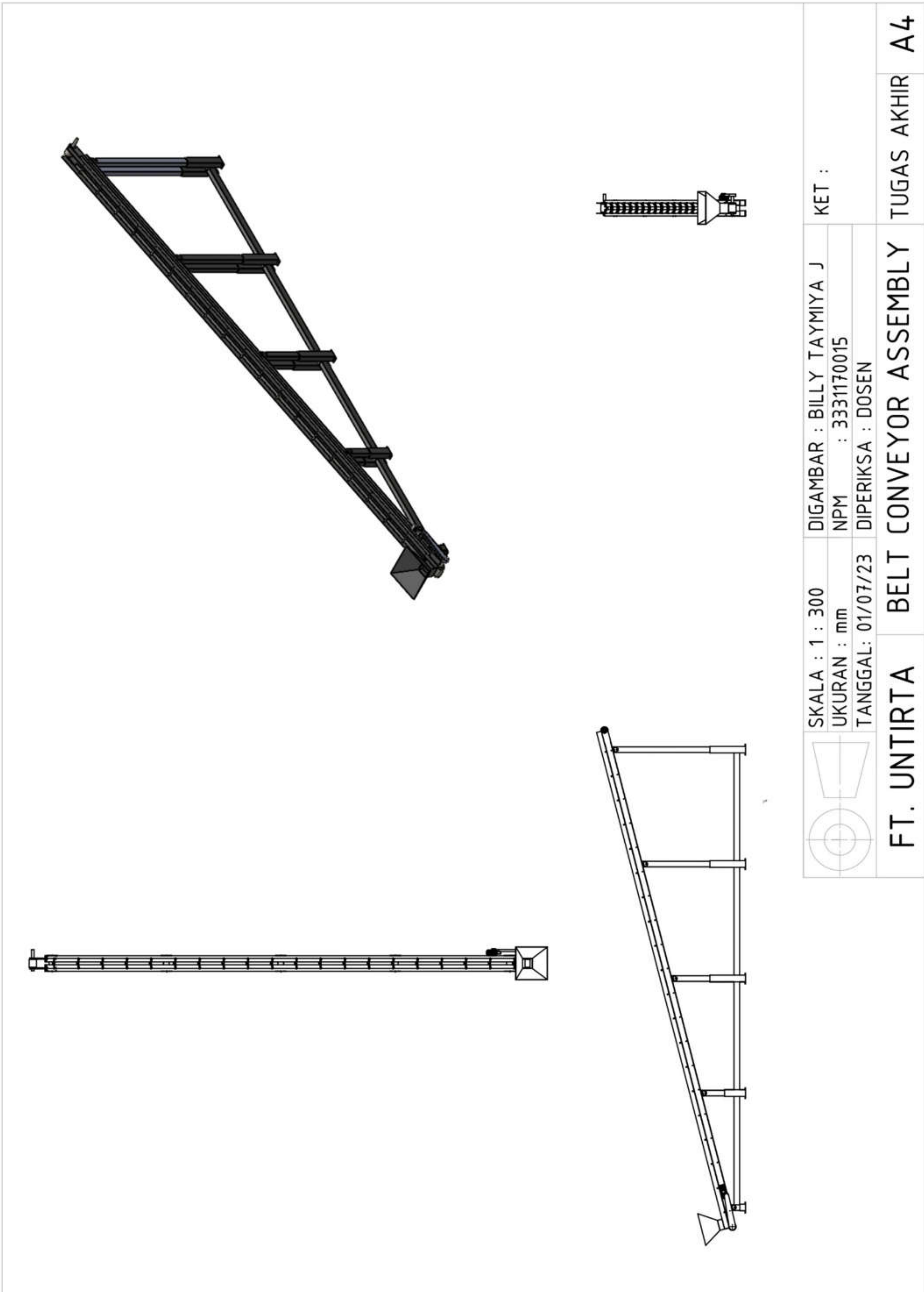
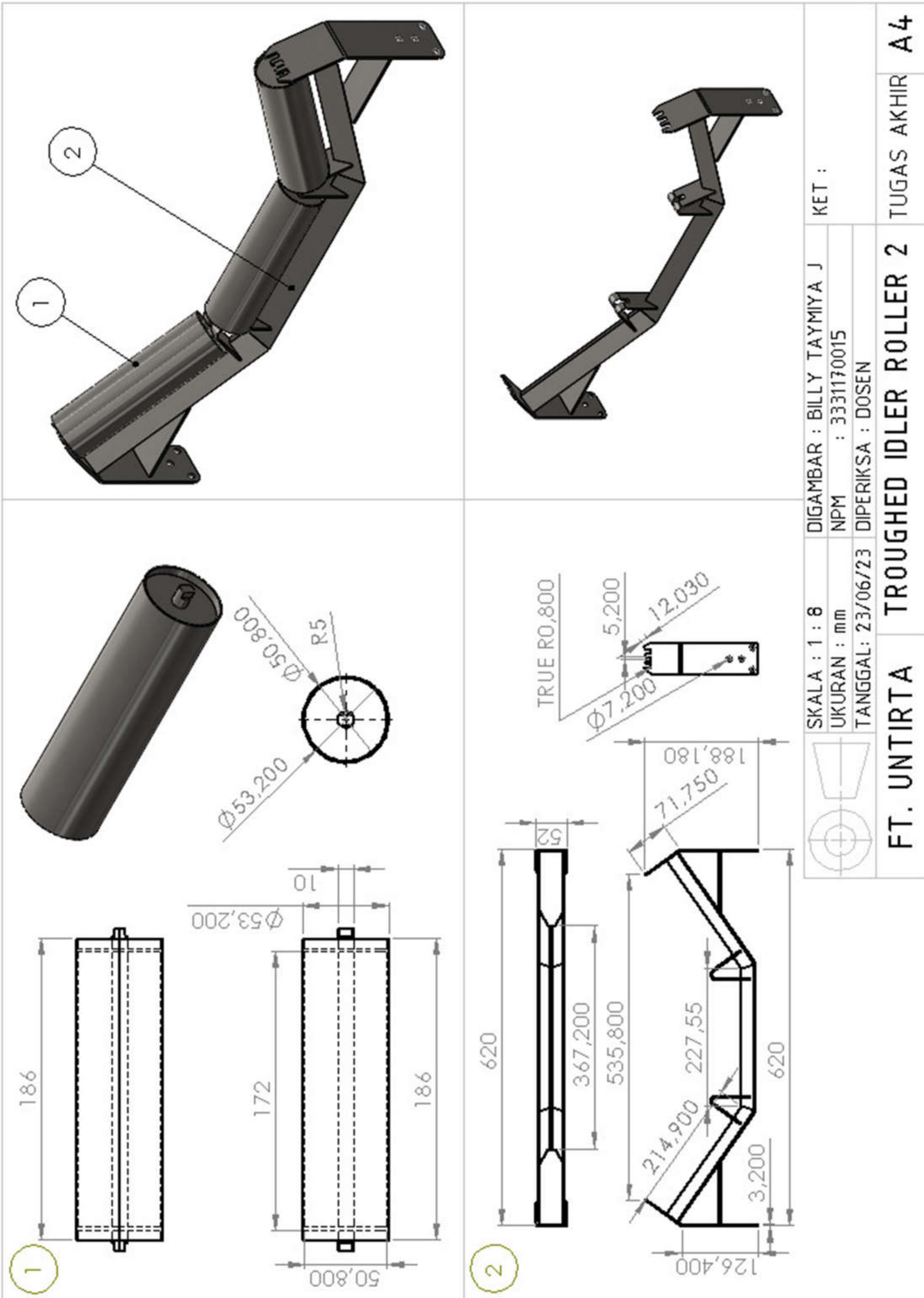
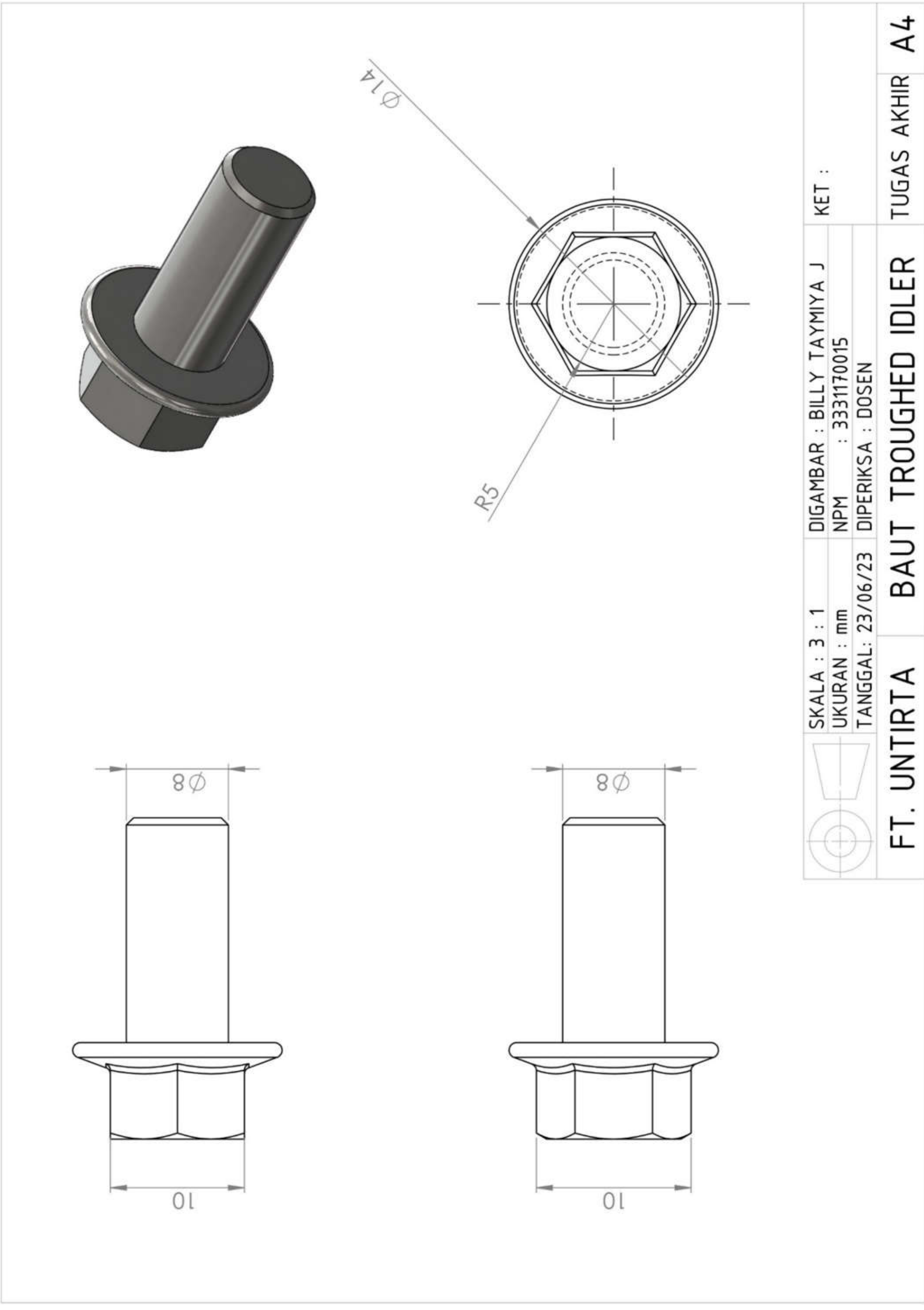
LAMPIRAN

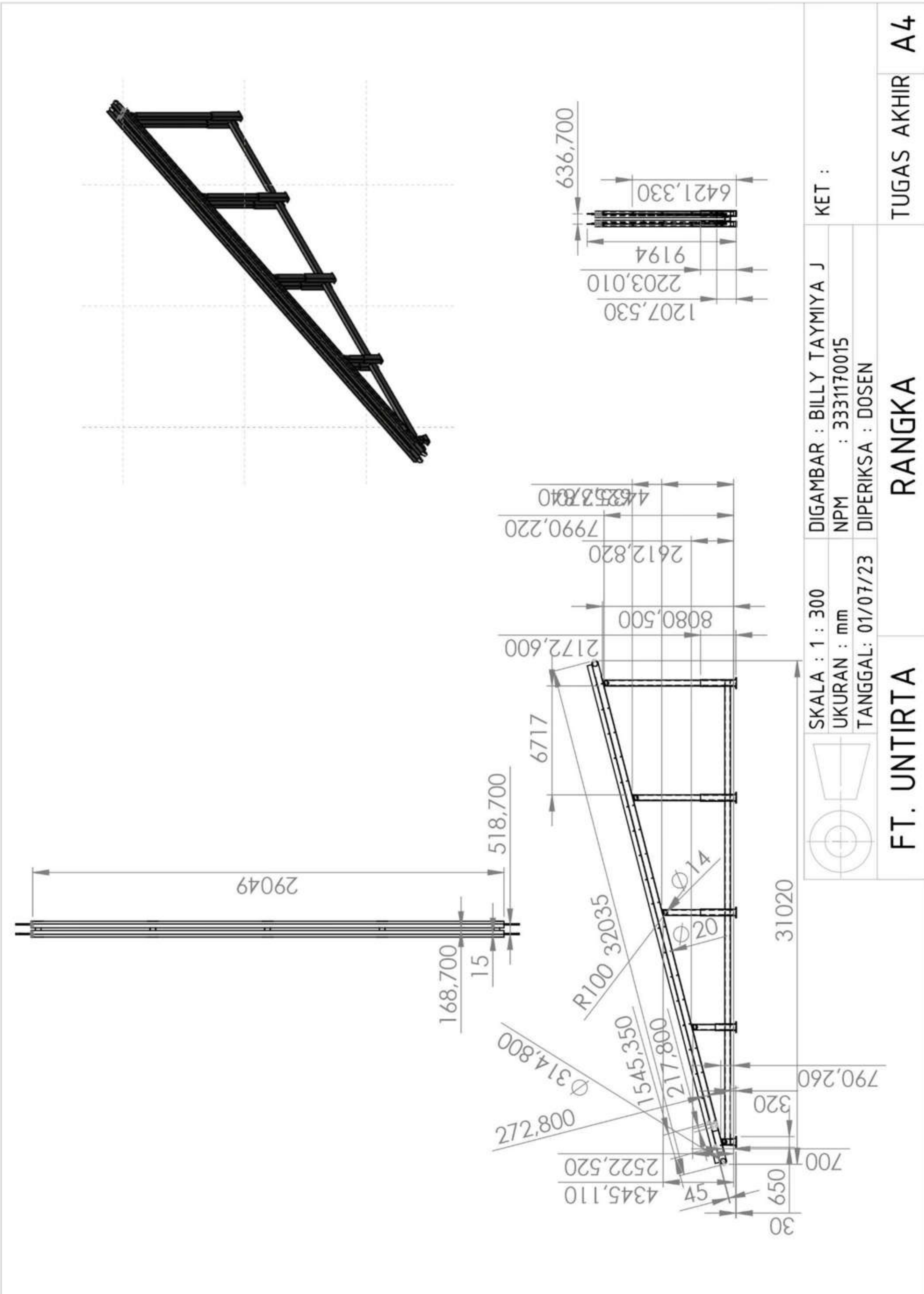

SKALA : 1 : 300
UKURAN : mm
TANGGAL: 01/07/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
BELT CONVEYOR ASSEMBLY
TUGAS AKHIR
A4

