 9 + 1	+ 12 0	+ 16 + 8	+ 12 0	+ 20 + 12	+ 12 0	+ 27 + 19	3	6
6	10	+ 90 0	– 80 – 170	+ 36 0	– 40 – 98	+ 36 0	– 25 – 61	+ 22 0	– 13 – 28	+ 15 0	– 5 – 14	+ 15 0	– 9 0	+ 15 0	+ 10 + 1	+ 15 0	+ 19 + 10	+ 15 0	+ 24 + 15	+ 15 0	+ 32 + 23	6	10
10	18	+ 110 0	– 95 – 205	+ 43 0	– 50 – 120	+ 43 0	– 32 – 75	+ 27 0	– 16 – 34	+ 18 0	– 6 – 17	+ 18 0	– 11 0	+ 18 0	+ 12 + 1	+ 18 0	+ 23 + 12	+ 18 0	+ 29 + 18	+ 18 0	+ 39 + 28	10	18
18	30	+ 130 0	– 110 – 240	+ 52 0	– 65 – 149	+ 52 0	– 40 – 92	+ 33 0	– 20 – 41	+ 21 0	– 7 – 20	+ 21 0	– 13 0	+ 21 0	+ 15 + 2	+ 21 0	+ 28 + 15	+ 21 0	+ 35 + 22	+ 21 0	+ 48 + 35	18	30
30	40	+ 160 0	– 120 – 280	+ 62	– 80	+ 62	– 50	+ 39	– 25	+ 25	– 9	+ 25	– 16	+ 25	+ 18	+ 25	+ 33	+ 25	+ 42	+ 25	+ 59	30	40
40	50	+ 160 0	– 130 – 290	0	– 180	0	– 112	0	– 50	0	– 25	0	0	0	+ 2	0	+ 17	0	+ 26	0	+ 43	40	50
50	65	+ 190 0	– 140 – 330	+ 74	– 100	– 74	– 60	+ 46	– 30	+ 30	– 10	+ 30	– 19	+ 30	+ 21	+ 30	+ 39	+ 30	+ 51	+ 30 0	+ 72 + 53	50	65
65	80	+ 190 0	– 150 – 340	0	– 220	0	– 134	0	– 60	0	– 29	0	0	0	+ 2	0	+ 20	0	+ 32	+ 30 0	+ 78 + 59	65	80
80	100	+ 220 0	– 170 – 390	+ 87	– 120	– 87	– 72	+ 54	– 36	+ 35	– 12	+ 35	– 22	+ 35	+ 25	+ 35	+ 45	+ 35	+ 59	+ 35 0	+ 93 + 71	80	100
100	120	+ 220 0	– 180 – 400	+ 0	– 260	– 0	– 159	0	– 71	0	– 34	0	0	0	+ 3	0	+ 23	0	+ 37	+ 35 + 0	+ 101 + 79	100	120
120	140	+ 250 0	– 200 – 450																	+ 40 0	+ 117 + 92	120	140
140	160	+ 250 0	– 210 – 460	+ 100 0	145 305	+ 100 0	– 84 – 185	+ 63 0	– 43 – 83	– 40 0	– 14 – 39	+ 40 0	– 25 0	+ 40 0	+ 28 + 3	+ 40 0	+ 52 + 27	– 40 0	+ 68 + 43	+ 40 0	+ 125 + 100	140	160
160	180	+ 250 0	– 230 – 480																	+ 40 0	+ 133 + 108	160	180
180	200	+ 290 0	– 240 530																	+ 46 0	+ 151 + 122	180	200
200	225	+ 290 0	260 550	+ 115 0	– 170 – 355	+ 115 0	– 100 – 215	+ 72 0	– 50 – 96	+ 46 0	– 15 – 44	+ 46 0	– 29 0	+ 46 0	+ 33 + 4	+ 46 0	+ 60 + 31	+ 46 0	+ 79 + 50	+ 46 0	+ 159 + 130	200	225
225	250	+ 290 0	280 570																	+ 46 0	+ 169 + 140	225	250
250	280	+ 320 0	300 620	+ 130	– 190	+ 130	– 110	+ 81	– 56	+ 52	– 17	+ 52	+ 32	+ 52	– 36	+ 52	+ 66	+ 52	+ 88	+ 52 0	+ 190 + 158	250	280
280	315	+ 320 0	330 650	0	– 400	0	– 240	0	– 108	0	– 49	0	0	0	+ 4	0	+ 34	0	+ 56	+ 52 0	+ 202 + 170	280	315
315	355	+ 360 0	360 – 720	+ 140	– 210	+ 140	– 125	+ 89	– 62	+ 57	– 18	+ 57	– 36	+ 57	+ 40	+ 57	+ 73	+ 57	+ 98	+ 57 0	+ 226 + 190	315	355
355	400	+ 360 0	400 760	0	– 440	0	– 265	0	– 119	0	– 54	0	0	0	+ 4	0	+ 37	0	+ 62	+57 0	+ 244 + 208	355	400
400	450	+ 400 0	440 840	+ 155	– 230	+ 155	– 135	+ 97	– 68	+ 63	– 20	+ 63	– 40	+ 63	+ 45	+ 63	+ 80	+ 63	+ 108	+ 63 0	+ 272 + 232	400	450
450	500	+ 400 0	480 880	0	– 480	0	– 290	0	– 131	0	– 60	0	0	0	+ 5	0	+ 40	0	+ 68	+ 63 0	+ 292 + 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 – 60	+ 120 + 60	0 – 25	+ 60 + 20	0 – 25	+ 39 + 14	0 – 10	+ 20 + 6	0 – 6	+ 12 + 2	0 – 6	+ 10 0	0 – 6	0 – 10	0 – 6	– 4 – 14	0 – 6	– 6 – 16	0 – 6	– 14 – 24	–	3