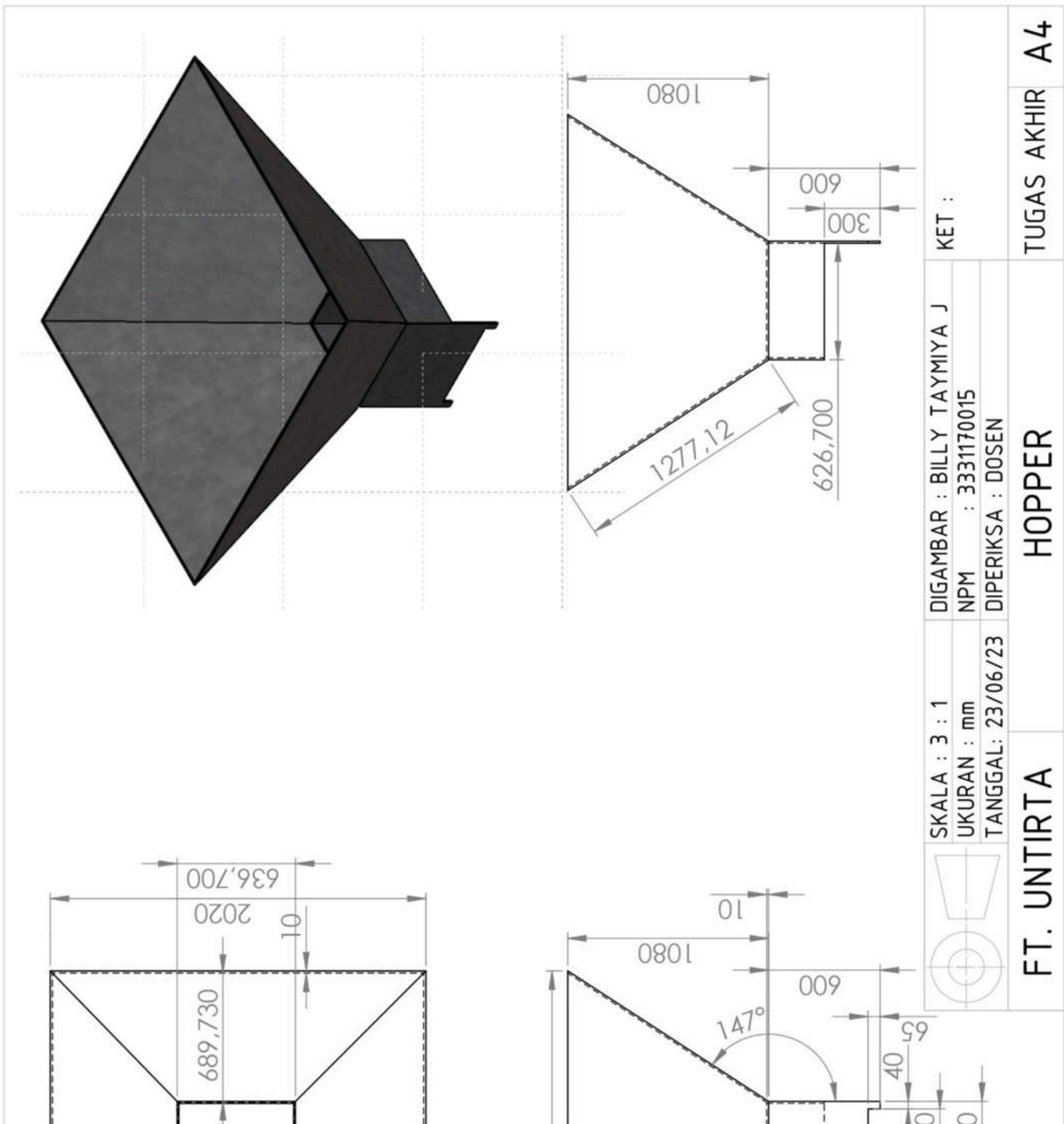


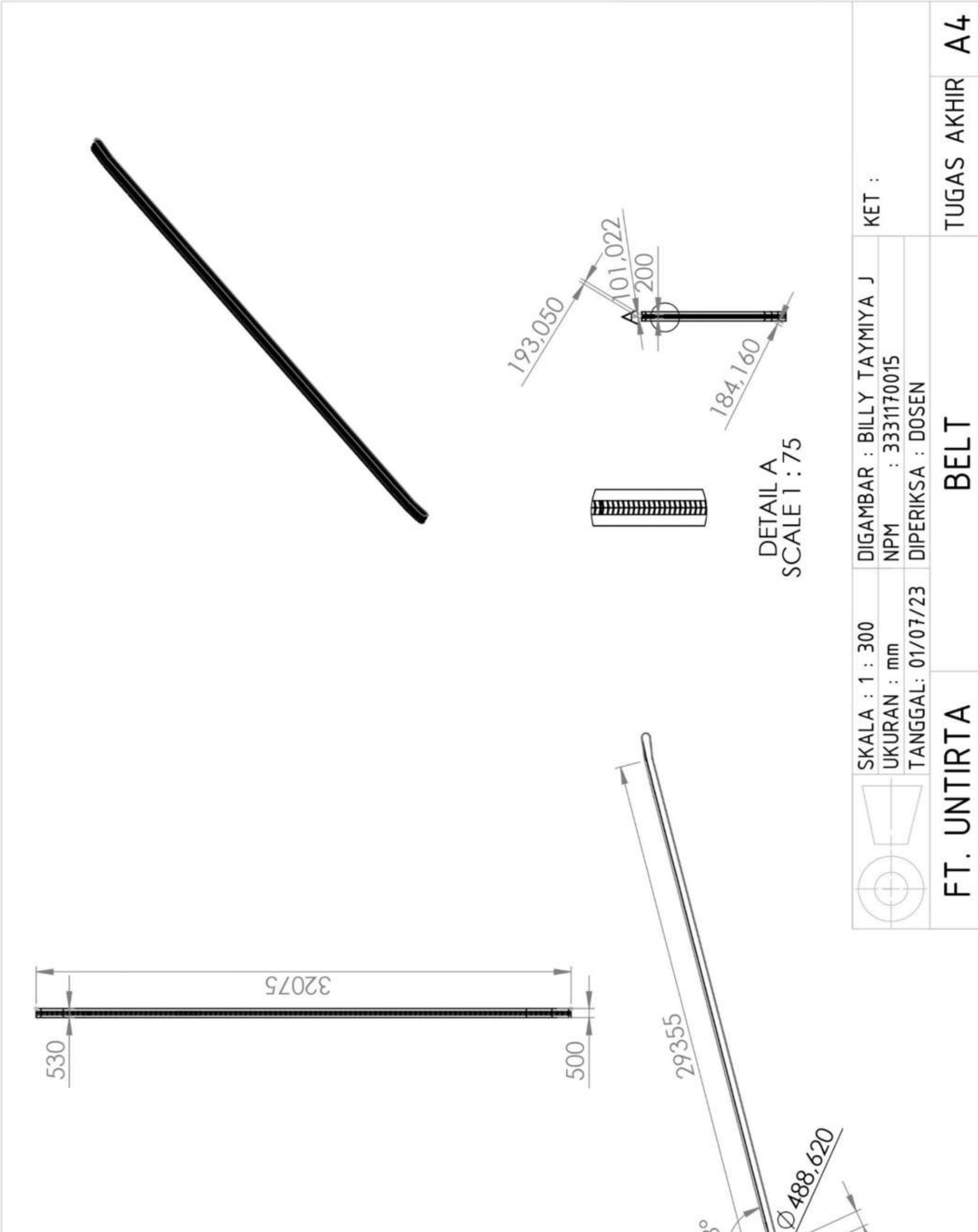
SKALA : 1 : 8
UKURAN : mm
TANGGAL: 23/06/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
TROUGHED IDLER ROLLER 2
TUGAS AKHIR
A4
1
2
186
172
50,800
Ø53,200
10
Ø50,800
R5
620
52
367,200
535,800
227,55
214,900
3,200
126,400
71,750
188,180
TRUE R0,800
5,200
12,030
Ø7,200



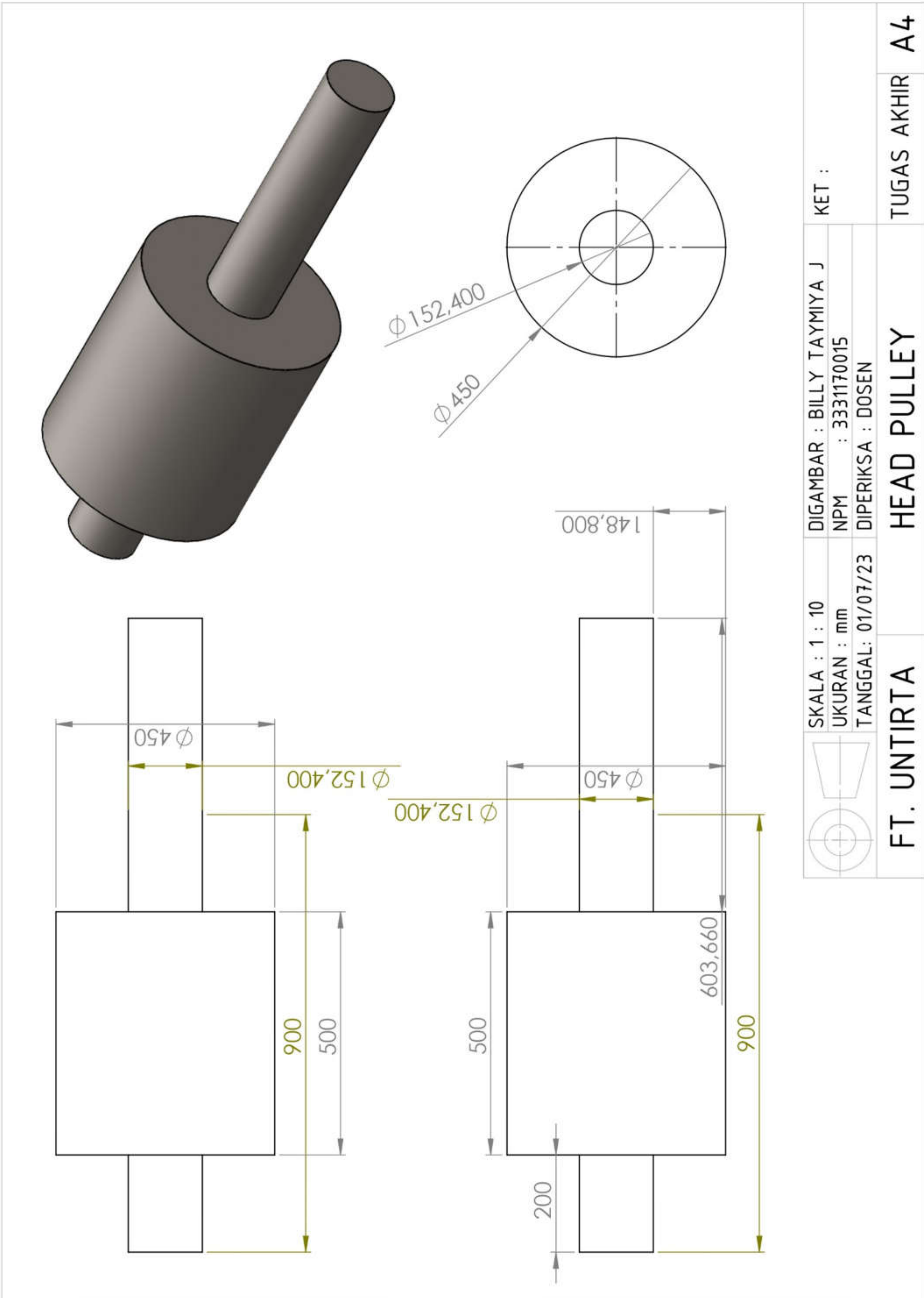
Ø14
R5
Ø8
Ø8
10
10
SKALA : 3 : 1
UKURAN : mm
TANGGAL: 23/06/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
BAUT TROUGHED IDLER
TUGAS AKHIR
A4

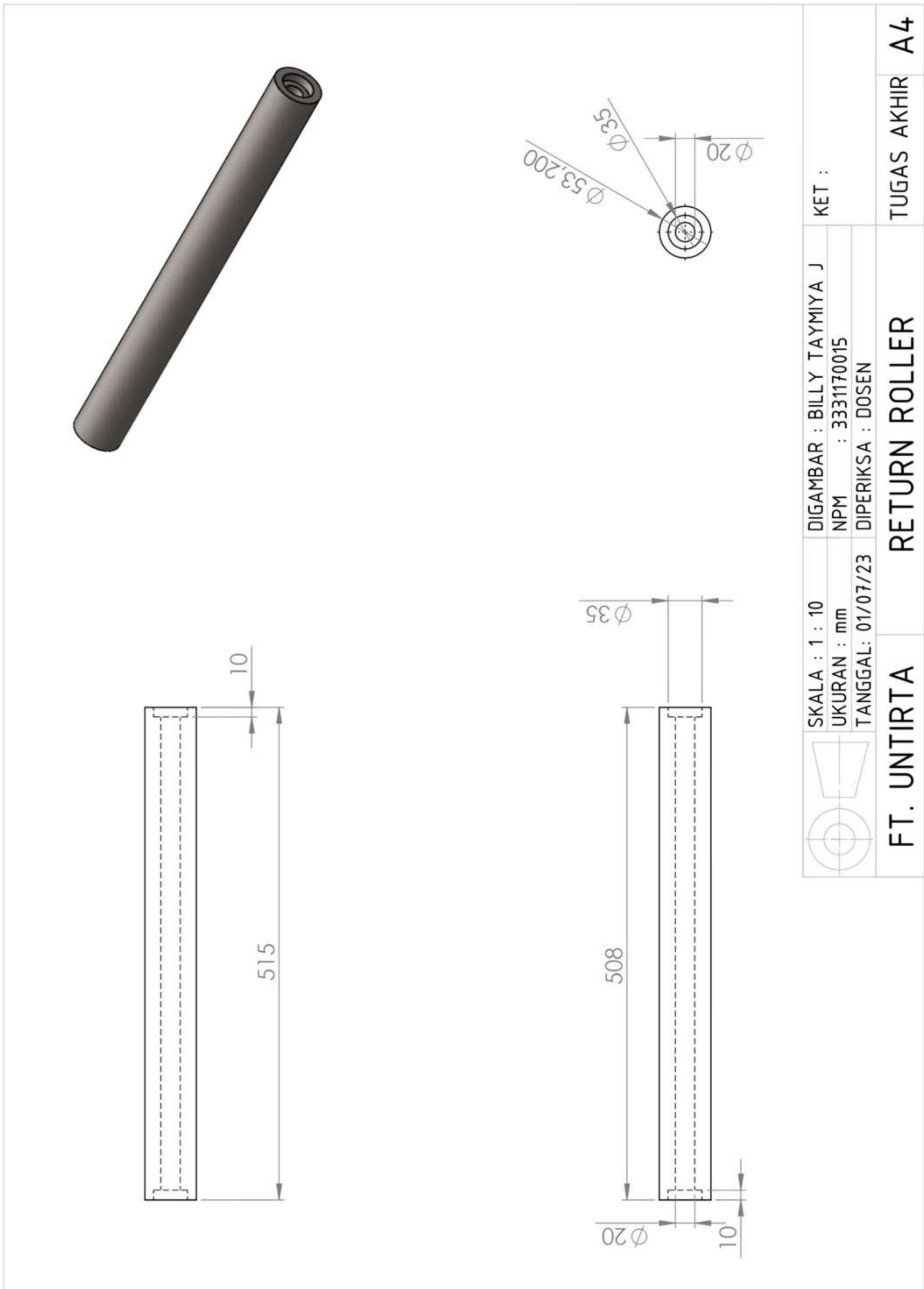

636,700
6421,330
9194
2203,010
1207,530
7990,220
2612,820
8080,500
2172,600
6717
518,700
29049
168,700
15
Ø14
Ø20
R100
32035
31020
1545,350
217,800
Ø314,800
272,800
790,260
320
2522,520
4345,110
45
650
700
30
SKALA : 1 : 300
UKURAN : mm
TANGGAL: 01/07/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
RANGKA
TUGAS AKHIR
A4

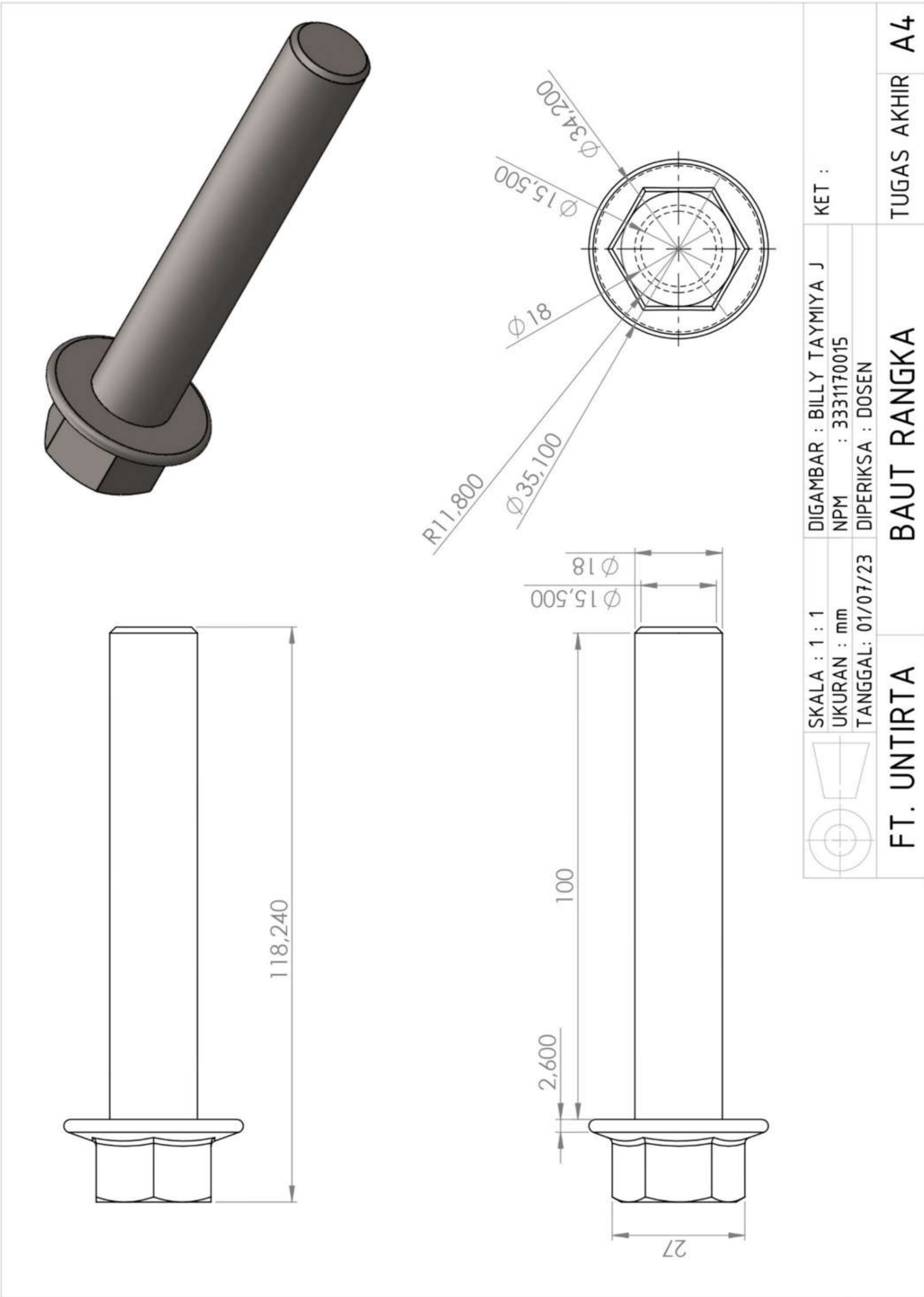

SKALA : 3 : 1
UKURAN : mm
TANGGAL: 23/06/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
HOPPER
TUGAS AKHIR
A4
1080
600
300
1277,12
626,700
636,700
2020
10
689,730
964
147°
65
40
556,700
1277,120
310



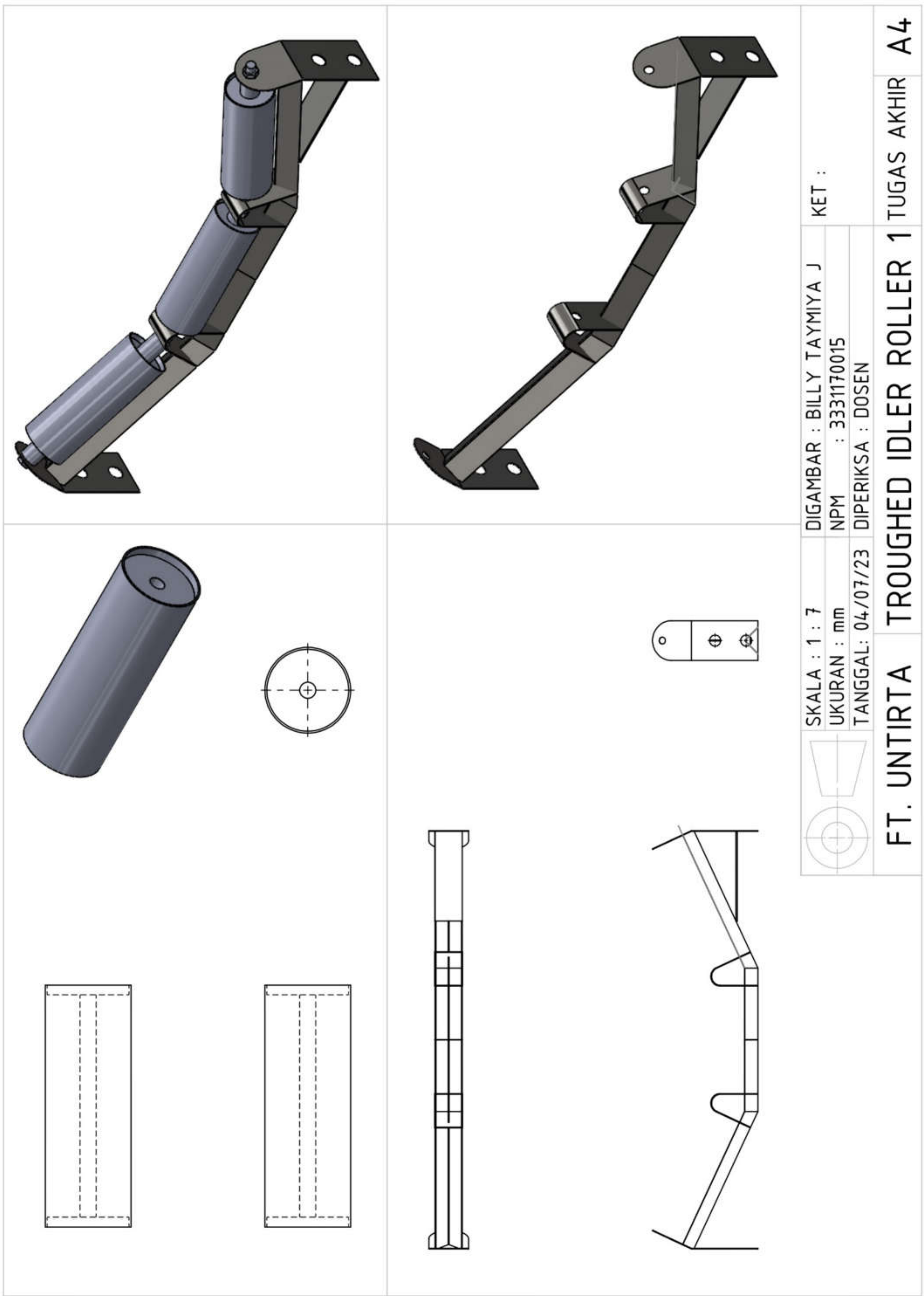
530
32075
500
29355
187,68°
Ø488,620
20
957,300
193,050
101,022
200
184,160
DETAIL A
SCALE 1 : 75
SKALA : 1 : 300
UKURAN : mm
TANGGAL: 01/07/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
BELT
TUGAS AKHIR
A4

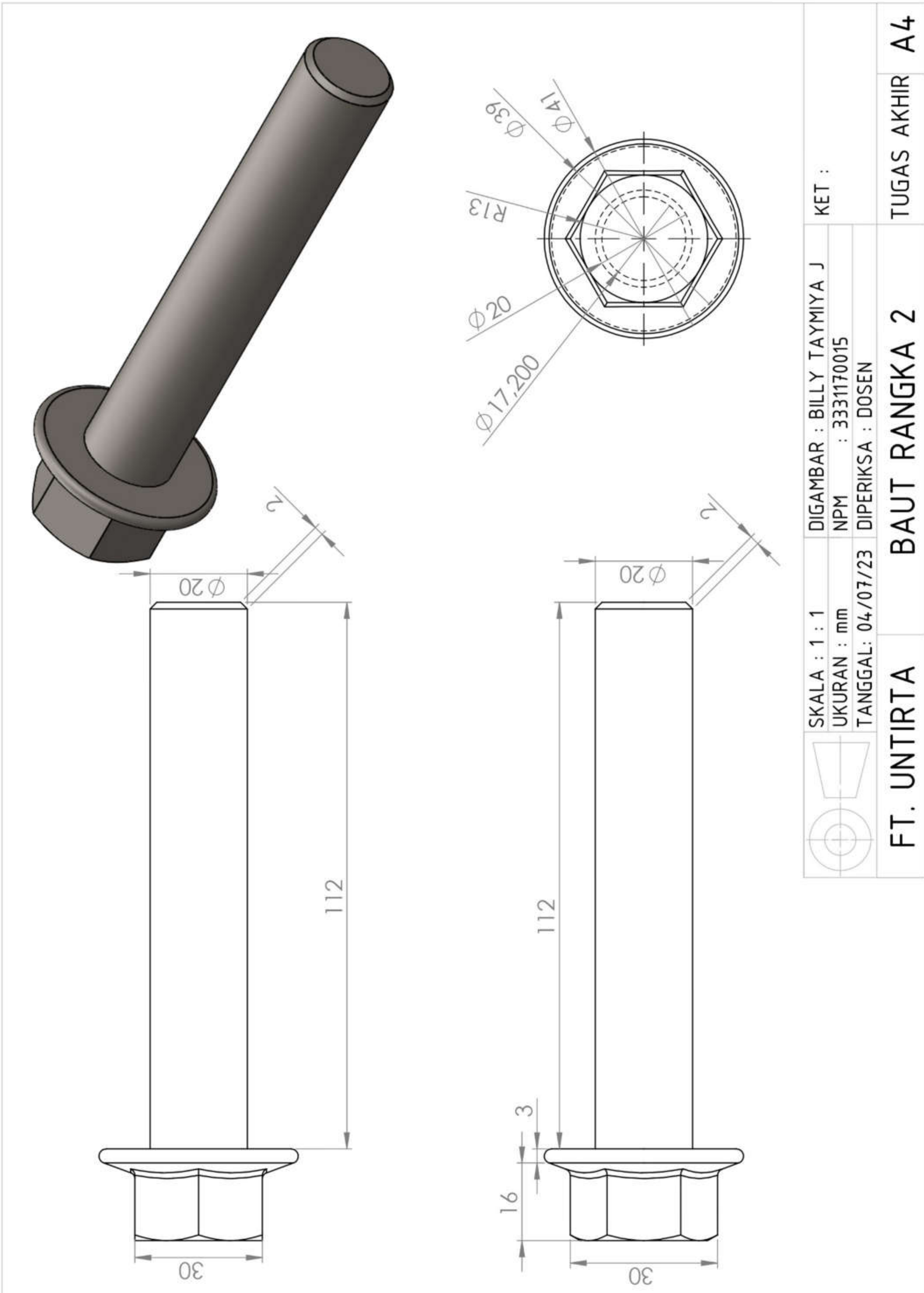

∅152,400
∅450
148,800
603,660
900
500
200
SKALA : 1 : 10
UKURAN : mm
TANGGAL: 01/07/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
HEAD PULLEY
TUGAS AKHIR
A4