3	6	0 – 75	+ 145 + 70	0 – 30	+ 78 + 30	0 – 30	+ 50 + 20	0 – 12	+ 28 + 10	0 – 8	+ 16 + 4	0 – 8	+ 12 0	0 – 8	+ 3 – 9	0 – 8	– 4 – 16	0 – 8	– 8 – 20	0 – 8	– 15 – 27	3	6
6	10	0 – 90	+ 170 + 80	0 – 36	+ 98 + 40	0 – 36	+ 61 + 25	0 – 15	+ 35 + 13	0 – 9	+ 20 + 5	0 – 9	+ 15 0	0 – 9	+ 5 – 10	0 – 9	– 4 – 19	0 – 9	– 9 – 24	0 – 9	– 17 – 32	6	10
10	18	0 – 110	+ 205 + 95	0 – 43	+ 120 + 50	0 – 43	+ 75 + 32	0 – 18	+ 43 + 16	0 – 11	+ 24 + 6	0 – 11	+ 18 0	0 – 11	+ 6 – 12	0 – 11	– 5 – 23	0 – 11	– 11 – 29	0 – 11	– 21 – 39	10	18
18	30	0 – 130	+ 240 + 110	0 – 52	+ 149 + 65	0 – 52	+ 92 + 40	0 – 21	+ 53 + 20	0 – 13	+ 28 + 7	0 – 13	+ 21 0	0 – 13	+ 6 – 15	0 – 13	– 7 – 28	0 – 13	– 14 – 35	0 – 13	– 27 – 48	18	30
30	40	0 – 160	+ 280 + 120	0	+ 180	0	+ 112	0	+ 64	0	+ 34	0	+ 25	0	+ 7	0	– 8	0	– 17	0	– 34	30	40
40	50	0 – 160	+ 290 + 130	– 62	+ 80	– 62	+ 50	– 25	+ 25	– 16	+ 9	– 16	0	– 16	– 18	– 16	– 33	– 16	– 42	– 16	– 59	40	50
50	65	0 – 190	+ 330 + 140	0	+ 220	0	+ 134	0	+ 76	0	+ 40	0	+ 30	0	+ 9	0	– 9	0	– 21	0 – 19	– 42 – 72	50	65
65	80	0 – 190	+ 340 + 150	– 74	+ 100	– 74	+ 60	– 30	+ 30	– 19	+ 10	– 19	0	– 19	– 21	– 19	– 39	– 19	– 51	0 – 19	– 48 – 78	65	80
80	100	0 – 220	+ 390 + 170	0	+ 260	0	+ 159	0	+ 90	0	+ 47	0	+ 35	0	+ 10	0	– 10	0	– 24	0 – 22	– 58 – 93	80	100
100	120	0 – 220	+ 400 + 800	– 87	+ 120	– 87	+ 72	– 35	+ 36	– 22	+ 12	– 22	0	– 22	– 25	– 22	– 45	– 22	– 59	0 – 22	– 66 – 101	100	120
120	140	0 – 250	+ 450 + 200																	0 – 25	– 77 – 117	120	140
140	160	0 – 250	+ 460 + 210	0 – 100	+ 305 + 145	0 – 100	+ 185 + 85	0 – 40	+ 106 + 43	0 – 25	+ 54 + 14	0 – 25	+ 40 0	0 – 25	+ 12 – 28	0 – 25	– 12 – 52	0 – 25	– 28 – 68	0 – 25	– 85 – 125	140	160
160	180	0 – 250	+ 480 + 230																	0 – 25	– 93 – 133	160	180
180	200	0 – 290	+ 530 + 240																	0 – 29	– 105 – 151	180	200
200	225	0 – 290	+ 550 – 260	0 – 115	+ 355 + 170	0 – 115	+ 215 + 100	0 – 46	+ 122 + 50	0 – 29	+ 61 + 15	0 – 29	+ 46 0	0 – 29	+ 13 – 33	0 – 29	– 14 – 60	0 – 29	– 33 – 79	0 – 29	– 113 – 159	200	225
225	250	0 – 290	+ 570 + 280																	0 – 29	– 123 – 169	225	250
250	280	0 – 320	+ 620 + 300	0	+ 400	0	+ 240	0	+ 137	0	+ 62	0	+ 52	0	+ 16	0	– 14	0	– 36	0 – 32	– 138 – 190	250	280
280	315	0 – 320	+ 650 + 330	– 130	+ 190	– 130	+ 110	– 52	+ 56	– 32	+ 17	– 32	0	– 32	– 36	– 32	– 66	– 32	– 88	0 – 32	– 150 – 202	280	315
315	355	0 – 360	+ 720 + 360	0	+ 440	0	+ 265	0	+ 151	0	+ 75	0	+ 57	0	+ 17	0	– 16	0	– 41	0 – 36	– 169 – 226	315	355
355	400	0 – 360	+ 760 + 400	– 140	+ 210	– 140	+ 125	– 57	+ 62	– 36	+ 18	– 36	0	– 36	– 40	– 36	– 73	– 36	– 98	0 – 36	– 187 – 244	355	400
400	450	0 – 400	+ 840 + 440	0	+ 480	0	+ 290	0	+ 165	0	+ 83	0	+ 63	0	+ 18	0	– 17	0	– 45	0 – 40	– 209 – 272	400	450
450	500	0 – 400	+ 880 + 480	– 155	+ 230	– 155	+ 135	– 63	+ 68	– 40	+ 20	– 40	0	– 40	– 45	– 40	– 80	– 40	– 108	0 – 40	– 229 – 292	450	500

Table 12.3 Selected ISO Fits : Shaft Bases