Ø53,200
Ø35
Ø20
10
515
Ø35
508
Ø20
10
SKALA : 1 : 10
UKURAN : mm
TANGGAL: 01/07/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
RETURN ROLLER
TUGAS AKHIR
A4

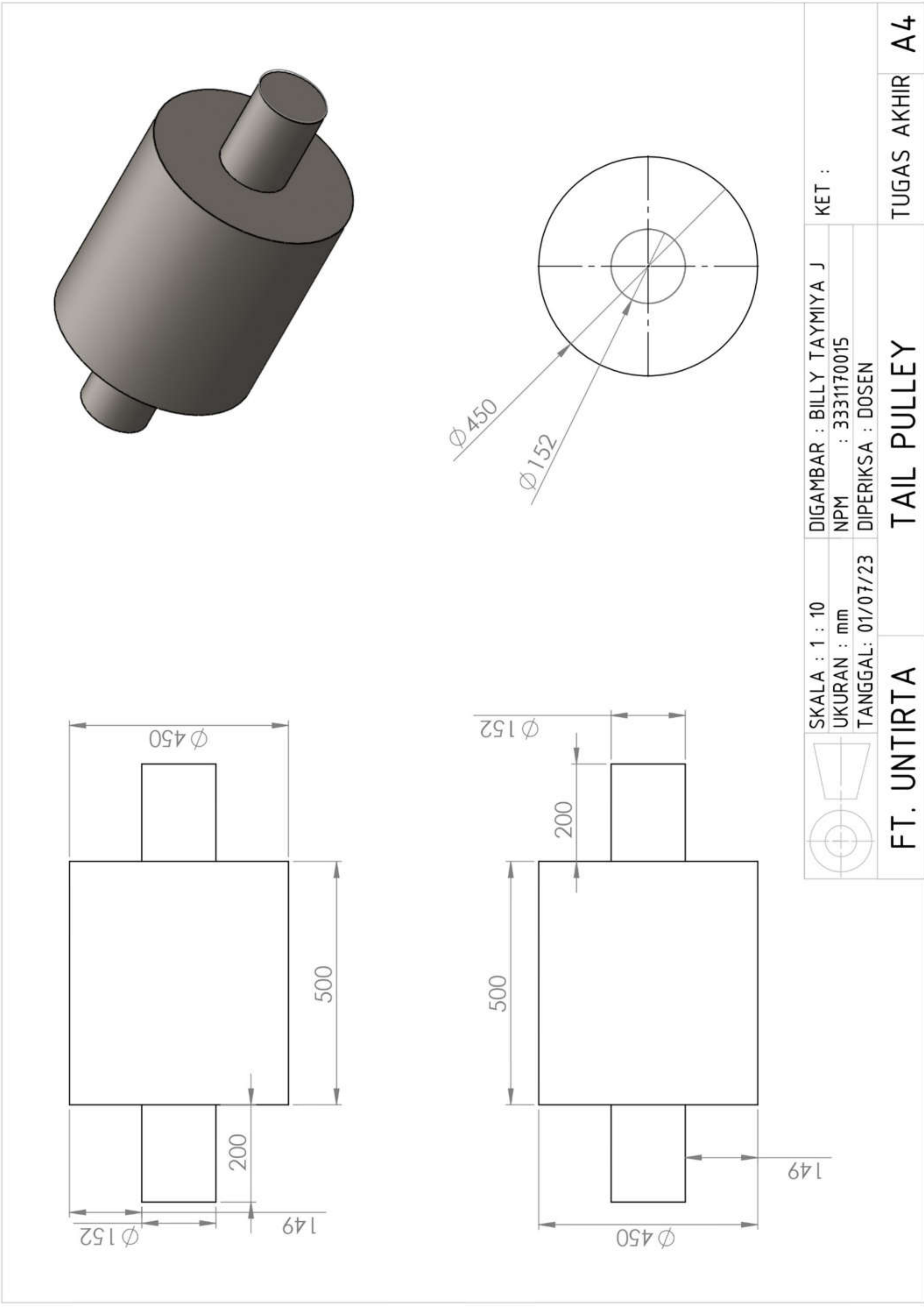


Ø34,200
Ø15,500
Ø18
R11,800
Ø35,100
Ø18
Ø15,500
118,240
100
2,600
27
SKALA : 1 : 1
UKURAN : mm
TANGGAL: 01/07/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
BAUT RANGKA
TUGAS AKHIR
A4

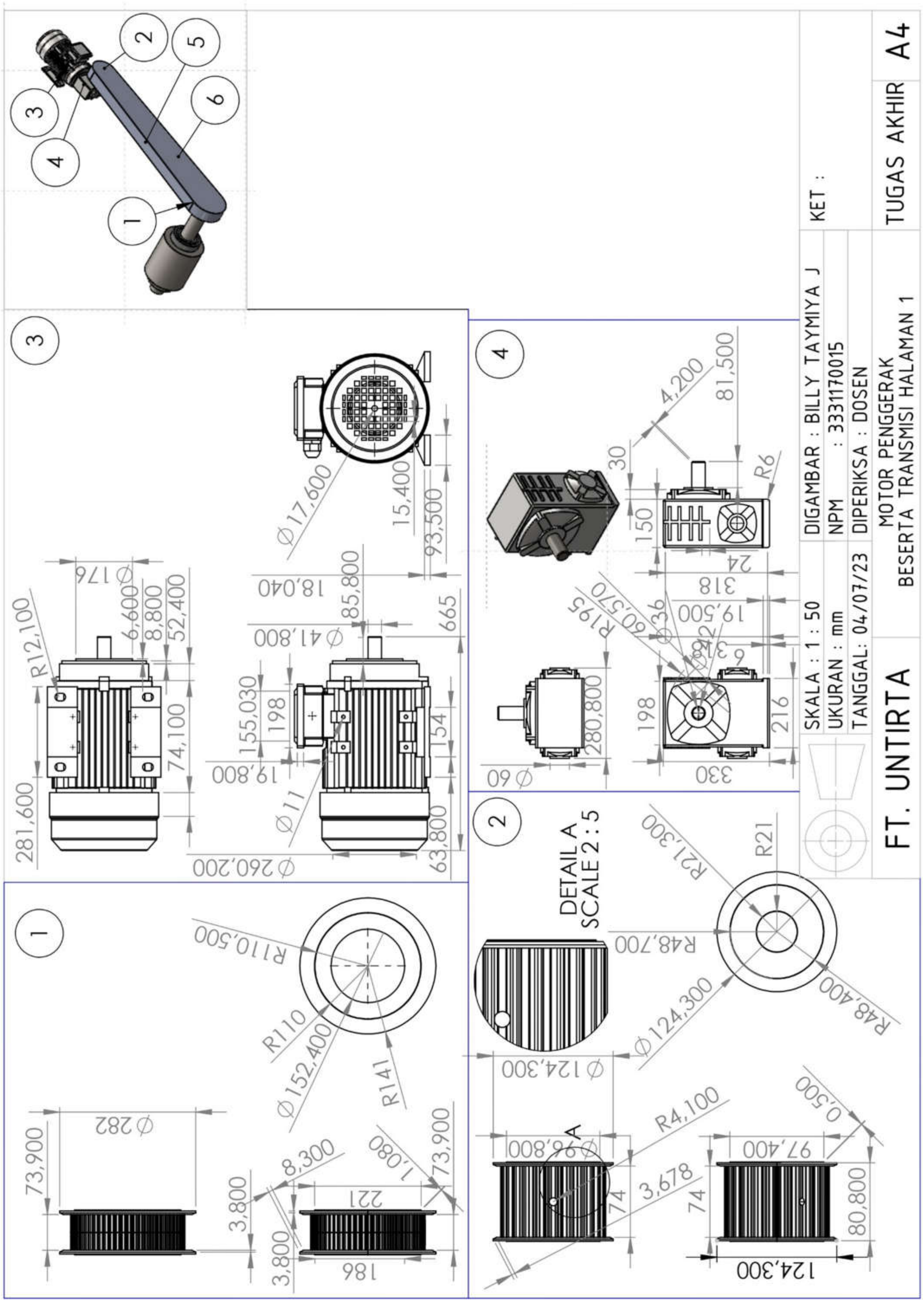

SKALA : 1 : 7
UKURAN : mm
TANGGAL: 04/07/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
TROUGHED IDLER ROLLER 1
TUGAS AKHIR
A4

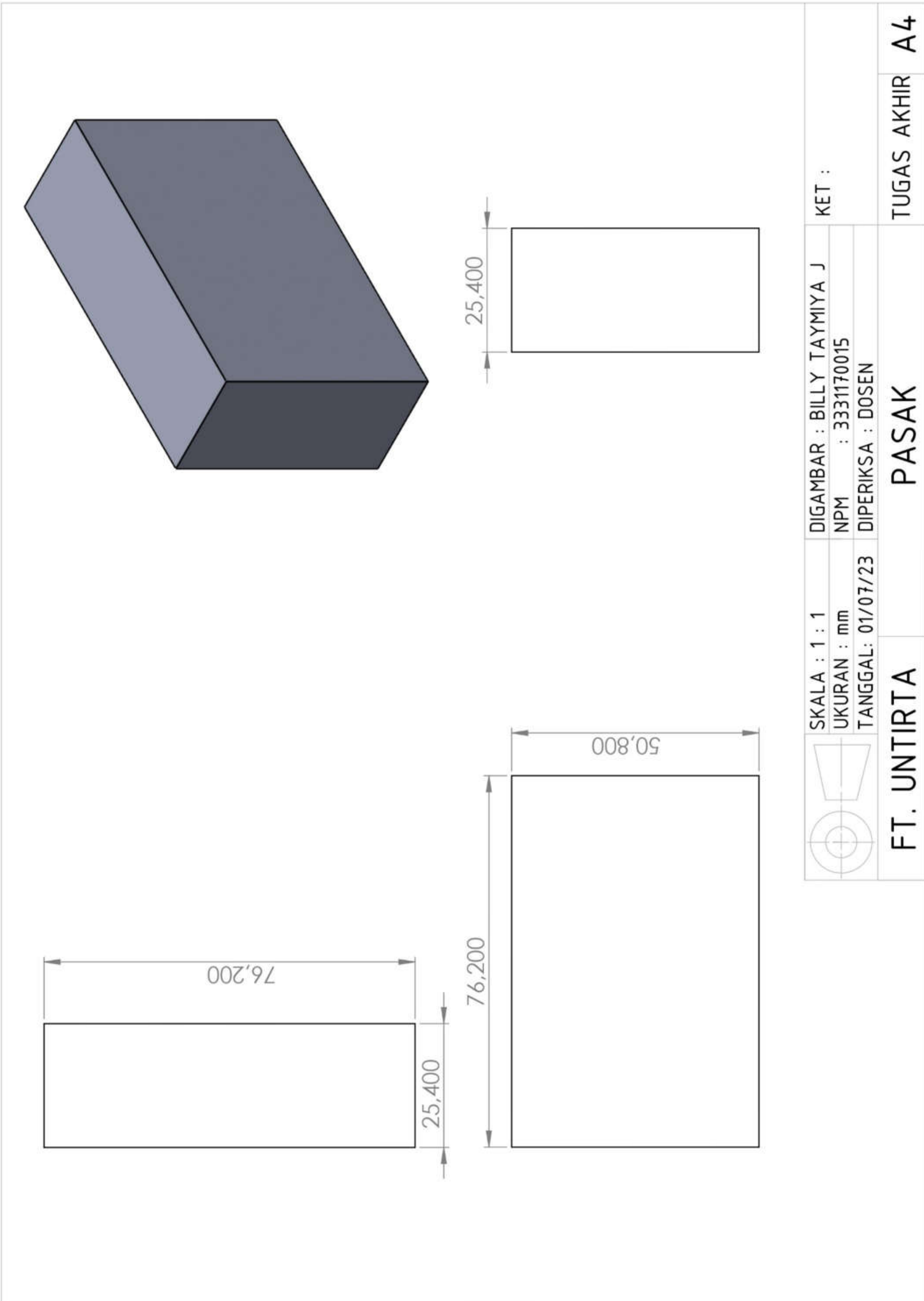


Ø39
Ø41
R13
Ø20
Ø17,200
2
Ø20
112
3
16
30
SKALA : 1 : 1
UKURAN : mm
TANGGAL: 04/07/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
BAUT RANGKA 2
TUGAS AKHIR
A4



SKALA : 1 : 10
UKURAN : mm
TANGGAL: 01/07/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
TAIL PULLEY
TUGAS AKHIR
A4
Ø450
Ø152
500
200
149


DETAIL A
SCALE 2 : 5
SKALA : 1 : 50
UKURAN : mm
TANGGAL: 04/07/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
MOTOR PENGGERAK
BESERTA TRANSMISI HALAMAN 1
TUGAS AKHIR
A4


25,400
50,800
76,200
76,200
25,400
SKALA : 1 : 1
UKURAN : mm
TANGGAL: 01/07/23
DIGAMBAR : BILLY TAYMIYA J
NPM : 3331170015
DIPERIKSA : DOSEN
KET :
FT. UNTIRTA
PASAK
TUGAS AKHIR
A4

BOUNDARY DIMENSIONS AND IDENTIFYING NUMBERS FOR BEARINGS

NSK

Units: mm

Bore Number	d	Diameter Series 7 D	17 B	27 B	37 B	17~37 r (min.)	Diameter Series 8 D	08 B	18 B	28 B	38 B	48 B	58 B	68 B	08 r (min.)	18~68 r (min.)
Single-Row Ball Brgs.									68							
Double-Row Ball Brgs.																
Cylindrical Roller Brgs.										N28	NN38	NN48				
Needle Roller Brgs.												NA48				
Spherical Roller Brgs.																
—	0.6	2	0.8	—	—	0.05	2.5	—	1	—	1.4	—	—	—	—	0.05
1	1	2.5	1	—	—	0.05	3	—	1	—	1.5	—	—	—	—	0.05
—	1.5	3	1	—	1.8	0.05	4	—	1.2	—	2	—	—	—	—	0.05
2	2	4	1.2	—	2	0.05	5	—	1.5	—	2.3	—	—	—	—	0.08
—	2.5	5	1.5	—	2.3	0.08	6	—	1.8	—	2.6	—	—	—	—	0.08
3	3	6	2	2.5	3	0.08	7	—	2	—	3	—	—	—	—	0.1
4	4	7	2	2.5	3	0.08	9	—	2.5	3.5	4	—	—	—	—	0.1
5	5	8	2	2.5	3	0.08	11	—	3	4	5	—	—	—	—	0.15
6	6	10	2.5	3	3.5	0.1	13	—	3.5	5	6	—	—	—	—	0.15
7	7	11	2.5	3	3.5	0.1	14	—	3.5	5	6	—	—	—	—	0.15
8	8	12	2.5	—	3.5	0.1	16	—	4	5	6	8	—	—	—	0.2
9	9	14	3	—	4.5	0.1	17	—	4	5	6	8	—	—	—	0.2
00	10	15	3	—	4.5	0.1	19	—	5	6	7	9	—	—	—	0.3
01	12	18	4	—	5	0.2	21	—	5	6	7	9	—	—	—	0.3
02	15	21	4	—	5	0.2	24	—	5	6	7	9	—	—	—	0.3
03	17	23	4	—	5	0.2	26	—	5	6	7	9	—	—	—	0.3
04	20	27	4	—	5	0.2	32	4	7	8	10	12	16	22	0.3	0.3
/22	22	—	—	—	—	—	34	4	7	—	10	—	16	22	0.3	0.3
05	25	32	4	—	5	0.2	37	4	7	8	10	12	16	22	0.3	0.3
/28	28	—	—	—	—	—	40	4	7	—	10	—	16	22	0.3	0.3
06	30	37	4	—	5	0.2	42	4	7	8	10	12	16	22	0.3	0.3
/32	32	—	—	—	—	—	44	4	7	—	10	—	16	22	0.3	0.3
07	35	—	—	—	—	—	47	4	7	8	10	12	16	22	0.3	0.3
08	40	—	—	—	—	—	52	4	7	8	10	12	16	22	0.3	0.3
09	45	—	—	—	—	—	58	4	7	8	10	13	18	23	0.3	0.3
10	50	—	—	—	—	—	65	5	7	10	12	15	20	27	0.3	0.3
11	55	—	—	—	—	—	72	7	9	11	13	17	23	30	0.3	0.3
12	60	—	—	—	—	—	78	7	10	12	14	18	24	32	0.3	0.3
13	65	—	—	—	—	—	85	7	10	13	15	20	27	36	0.3	0.6
14	70	—	—	—	—	—	90	8	10	13	15	20	27	36	0.3	0.6
15	75	—	—	—	—	—	95	8	10	13	15	20	27	36	0.3	0.6
16	80	—	—	—	—	—	100	8	10	13	15	20	27	36	0.3	0.6
17	85	—	—	—	—	—	110	9	13	16	19	25	34	45	0.3	1
18	90	—	—	—	—	—	115	9	13	16	19	25	34	45	0.3	1
19	95	—	—	—	—	—	120	9	13	16	19	25	34	45	0.3	1
20	100	—	—	—	—	—	125	9	13	16	19	25	34	45	0.3	1
21	105	—	—	—	—	—	130	9	13	16	19	25	34	45	0.3	1
22	110	—	—	—	—	—	140	10	16	19	23	30	40	54	0.6	1
24	120	—	—	—	—	—	150	10	16	19	23	30	40	54	0.6	1
26	130	—	—	—	—	—	165	11	18	22	26	35	46	63	0.6	1.1
28	140	—	—	—	—	—	175	11	18	22	26	35	46	63	0.6	1.1
30	150	—	—	—	—	—	190	13	20	24	30	40	54	71	0.6	1.1
32	160	—	—	—	—	—	200	13	20	24	30	40	54	71	0.6	1.1
34	170	—	—	—	—	—	215	14	22	27	34	45	60	80	0.6	1.1
36	180	—	—	—	—	—	225	14	22	27	34	45	60	80	0.6	1.1
38	190	—	—	—	—	—	240	16	24	30	37	50	67	90	1	1.5
40	200	—	—	—	—	—	250	16	24	30	37	50	67	90	1	1.5
44	220	—	—	—	—	—	270	16	24	30	37	50	67	90	1	1.5
48	240	—	—	—	—	—	300	19	28	36	45	60	80	109	1	2
52	260	—	—	—	—	—	320	19	28	36	45	60	80	109	1	2
56	280	—	—	—	—	—	350	22	33	42	52	69	95	125	1.1	2
60	300	—	—	—	—	—	380	25	38	48	60	80	109	145	1.5	2.1
64	320	—	—	—	—	—	400	25	38	48	60	80	109	145	1.5	2.1
68	340	—	—	—	—	—	420	25	38	48	60	80	109	145	1.5	2.1
72	360	—	—	—	—	—	440	25	38	48	60	80	109	145	1.5	2.1
76	380	—	—	—	—	—	480	31	46	60	75	100	136	180	2	2.1
80	400	—	—	—	—	—	500	31	46	60	75	100	136	180	2	2.1
84	420	—	—	—	—	—	520	31	46	60	75	100	136	180	2	2.1
88	440	—	—	—	—	—	540	31	46	60	75	100	136	180	2	2.1
92	460	—	—	—	—	—	580	37	56	72	90	118	160	218	2.1	3
96	480	—	—	—	—	—	600	37	56	72	90	118	160	218	2.1	3
/500	500	—	—	—	—	—	620	37	56	72	90	118	160	218	2.1	3
/530	530	—	—	—	—	—	650	37	56	72	90	118	160	218	2.1	3
/560	560	—	—	—	—	—	680	37	56	72	90	118	160	218	2.1	3
/600	600	—	—	—	—	—	730	42	60	78	98	128	175	236	3	3
/630	630	—	—	—	—	—	780	48	69	88	112	150	200	272	3	4
/670	670	—	—	—	—	—	820	48	69	88	112	150	200	272	3	4
/710	710	—	—	—	—	—	870	50	74	95	118	160	218	290	4	4
/750	750	—	—	—	—	—	920	54	78	100	128	170	230	308	4	5
/800	800	—	—	—	—	—	980	57	82	106	136	180	243	325	4	5
/850	850	—	—	—	—	—	1030	57	82	106	136	180	243	325	4	5
/900	900	—	—	—	—	—	1090	60	85	112	140	190	258	345	5	5
/950	950	—	—	—	—	—	1150	63	90	118	150	200	272	355	5	5
/1000	1000	—	—	—	—	—	1220	71	100	128	165	218	300	400	5	6
/1060	1060	—	—	—	—	—	1280	71	100	128	165	218	300	400	5	6
/1120	1120	—	—	—	—	—	1360	78	106	140	180	243	325	438	5	6
/1180	1180	—	—	—	—	—	1420	78	106	140	180	243	325	438	5	6
/1250	1250	—	—	—	—	—	1500	80	112	145	185	250	335	450	6	6
/1320	1320	—	—	—	—	—	1600	88	122	165	206	280	375	500	6	6
/1400	1400	—	—	—	—	—	1700	95	132	175	224	300	400	545	6	7.5
/1500	1500	—	—	—	—	—	1820	—	140	185	243	315	—	—	—	7.5
/1600	1600	—	—	—	—	—	1950	—	155	200	265	345	—	—	—	7.5
/1700	1700	—	—	—	—	—	2060	—	160	206	272	355	—	—	—	7.5
/1800	1800	—	—	—	—	—	2180	—	165	218	290	375	—	—	—	9.5
/1900	1900	—	—	—	—	—	2300	—	175	230	300	400	—	—	—	9.5
/2000	2000	—	—	—	—	—	2430	—	190	250	325	425	—	—	—	9.5

Bore Number	d	Diameter Series 9 D	09 B	19 B	29 B	39 B	49 B	59 B	69 B	09 r (min.)	19~39 r (min.)	49~69 r (min.)	Diameter Series 0 D	00 B	10 B	20 B	30 B	40 B	50 B	60 B	00 r (min.)	10~60 r (min.)
Single-Row Ball Brgs.				69 79										160	60 70							
Double-Row Ball Brgs.																						
Cylindrical Roller Brgs.				N19	N29	NN39	NN49								N10	N20	NN30	NN40				
Needle Roller Brgs.							NA49	NA59	NA69													
Spherical Roller Brgs.						239											230	240				
—	0.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	1	4	—	1.6	—	2.3	—	—	—	—	0.1	—	—	—	—	—	—	—	—	—	—	—
—	1.5	5	—	2	—	2.6	—	—	—	—	0.15	—	6	—	2.5	—	3	—	—	—	—	0.15
2	2	6	—	2.3	—	3	—	—	—	—	0.15	—	7	—	2.8	—	3.5	—	—	—	—	0.15
—	2.5	7	—	2.5	—	3.5	—	—	—	—	0.15	—	8	—	2.8	—	4	—	—	—	—	0.15
3	3	8	—	3	—	4	—	—	—	—	0.15	—	9	—	3	—	5	—	—	—	—	0.15
4	4	11	—	4	—	5	—	—	—	—	0.15	—	12	—	4	—	6	—	—	—	—	0.2
5	5	13	—	4	—	6	10	—	—	—	0.2	0.15	14	—	5	—	7	—	—	—	—	0.2
6	6	15	—	5	—	7	10	—	—	—	0.2	0.15	17	—	6	—	9	—	—	—	—	0.3
7	7	17	—	5	—	7	10	—	—	—	0.3	0.15	19	—	6	8	10	—	—	—	—	0.3
8	8	19	—	6	—	9	11	—	—	—	0.3	0.2	22	—	7	9	11	14	19	25	—	0.3
9	9	20	—	6	—	9	11	—	—	—	0.3	0.3	24	—	7	10	12	15	20	27	—	0.3
00	10	22	—	6	8	10	13	16	22	—	0.3	0.3	26	—	8	10	12	16	21	29	—	0.3
01	12	24	—	6	8	10	13	16	22	—	0.3	0.3	28	7	8	10	12	16	21	29	0.3	0.3
02	15	28	—	7	8.5	10	13	18	23	—	0.3	0.3	32	8	9	11	13	17	23	30	0.3	0.3
03	17	30	—	7	8.5	10	13	18	23	—	0.3	0.3	35	8	10	12	14	18	24	32	0.3	0.3
04	20	37	7	9	11	13	17	23	30	0.3	0.3	0.3	42	8	12	14	16	22	30	40	0.3	0.6
/22	22	39	7	9	11	13	17	23	30	0.3	0.3	0.3	44	8	12	14	16	22	30	40	0.3	0.6
05	25	42	7	9	11	13	17	23	30	0.3	0.3	0.3	47	8	12	14	16	22	30	40	0.3	0.6
/28	28	45	7	9	11	13	17	23	30	0.3	0.3	0.3	52	8	12	15	18	24	32	43	0.3	0.6
06	30	47	7	9	11	13	17	23	30	0.3	0.3	0.3	55	9	13	16	19	25	34	45	0.3	1
/32	32	52	7	10	13	15	20	27	36	0.3	0.6	0.6	58	9	13	16	20	26	35	47	0.3	1
07	35	55	7	10	13	15	20	27	36	0.3	0.6	0.6	62	9	14	17	20	27	36	48	0.3	1
08	40	62	8	12	14	16	22	30	40	0.3	0.6	0.6	68	9	15	18	21	28	38	50	0.3	1
09	45	68	8	12	14	16	22	30	40	0.3	0.6	0.6	75	10	16	19	23	30	40	54	0.6	1
10	50	72	8	12	14	16	22	30	40	0.3	0.6	0.6	80	10	16	19	23	30	40	54	0.6	1
11	55	80	9	13	16	19	25	34	45	0.3	1	1	90	11	18	22	26	35	46	63	0.6	1.1
12	60	85	9	13	16	19	25	34	45	0.3	1	1	95	11	18	22	26	35	46	63	0.6	1.1
13	65	90	9	13	16	19	25	34	45	0.3	1	1	100	11	18	22	26	35	46	63	0.6	1.1
14	70	100	10	16	19	23	30	40	54	0.6	1	1	110	13	20	24	30	40	54	71	0.6	1.1
15	75	105	10	16	19	23	30	40	54	0.6	1	1	115	13	20	24	30	40	54	71	0.6	1.1
16	80	110	10	16	19	23	30	40	54	0.6	1	1	125	14	22	27	34	45	60	80	0.6	1.1
17	85	120	11	18	22	26	35	46	63	0.6	1.1	1.1	130	14	22	27	34	45	60	80	0.6	1.1
18	90	125	11	18	22	26	35	46	63	0.6	1.1	1.1	140	16	24	30	37	50	67	90	1	1.5
19	95	130	11	18	22	26	35	46	63	0.6	1.1	1.1	145	16	24	30	37	50	67	90	1	1.5
20	100	140	13	20	24	30	40	54	71	0.6	1.1	1.1	150	16	24	30	37	50	67	90	1	1.5
21	105	145	13	20	24	30	40	54	71	0.6	1.1	1.1	160	18	26	33	41	56	75	100	1	2
22	110	150	13	20	24	30	40	54	71	0.6	1.1	1.1	170	19	28	36	45	60	80	109	1	2
24	120	165	14	22	27	34	45	60	80	0.6	1.1	1.1	180	19	28	36	46	60	80	109	1	2
26	130	180	16	24	30	37	50	67	90	1	1.5	1.5	200	22	33	42	52	69	95	125	1.1	2
28	140	190	16	24	30	37	50	67	90	1	1.5	1.5	210	22	33	42	53	69	95	125	1.1	2
30	150	210	19	28	36	45	60	80	109	1	2	2	225	24	35	45	56	75	100	136	1.1	2.1
32	160	220	19	28	36	45	60	80	109	1	2	2	240	25	38	48	60	80	109	145	1.5	2.1
34	170	230	19	28	36	45	60	80	109	1	2	2	260	28	42	54	67	90	122	160	1.5	2.1
36	180	250	22	33	42	52	69	95	125	1.1	2	2	280	31	46	60	74	100	136	180	2	2.1
38	190	260	22	33	42	52	69	95	125	1.1	2	2	290	31	46	60	75	100	136	180	2	2.1
40	200	280	25	38	48	60	80	109	145	1.5	2.1	2.1	310	34	51	66	82	109	150	200	2	2.1
44	220	300	25	38	48	60	80	109	145	1.5	2.1	2.1	340	37	56	72	90	118	160	218	2.1	3
48	240	320	25	38	48	60	80	109	145	1.5	2.1	2.1	360	37	56	72	92	118	160	218	2.1	3
52	260	360	31	46	60	75	100	136	180	2	2.1	2.1	400	44	65	82	104	140	190	250	3	4
56	280	380	31	46	60	75	100	136	180	2	2.1	2.1	420	44	65	82	106	140	190	250	3	4
60	300	420	37	56	72	90	118	160	218	2.1	3	3	460	50	74	95	118	160	218	290	4	4
64	320	440	37	56	72	90	118	160	218	2.1	3	3	480	50	74	95	121	160	218	290	4	4
68	340	460	37	56	72	90	118	160	218	2.1	3	3	520	57	82	106	133	180	243	325	4	5
72	360	480	37	56	72	90	118	160	218	2.1	3	3	540	57	82	106	134	180	243	325	4	5
76	380	520	44	65	82	106	140	190	250	3	4	4	560	57	82	106	135	180	243	325	4	5
80	400	540	44	65	82	106	140	190	250	3	4	4	600	63	90	118	148	200	272	355	5	5
84	420	560	44	65	82	106	140	190	250	3	4	4	620	63	90	118	150	200	272	355	5	5
88	440	600	50	74	95	118	160	218	290	4	4	4	650	67	94	122	157	212	280	375	5	6
92	460	620	50	74	95	118	160	218	290	4	4	4	680	71	100	128	163	218	300	400	5	6
96	480	650	54	78	100	128	170	230	308	4	5	5	700	71	100	128	165	218	300	400	5	6
/500	500	670	54	78	100	128	170	230	308	4	5	5	720	71	100	128	167	218	300	400	5	6
/530	530	710	57	82	106	136	180	243	325	4	5	5	780	80	112	145	185	250	335	450	6	6
/560	560	750	60	85	112	140	190	258	345	5	5	5	820	82	115	150	195	258	355	462	6	6
/600	600	800	63	90	118	150	200	272	355	5	5	5	870	85	118	155	200	272	365	488	6	6
/630	630	850	71	100	128	165	218	300	400	5	6	6	920	92	128	170	212	290	388	515	6	7.5
/670	670	900	73	103	136	170	230	308	412	5	6	6	980	100	136	180	230	308	425	560	6	7.5
/710	710	950	78	106	140	180	243	325	438	5	6	6	1030	103	140	185	236	315	438	580	6	7.5
/750	750	1000	80	112	145	185	250	335	450	6	6	6	1090	109	150	195	250	335	462	615	7.5	7.5
/800	800	1060	82	115	150	195	258	355	462	6	6	6	1150	112	155	200	258	345	475	630	7.5	7.5
/850	850	1120	85	118	155	200	272	365	488	6	6	6	1220	118	165	212	272	365	500	670	7.5	7.5
/900	900	1180	88	122	165	206	280	375	500	6	6	6	1280	122	170	218	280	375	515	690	7.5	7.5
/950	950	1250	95	132	175	224	300	400	545	6	7.5	7.5	1360	132	180	236	300	412	560	730	7.5	7.5
/1000	1000	1320	103	140	185	236	315	438	580	6	7.5	7.5	1420	136	185	243	308	412	560	750	7.5	7.5
/1060	1060	1400	109	150	195	250	335	462	615	7.5	7.5	7.5	1500	140	195	250	325	438	600	800	9.5	9.5
/1120	1120	1460	109	150	195	250	335	462	615	7.5	7.5	7.5	1580	145	200	265	345	462	615	825	9.5	9.5
/1180	1180	1540	115	160	206	272	355	488	650	7.5	7.5	7.5	1660	155	212	272	355	475	650	875	9.5	9.5
/1250	1250	1630	122	170	218	280	375	515	690	7.5	7.5	7.5	1750	—	218	290	375	500	—	—	—	9.5
/1320	1320	1720	128	175	230	300	400	545	710	7.5	7.5	7.5	1850	—	230	300	400	530	—	—	—	12
/1400	1400	1820	—	185	243	315	425	—	—	—	9.5	9.5	1950	—	243	315	412	545	—	—	—	12
/1500	1500	1950	—	195	258	335	450	—	—	—	9.5	9.5	2120	—	272	355	462	615	—	—	—	12
/1600	1600	2060	—	200	265	345	462	—	—	—	9.5	9.5	2240	—	280	365	475	630	—	—	—	12
/1700	1700	2180	—	212	280	355	475	—	—	—	9.5	9.5	2360	—	290	375	500	650	—	—	—	15
/1800	1800	2300	—	218	290	375	500	—	—	—	12	12	2500	—	308	400	530	690	—	—	—	15
/1900	1900	2430	—	230	308	400	530	—	—	—	12	12	—	—	—	—	—	—	—	—	—	—
/2000	2000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Remarks The chamfer dimensions listed in this table do not necessarily apply to the following chamfers: (a) Chamfers of the grooves in outer rings that have snap ring grooves.
(b) For thin section cylindrical roller bearings, the chamfers on side without rib and bearing bore (in case of an inner ring) or outer surface (in case of an outer ring).
(c) For angular contact ball bearings, the chamfers between the front face and bore (in case of an inner ring) or outer surface (in case of an outer ring).
(d) Chamfers on inner rings of bearings with tapered bores.

Overview of materials for Medium Carbon Steel

Categories: Metal; Ferrous Metal; Carbon Steel; Medium Carbon Steel

Material Notes: This property data is a summary of similar materials in the MatWeb database for the category "Medium Carbon Steel". Each property range of values reported is minimum and maximum values of appropriate MatWeb entries. The comments report the average value, and number of data points used to calculate the average. The values are not necessarily typical of any specific grade, especially less common values and those that can be most affected by additives or processing methods.

Vendors: No vendors are listed for this material. Please click here if you are a supplier and would like information on how to add your listing to this material.

Physical Properties	Metric	English	Comments
Density	7.75 - 7.89 g/cc	0.280 - 0.285 lb/in³	Average value: 7.85 g/cc Grade Count:914
Particle Size	6.70 - 12.0 µm	6.70 - 12.0 µm	Average value: 9.27 µm Grade Count:12

Mechanical Properties	Metric	English	Comments
Hardness, Brinell	126 - 578	126 - 578	Average value: 247 Grade Count:831
Hardness, Knoop	145 - 616	145 - 616	Average value: 276 Grade Count:838
Hardness, Rockwell B	71.0 - 112	71.0 - 112	Average value: 94.8 Grade Count:779
Hardness, Rockwell C	9.00 - 71.0	9.00 - 71.0	Average value: 25.9 Grade Count:703
Hardness, Vickers	131 - 614	131 - 614	Average value: 265 Grade Count:838
Tensile Strength, Ultimate	450 - 2730 MPa	65300 - 396000 psi	Average value: 987 MPa Grade Count:835
Tensile Strength, Yield	245 - 1740 MPa	35500 - 252000 psi	Average value: 685 MPa Grade Count:828
Elongation at Break	5.00 - 34.2 %	5.00 - 34.2 %	Average value: 18.9 % Grade Count:819
Reduction of Area	20.0 - 71.4 %	20.0 - 71.4 %	Average value: 49.7 % Grade Count:526
Modulus of Elasticity	187 - 213 GPa	27100 - 30900 ksi	Average value: 203 GPa Grade Count:899
Bulk Modulus	152 - 163 GPa	22000 - 23600 ksi	Average value: 160 GPa Grade Count:863
Poissons Ratio	0.280 - 0.300	0.280 - 0.300	Average value: 0.290 Grade Count:884
Fatigue Strength	138 - 614 MPa	20000 - 89100 psi	Average value: 370 MPa Grade Count:13
Fracture Toughness	80.9 - 143 MPa-m½	73.7 - 130 ksi-in½	Average value: 120 MPa-m½ Grade Count:4
Machinability	40.0 - 80.0 %	40.0 - 80.0 %	Average value: 60.1 % Grade Count:641
Shear Modulus	72.0 - 82.0 GPa	10400 - 11900 ksi	Average value: 79.6 GPa Grade Count:891
Izod Impact	9.00 - 135 J	6.64 - 99.6 ft-lb	Average value: 45.7 J Grade Count:256
Charpy Impact	10.8 - 65.0 J	8.00 - 47.9 ft-lb	Average value: 31.7 J Grade Count:8

Electrical Properties	Metric	English	Comments
Electrical Resistivity	0.0000166 - 0.0000263 ohm-cm	0.0000166 - 0.0000263 ohm-cm	Average value: 0.0000213 ohm-cm Grade Count:795

Thermal Properties	Metric	English	Comments
CTE, linear	10.4 - 15.1 µm/m-°C	5.78 - 8.39 µin/in-°F	Average value: 12.9 µm/m-°C Grade Count:592
Specific Heat Capacity	0.470 - 0.519 J/g-°C	0.112 - 0.124 BTU/lb-°F	Average value: 0.477 J/g-°C Grade Count:616
Thermal Conductivity	21.9 - 52.0 W/m-K	152 - 361 BTU-in/hr-ft²-°F	Average value: 47.7 W/m-K Grade Count:710

Processing Properties	Metric	English	Comments
Processing Temperature	166 - 838 °C	331 - 1540 °F	Average value: 600 °C Grade Count:8

Component Elements Properties	Metric	English	Comments
Aluminum, Al	0.0200 - 1.15 %	0.0200 - 1.15 %	Average value: 0.324 % Grade Count:4
Boron, B	0.000500 - 0.00300 %	0.000500 - 0.00300 %	Average value: 0.00175 % Grade Count:43
Carbon, C	0.100 - 1.29 %	0.100 - 1.29 %	Average value: 0.418 % Grade Count:952
Chromium, Cr	0.130 - 4.50 %	0.130 - 4.50 %	Average value: 0.829 % Grade Count:597
Cobalt, Co	4.50 - 8.00 %	4.50 - 8.00 %	Average value: 6.60 % Grade Count:5
Copper, Cu	0.200 - 0.500 %	0.200 - 0.500 %	Average value: 0.300 % Grade Count:9
Iron, Fe	78.7 - 100 %	78.7 - 100 %	Average value: 97.4 % Grade Count:952
Manganese, Mn	0.100 - 3.00 %	0.100 - 3.00 %	Average value: 0.913 % Grade Count:949
Molybdenum, Mo	0.0300 - 4.25 %	0.0300 - 4.25 %	Average value: 0.266 % Grade Count:476
Nickel, Ni	0.150 - 10.0 %	0.150 - 10.0 %	Average value: 1.13 % Grade Count:294
Phosphorus, P	0.00800 - 0.400 %	0.00800 - 0.400 %	Average value: 0.0363 % Grade Count:918
Silicon, Si	0.0500 - 2.20 %	0.0500 - 2.20 %	Average value: 0.292 % Grade Count:666
Sulfur, S	0.00200 - 0.500 %	0.00200 - 0.500 %	Average value: 0.0546 % Grade Count:921
Vanadium, V	0.0300 - 1.00 %	0.0300 - 1.00 %	Average value: 0.176 % Grade Count:57

Vanadium, V	0.0500 - 1.00 %	0.0500 - 1.00 %	Average value: 0.176 % Grade Count:57

Belt Capacity Chart

The Following conveyor belt capacity charts show tons per hour (TPH) based on material weighing 100 lbs. per cubic foot, 20° material surcharge angle with three equal length rolls on troughing idlers.

CAPACITY (TPH) = .03 x Belt Speed (FPM) x material weight (lb. per cu. ft.) x load cross section (sq. ft.)

TPH with 20° Troughing Idlers

Belt Width in Inches	Belt Speed in feet per minute (FPM)											
	100	150	200	250	300	350	400	450	500	550	600	650
16	42	63	84	105	125	147	168	-	-	-	-	-
18	54	80	110	135	160	190	218	243	270	-	-	-
24	100	150	200	250	300	350	400	450	500	550	600	-
30	160	240	320	400	480	560	640	720	800	880	960	1040
36	235	350	470	585	700	820	935	1050	1170	1290	1400	1520
42	330	495	660	825	980	1155	1320	1485	1650	1815	1980	2140
48	440	660	880	1100	1320	1540	1760	1980	2200	2420	2640	2860
54	570	855	1140	1420	1710	2000	2280	2560	2850	3130	3420	3700
60	720	1080	1440	1800	2160	2520	2880	3240	3600	3960	4320	4680

TPH with 35° Troughing Idlers

Belt Width in Inches	Belt Speed in feet per minute (FPM)											
	100	150	200	250	300	350	400	450	500	550	600	650
18	66	100	135	170	200	235	270	305	338	-	-	-
24	125	187	250	310	380	435	500	560	625	685	750	-
30	200	300	400	500	600	700	800	900	1000	1100	1200	1300
36	300	450	600	750	900	1050	1200	1350	1500	1650	1800	1950
42	420	635	845	1060	1270	1480	1690	1900	2120	2320	2540	2750
48	560	845	1125	1400	1690	1970	2250	2530	2810	3090	3370	3660
54	740	1110	1480	1850	2220	2600	2960	3340	3700	4080	4450	4820
60	935	1400	1870	2340	2800	3280	3740	4200	4680	5150	5610	6100

TPH with 45° Troughing Idlers

Belt Width in Inches	Belt Speed in feet per minute (FPM)											
	100	150	200	250	300	350	400	450	500	550	600	650
24	145	217	290	360	435	508	580	650	725	795	870	-
30	232	348	465	580	695	810	930	1040	1160	1270	1390	1500
36	335	510	680	850	1020	1190	1360	1530	1700	1860	2040	2200
42	478	720	960	1200	1440	1680	1910	2150	2390	2630	2870	3110
48	640	955	1275	1600	1910	2230	2550	2870	3190	3500	3820	4150
54	830	1240	1655	2070	2480	2900	3310	3720	4140	4550	4960	5380
60	1040	1570	2090	2610	3130	3660	4180	4700	5220	5740	6260	6800

	Maximum Size of Lumps * (Inches)	Maximum Belt Speeds in feet per minute (FPM)

Belt Width in Inches	Equal Size Lumps	Mixed with 90% Fines	Light Free Flowing Material As Grain, Pulverized Coal 50 Lb./Cu. Ft.	Average Material As Sand, Gravel, Stone, Coal, Fine Ore 100 Lb./Cu. Ft.	Abrasive Material As Coal, Screened Lump Coke 30 To 50 Lb./Cu. Ft.
16	2	4	500	400	350
18	3	5	500	500	400
24	5	8	600	600	450
30	6	11	700	650	500
36	8	15	800	650	500
42	10	18	800	650	500
48	12	21	800	650	500
54	14	24	800	650	500
60	16	28	800	650	500

* Based on 20° Troughing Idlers and 100 Lb. Per Cu. Ft. Material.
Conversion: Cu. Ft. = BPH x 1.25
Note: Capacities of flat belts are taken at one-half of those listed above.

materials, damp sand, coal, earth with no large lumps, and crushed stone. An increase in belt speed permits decreases in belt width and tension. However, these benefits must be weighed against the possible disadvantage of increased belt wear, material degradation, windage losses, lump impact on carrying idlers, and generally reduced life of all conveyor components.

Consult a CEMA member company when considering operation at these higher speeds.

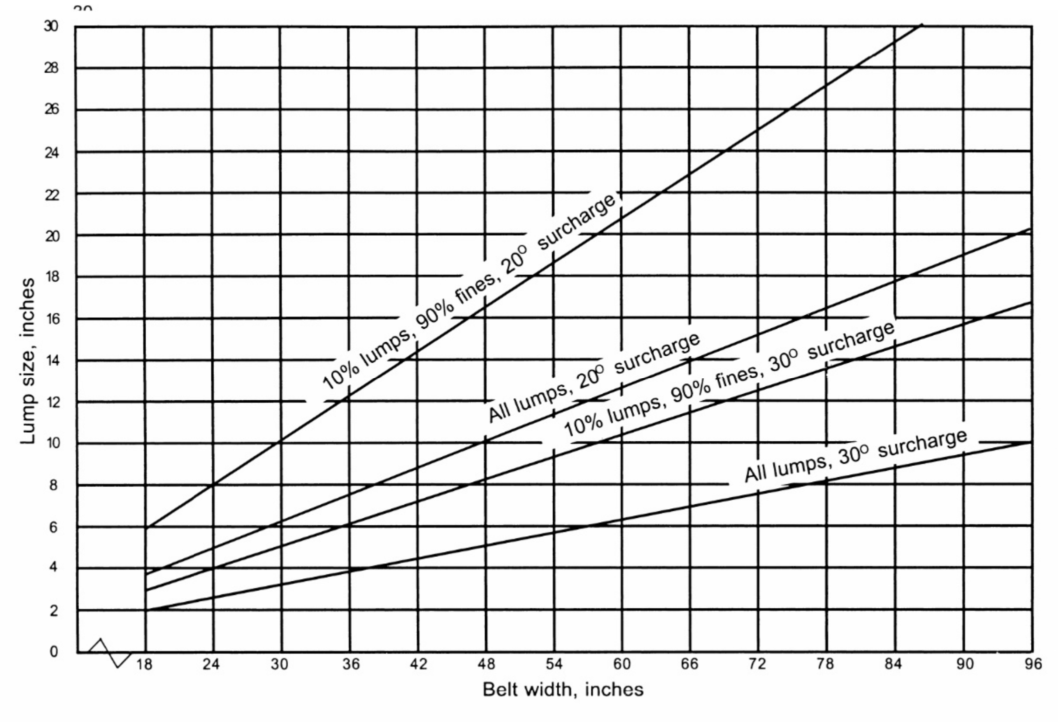


Figure 4.1 Belt width necessary for a given lump size. Fines: no greater than 1/10 maximum lump size.

The design of the loading area and the discharge of the material over the head pulley also must be considered when choosing the belt speed. If the material is dry and fine and the belt velocity is high, dusting of the material may be intolerable. Also, if the material is heavy or contains large lumps, or if the particle edges are angular and sharp, a high velocity of discharge may cause undue wear on the discharge or transfer chutes.

Belt Conveyor Capacities

For a given speed, belt conveyor capacities increase as the belt width increases. Also, the capacity of a belt conveyor depends on the surcharge angle and on the inclination of the side rolls of three-roll troughing idlers.

The nominal cross section of the material on a belt is measured in a plane normal to the belt. On an inclined or declined conveyor, the material tends to conform to its surcharge angle as measured in a vertical plane. This decreases the area, A_s, as the cosine of the angle of conveyor slope. See Figure 4.2. However, in most cases, the actual loss of capacity is very small.

Assuming a uniform feed to the conveyor, the cross-sectional area of the load on the conveyor belt is the determinant of the belt conveyor capacity. In this manual, the cross-sectional area is based upon the following two conditions. First, the material load on the troughed belt does not extend to the belt edges. The distance from the edges of the material load to the edges of the belt is set at “standard edge distance,” which is defined as $0.055b + 0.9$ inch, where b is the width of the belt in inches. Throughout this manual, standard edge distance is presumed to be in effect unless otherwise specified. Second, the top of the load of the material is the arc of a circle tangent, at the edges of the load, to the surcharge angle of loading.

Table 4-1. Recommended maximum belt speeds.

Material Being Conveyed	Belt Speeds (fpm)	Belt Width (inches)
Grain or other free-flowing, nonabrasive material	500 700 800 1000	18 24-30 36-42 48-96
Coal, damp clay, soft ores, overburden and earth, fine-crushed stone	400 600 800 1000	18 24-36 42-60 72-95
Heavy, hard, sharp-edged ore, coarse-crushed stone	350 500 600	18 24-36 Over 36
Foundry sand, prepared or damp; shake-out sand with small cores, with or without small castings (not hot enough to harm belting)	350	Any width
Prepared foundry sand and similar damp (or dry abrasive) materials discharged from belt by rubber-edged plows	200	Any width
Nonabrasive materials discharged from belt by means of plows	200, except for wood pulp, where 300 to 400 is preferable	Any width
Feeder belts, flat or troughed, for feeding fine, nonabrasive, or mildly abrasive materials from hoppers and bins	50 to 100	Any width

Table 4-2. 20-degree troughed belt—three equal rolls standard edge distance = 0.055*b* + 0.9 inch.

Belt Width (Inches)	A_t - Cross Section of Load (ft^2)							Capacity at 100 FPM (ft^3/hr)						
	Surcharge Angle							Surcharge Angle						
	0°	5°	10°	15°	20°	25°	30°	0°	5°	10°	15°	20°	25°	30°
18	.089	.108	.128	.147	.167	.188	.209	537	653	769	886	1005	1128	1254
24	.173	.209	.246	.283	.320	.359	.399	1041	1258	1477	1698	1924	2155	2394
30	.284	.343	.402	.462	.522	.585	.649	1708	2060	2414	2772	3137	3511	3897
36	.423	.509	.596	.684	.774	.866	.960	2538	3057	3579	4107	4645	5196	5765
42	.588	.708	.828	.950	1.074	1.201	1.332	3533	4250	4972	5703	6447	7210	7997
48	.781	.940	1.099	1.260	1.424	1.592	1.765	4691	5640	6594	7560	8544	9552	10592
54	1.002	1.204	1.407	1.613	1.822	2.037	2.258	6013	7225	8444	9678	10935	12223	13552
60	1.249	1.501	1.753	2.009	2.270	2.537	2.812	7498	9006	10522	12057	13621	15223	16876
72	1.826	2.192	2.560	2.933	3.312	3.701	4.102	10961	13155	15364	17599	19876	22210	24617
84	2.513	3.014	3.519	4.030	4.551	5.085	5.635	15079	18089	21119	24186	27309	30511	33813
96	3.308	3.967	4.631	5.302	5.986	6.687	7.411	19850	23806	27787	31816	35921	40128	44466

Table 4-3. 35-degree troughed belt—three equal rolls standard edge distance = 0.055*b* + 0.9 inch.

Belt Width (Inches)	A_t - Cross Section of Load (ft^2)							Capacity at 100 FPM (ft^3/hr)						
	Surcharge Angle							Surcharge Angle						
	0°	5°	10°	15°	20°	25°	30°	0°	5°	10°	15°	20°	25°	30°
18	.144	.160	.177	.194	.212	.230	.248	864	964	1066	1169	1274	1381	1492
24	.278	.309	.341	.373	.406	.440	.474	1668	1857	2048	2241	2438	2640	2847
30	.455	.506	.557	.609	.662	.716	.772	2733	3039	3346	3658	3975	4300	4636
36	.676	.751	.826	.903	.980	1.060	1.142	4058	4508	4961	5419	5886	6364	6857
42	.940	1.044	1.148	1.254	1.361	1.471	1.585	5644	6266	6891	7524	8169	8830	9511
48	1.248	1.385	1.523	1.662	1.804	1.949	2.099	7491	8312	9138	9974	10825	11698	12598
54	1.599	1.774	1.950	2.128	2.309	2.494	2.686	9598	10646	11700	12768	13855	14969	16118
60	1.994	2.211	2.429	2.651	2.876	3.107	3.345	11966	13269	14580	15906	17257	18642	21058
72	2.913	3.229	3.547	3.869	4.197	4.532	4.879	17484	19378	21285	23215	25182	27196	29275
84	4.007	4.440	4.876	5.317	5.766	6.226	6.701	24043	26641	29256	31902	34597	37360	40210
96	5.274	5.842	6.415	6.994	7.584	8.189	8.812	31645	35058	38490	41966	45506	49134	52876

Table 4-4. 45-degree troughed belt—three equal rolls standard edge distance = 0.055*b* + 0.9 inch.

Belt Width (Inches)	A_t - Cross Section of Load (ft^2)							Capacity at 100 FPM (ft^3/hr)						
	Surcharge Angle							Surcharge Angle						
	0°	5°	10°	15°	20°	25°	30°	0°	5°	10°	15°	20°	25°	30°
18	.170	.184	.199	.214	.230	.245	.262	1021	1109	1198	1289	1380	1475	1572
24	.327	.355	.383	.411	.439	.469	.499	1967	2132	2299	2467	2638	2814	2996
30	.536	.580	.625	.670	.716	.763	.812	3218	3484	3752	4023	4299	4581	4873
36	.795	.860	.926	.992	1.060	1.129	1.200	4775	5165	5558	5955	6360	6775	7204
42	1.106	1.195	1.286	1.377	1.470	1.566	1.664	6636	7175	7717	8265	8824	9397	9987
48	1.467	1.585	1.704	1.825	1.948	2.074	2.204	8803	9514	10229	10953	11690	12445	13224
54	1.879	2.030	2.182	2.336	2.492	2.653	2.819	11276	12182	13094	14017	14957	15921	16915
60	2.342	2.529	2.718	2.909	3.104	3.303	3.509	14053	15179	16312	17458	18626	19823	21059
72	3.420	3.693	3.967	4.245	4.528	4.818	5.117	20524	22160	23807	25473	27171	28910	30705
84	4.702	5.076	5.452	5.832	6.220	6.617	7.027	28216	30458	32713	34997	37322	39706	42165
96	6.188	6.678	7.172	7.671	8.180	8.701	9.239	37128	40071	43032	46029	49081	52210	55437

Table 4-5. Flat belt capacity standard edge distance = $0.055b + 0.9$ inch.

Belt Width (Inches)	A_s - Cross Section of Load (ft^2)							Capacity at 100 FPM (ft^3/hr)						
	Surcharge Angle							Surcharge Angle						
	0°	5°	10°	15°	20°	25°	30°	0°	5°	10°	15°	20°	25°	30°
18		.020	.041	.062	.083	.105	.127		123	246	372	498	630	762
24		.039	.077	.117	.157	.198	.241		232	466	702	942	1190	1444
30		.063	.126	.190	.255	.321	.390		376	756	1137	1527	1928	2340
36		.092	.185	.280	.376	.474	.575		555	1113	1677	2253	2844	3450
42		.130	.257	.387	.520	.656	.796		768	1540	2322	3120	3936	4776
48		.169	.340	.512	.688	.868	1.053		1016	2037	3072	4126	5208	6318
54		.216	.434	.654	.879	1.109	1.346		1298	2604	3927	5273	6654	8076
60		.269	.540	.814	1.093	1.380	1.675		1614	3240	4885	6560	8278	10050
72		.392	.786	1.186	1.593	2.010	2.440		2353	4720	7116	9558	12060	14640
84		.538	1.080	1.628	2.186	2.758	3.349		3229	6478	9767	13117	16550	20091
96		.707	1.419	2.139	2.873	3.625	4.400		4243	8514	12835	17238	21750	26404

Idler Requirements

Important requirements for idlers are proper support and protection for the belt and proper support for the load being conveyed.

Belt conveyor idlers for bulk materials are designed to incorporate rolls with various diameters. The rolls are fitted with antifriction bearings and seals, and are mounted on shafts.

Frictional resistance of the idler roll influences belt tension and, consequently, the horsepower requirement. Roll diameter, bearing design, and seal requirements constitute the major components affecting frictional resistance.

This manual does not discuss the relative merits of the various antifriction bearings used, nor the merits of the seals to protect these bearings from dirt and moisture and to retain the lubricant. Each belt conveyor idler manufacturer chooses a particular bearing and seal arrangement. Much ingenuity has been exercised by these idler manufacturers to provide dependable idlers.

Idler Classifications

Selection of the proper roll diameter and size of bearing and shaft is based on the type of service, operating condition, load carried, and belt speed. For ease and accuracy of idler selection, the various idler designs can be grouped into classifications as shown in Table 5-1.

Table 5-1. Idler classification.

Classification	Former Series Number	Roll Diameter (inches)	Belt Width (inches)	Description
A4	STANDARD WITHDRAWN			
A5	OCTOBER 1, 1996			
B4	II	4"	18" through 48"	Light Duty
B5	II	5"	18" through 48"	"
C4	III	4"	18" through 60"	Medium Duty
C5	III	5"	18" through 60"	"
C6	IV	6"	24" through 60"	"
D5	None	5"	24" through 72"	"
D6	None	6"	24" through 72"	"
E6	V	6"	36" through 96"	Heavy Duty
E7	VI	7"	36" through 96"	"

General Types of Belt Conveyor Idlers

There are two basic types of belt conveyor idlers: carrying idlers, which support the loaded run of the conveyor belt; and return idlers, which support the empty return run of the conveyor belt. See Figures 5.1 through 5.3.

Idler Spacing

Factors to consider when selecting idler spacing are belt weight, material weight, idler load rating, belt sag, idler life, belt rating, belt tension, and radius in vertical curves (see Chapter 9).

More complex issues (such as belt flap or vibration stability in wind, and power usage from belt indentation, material tramping, and rolling resistance) will be affected less by idler spacing.

If too much sag of a loaded troughed belt is permitted between the troughing idlers, the material may spill over the edges of the belt. For the best design, especially on long-center troughed belt conveyors, the sag between idlers should be limited as described in Chapter 6.

Table 5-2 lists suggested normal troughing idler spacing for use in general engineering practice, when the amount of belt sag is not specifically limited. These figures on spacing should be used in conjunction with the information on sag selection in Chapter 6. Spacing is normally varied in 6-inch increments.

Some conveyor systems have been designed successfully utilizing extended idler spacing and/or graduated idler spacing. Extended idler spacing is simply greater than normal spacing. This is sometimes applied where belt tension, sag, belting strength, and idler rating permit. Advantages may be lower idler cost (fewer used) and better belt training.

Graduated idler spacing is greater than normal spacing at high tension portions of the belt. As the tension along the belt increases, the idler spacing is increased. Usually this type of spacing occurs toward and near the discharge end.

Extended and graduated spacing are not commonly used but if either is employed, care should be taken not to exceed idler load rating and sag limits during starting and stopping.

Table 5-2. Suggested normal spacing of belt idlers (S_i).*

Belt Width (inches)	Troughing Idler Spacing — Weight of Material Handled, lbs/cu ft						Return Idlers
	30	50	75	100	150	200	
18	5.5	5.0	5.0	5.0	4.5	4.5	10.0
24	5.0	4.5	4.5	4.0	4.0	4.0	10.0
30	5.0	4.5	4.5	4.0	4.0	4.0	10.0
36	5.0	4.5	4.0	4.0	3.5	3.5	10.0
42	4.5	4.5	4.0	3.5	3.0	3.0	10.0
48	4.5	4.0	4.0	3.5	3.0	3.0	10.0
54	4.5	4.0	3.5	3.5	3.0	3.0	10.0
60	4.0	4.0	3.5	3.0	3.0	3.0	10.0
72	4.0	3.5	3.5	3.0	2.5	2.5	8.0
84	3.5	3.5	3.0	2.5	2.5	2.0	8.0
96	3.5	3.5	3.0	2.5	2.0	2.0	8.0

*** Spacing indicated in feet. Spacing may be limited by load rating of idler. See idler load ratings in Tables 5-7— 5-11.**

Table 5-4. Belt speeds at 500 rpm.

Roll Diameter (inches)	Belt Speed (fpm)
4"	524
5"	654
6"	785
7"	916

Figure 5.18 (Step No. 4) shows the effect of belt speed on predicted bearing L_{10} life. However, suitable belt conveyor speeds also depend upon the characteristics of the material to be conveyed, the capacity desired, and the belt tensions employed. This subject is covered in more detail in Chapter 4.

Roll Diameter

For a given belt speed, using larger diameter rolls will increase idler bearing L_{10}. Figure 5.19 (Step No. 5) shows this relationship. In addition, since larger diameter rolls will be contacting the belt less due to a slower rpm, the wear life of the shell will be increased.

Environmental, Maintenance and Other Special Conditions

Step No. 6 in the idler selection procedure identifies conditions that will affect potential idler life. All of these conditions do not have an exact mathematical basis and therefore can be very subjective. The most important phase of this step is identifying the idler life condition for the application and then arriving at solutions to obtain maximum idler life for that application. Since idler roll configuration, type of bearing, and seal design can vary with each idler manufacturer, it is logical to state that idler life can also vary for a given environmental and maintenance condition.

Figures 5.20, 5.21, and 5.22 show general conditions which will affect idler life. Those conditions are independent of idler load but can cause idler failure before obtaining predicted L_{10} life rating. CEMA recommends contacting your CEMA idler manufacturer for assistance in establishing guidelines for "Potential Idler Life" for the various conditions shown or any unusual conditions not listed.

Special Conditions

Idler roll shell material usually used throughout the industry is electric resistance welded steel mechanical tubing. For most belt conveyor applications, this material provides sufficient idler life most economically. For severe abrasive or corrosive conditions, covered idler rolls are available in a variety of materials. CEMA has not compiled a relative wear index or corrosion compatibility index for these various materials. This information can be supplied by your CEMA idler manufacturer. However, the economic issue vs. increased life should be investigated thoroughly. Some of the generically available materials are listed below. There are numerous grades available in each of these materials which will affect performance.

1. Steel sleeves
2. Rubber lagging
3. Neoprene lagging

1. Impact force on idler at conveyor loading points.

2. Effect of belt transitions (head and tail pulley) on idler load.

Idler series selection for these load conditions should be verified by your CEMA idler manufacturer.

Table 5-5. *WB*-Estimated average belt weight, multiple- and reduced-ply belts, lbs/ft.

Belt Width (inches (*b*))	Material Carried, lbs/cu ft		
	30-74	75-129	130-200
18	3.5	4.0	4.5
24	4.5	5.5	6.0
30	6.0	7.0	8.0
36	9.0	10.0	12.0
42	11.0	12.0	14.0
48	14.0	15.0	17.0
54	16.0	17.0	19.0
60	18.0	20.0	22.0
72	21.0	24.0	26.0
84	25.0	30.0	33.0
96	30.0	35.0	38.0

1. Steel cable belts increase the above value by 50%.

2. Actual belt weights vary with different constructions, manufacturers, cover gauges, etc. Use the above values for estimating. Obtain actual values from the belt manufacturer whenever possible.

Table 5-6. K1-Lump adjustment factor.

Maximum Lump Size (inches)	Material Weight, lbs/cu ft						
	50	75	100	125	150	175	200
4	1.0	1.0	1.0	1.0	1.1	1.1	1.1
6	1.0	1.0	1.0	1.1	1.1	1.1	1.1
8	1.0	1.0	1.1	1.1	1.2	1.2	1.2
10	1.0	1.1	1.1	1.1	1.2	1.2	1.2
12	1.0	1.1	1.1	1.2	1.2	1.2	1.3
14	1.1	1.1	1.1	1.2	1.2	1.3	1.3
16	1.1	1.1	1.2	1.2	1.3	1.3	1.4
18	1.1	1.1	1.2	1.2	1.3	1.3	1.4

K_x — Idler Friction Factor

The frictional resistance of idler rolls to rotation and sliding resistance between the belt and the idler rolls can be calculated by using the multiplying factor K_x . K_x is a force in lbs/ft of conveyor length to rotate the idler rolls, carrying and return, and to cover the sliding resistance of the belt on the idler rolls. The K_x value required to rotate the idlers is calculated using equation (3).

The resistance of the idlers to rotation is primarily a function of bearing, grease, and seal resistance. A typical idler roll equipped with antifriction bearings and supporting a load of 1,000 lbs will require a turning force at the idler roll periphery of from 0.5 to 0.7 lbs to overcome the bearing friction. The milling or churning of the grease in the bearings and the bearing seals will require additional force. This force, however, is generally independent of the load on the idler roll.

Under normal conditions, the grease and seal friction in a well-lubricated idler will vary from 0.1 to 2.3 lbs/idler, depending upon the type of idler, the seals, and the condition of the grease.

Sliding resistance between the belt and idler rolls is generated when the idler rolls are not exactly at 90 degrees to the belt movement. After initial installation, deliberate idler misalignment is often an aid in training the belt. Even the best installations have a small requirement of this type. However, excessive idler misalignment results in an extreme increase in frictional resistance and should be avoided.

Table 6-1. Estimated average belt weight, multiple- and reduced-ply belts, lbs/ft.

Belt Width	Material Carried, lbs/ft^3		
inches (b)	30-74	75-129	130-200
18	3.5	4.0	4.5
24	4.5	5.5	6.0
30	6.0	7.0	8.0
36	9.0	10.0	12.0
42	11.0	12.0	14.0
48	14.0	15.0	17.0
54	16.0	17.0	19.0
60	18.0	20.0	22.0
72	21.0	24.0	26.0
84	25.0	30.0	33.0
96	30.0	35.0	38.0

1. Steel-cable belts — increase above value by 50 percent.
2. Actual belt weights vary with different constructions, manufacturers, cover gauges, etc. Use the above values for estimating. Obtain actual values from the belt manufacturer whenever possible.

Some troughing idlers are designed to operate with a small degree of tilt in the direction of belt travel, to aid in belt training. This tilt results in a slight increase in sliding friction that must be considered in the horsepower formula.

Table 6-2. Factor K_y values.

Conveyor Length (ft)	$W_b + W_m$ (lbs/ft)	Percent Slope						
		0	3	6	9	12	24	33
		Approximate Degrees						
		0	2	3.5	5	7	14	18
	20	0.035	0.035	0.034	0.031	0.031	0.031	0.031
	50	0.035	0.034	0.033	0.032	0.031	0.028	0.027
	75	0.035	0.034	0.032	0.032	0.030	0.027	0.025
250	100	0.035	0.033	0.032	0.031	0.030	0.026	0.023
	150	0.035	0.035	0.034	0.033	0.031	0.025	0.021
	200	0.035	0.035	0.035	0.035	0.032	0.024	0.018
	250	0.035	0.035	0.035	0.035	0.033	0.021	0.018
	300	0.035	0.035	0.035	0.035	0.032	0.019	0.018
	20	0.035	0.034	0.032	0.030	0.030	0.030	0.030
	50	0.035	0.033	0.031	0.029	0.029	0.026	0.025
	75	0.034	0.033	0.030	0.029	0.028	0.024	0.021
400	100	0.034	0.032	0.030	0.028	0.028	0.022	0.019
	150	0.035	0.034	0.031	0.028	0.027	0.019	0.016
	200	0.035	0.035	0.033	0.030	0.027	0.016	0.014
	250	0.035	0.035	0.034	0.030	0.026	0.017	0.016
	300	0.035	0.035	0.034	0.029	0.024	0.018	0.018
	20	0.035	0.033	0.031	0.030	0.030	0.030	0.030
	50	0.034	0.032	0.030	0.028	0.028	0.024	0.023
	75	0.033	0.032	0.029	0.027	0.027	0.021	0.019
500	100	0.033	0.031	0.029	0.028	0.026	0.019	0.016
	150	0.035	0.033	0.030	0.027	0.024	0.016	0.016
	200	0.035	0.035	0.030	0.027	0.023	0.016	0.016
	250	0.035	0.035	0.030	0.025	0.021	0.016	0.015
	300	0.035	0.035	0.029	0.024	0.019	0.018	0.018
	20	0.035	0.032	0.030	0.029	0.029	0.029	0.029
	50	0.033	0.030	0.029	0.027	0.026	0.023	0.021
	75	0.032	0.030	0.028	0.026	0.024	0.020	0.016
600	100	0.032	0.030	0.027	0.025	0.022	0.016	0.016
	150	0.035	0.031	0.026	0.024	0.019	0.016	0.016
	200	0.035	0.031	0.026	0.021	0.017	0.016	0.016
	250	0.035	0.031	0.024	0.020	0.017	0.016	0.016
	300	0.035	0.031	0.023	0.018	0.018	0.018	0.018
	20	0.035	0.031	0.030	0.029	0.029	0.029	0.029
	50	0.032	0.029	0.028	0.026	0.025	0.021	0.018
	75	0.031	0.029	0.026	0.024	0.022	0.016	0.016
800	100	0.031	0.028	0.025	0.022	0.020	0.016	0.016
	150	0.034	0.028	0.023	0.019	0.017	0.016	0.016
	200	0.035	0.027	0.021	0.016	0.016	0.016	0.016
	250	0.035	0.026	0.020	0.017	0.016	0.016	0.016
	300	0.035	0.025	0.018	0.018	0.018	0.018	0.018

Idler spacing: The above values of K_y are based on the following idler spacing (for other spacing, see Table 6-3).

(W_b+W_m), lbs per ft	S_i, ft	(W_b+W_m), lbs per ft	S_i, ft
Less than 50	4.5	100 to 149	3.5
50 to 99	4.0	150 and above	3.0

Table 6-2. Factor K_y values.

Conveyor Length (ft)	$W_b + W_m$ (lbs/ft)	Percent Slope						
		0	3	6	9	12	24	33
		Approximate Degrees						
		0	2	3.5	5	7	14	18
1000	50	0.031	0.028	0.026	0.024	0.023	0.019	0.016
	75	0.030	0.027	0.024	0.022	0.019	0.016	0.016
	100	0.030	0.026	0.022	0.019	0.017	0.016	0.016
	150	0.033	0.024	0.019	0.016	0.016	0.016	0.016
	200	0.032	0.023	0.017	0.016	0.016	0.016	0.016
	250	0.033	0.022	0.017	0.016	0.016	0.016	0.016
	300	0.033	0.021	0.018	0.018	0.018	0.018	0.018
1400	50	0.029	0.026	0.024	0.022	0.021	0.016	0.016
	75	0.028	0.024	0.021	0.019	0.016	0.016	0.016
	100	0.028	0.023	0.019	0.016	0.016	0.016	0.016
	150	0.029	0.020	0.016	0.016	0.016	0.016	0.016
	200	0.030	0.021	0.016	0.016	0.016	0.016	0.016
	250	0.030	0.020	0.017	0.016	0.016	0.016	0.016
	300	0.030	0.019	0.018	0.018	0.018	0.018	0.018
2000	50	0.027	0.024	0.022	0.020	0.018	0.016	0.016
	75	0.026	0.021	0.019	0.016	0.016	0.016	0.016
	100	0.025	0.020	0.016	0.016	0.016	0.016	0.016
	150	0.026	0.017	0.016	0.016	0.016	0.016	0.016
	200	0.024	0.016	0.016	0.016	0.016	0.016	0.016
	250	0.023	0.016	0.016	0.016	0.016	0.016	0.016
	300	0.022	0.018	0.018	0.018	0.018	0.018	0.018
2400	50	0.026	0.023	0.021	0.018	0.017	0.016	0.016
	75	0.025	0.021	0.017	0.016	0.016	0.016	0.016
	100	0.024	0.019	0.016	0.016	0.016	0.016	0.016
	150	0.024	0.016	0.016	0.016	0.016	0.016	0.016
	200	0.021	0.016	0.016	0.016	0.016	0.016	0.016
	250	0.021	0.016	0.016	0.016	0.016	0.016	0.016
	300	0.020	0.018	0.018	0.018	0.018	0.018	0.018
3000	50	0.024	0.022	0.019	0.017	0.016	0.016	0.016
	75	0.023	0.019	0.016	0.016	0.016	0.016	0.016
	100	0.022	0.017	0.016	0.016	0.016	0.016	0.016
	150	0.022	0.016	0.016	0.016	0.016	0.016	0.016
	200	0.019	0.016	0.016	0.016	0.016	0.016	0.016
	250	0.018	0.016	0.016	0.016	0.016	0.016	0.016
	300	0.018	0.018	0.018	0.018	0.018	0.018	0.018

Idler spacing: The above values of K_y are based on the following idler spacing (for other spacing, see Table 6-3).

(W_b+W_m), lbs per ft	S_i, ft	(W_b+W_m), lbs per ft	S_i, ft
Less than 50	4.5	100 to 149	3.5
50 to 99	4.0	150 and above	3.0

K_y values in Tables 6-2 and 6-3 are applicable for conveyors up to 3,000 ft long with a single slope and a 3% maximum sag of the belt between the troughing and between the return idlers. The return idler spacing is 10 ft nominal and loading of the belt is uniform and continuous.

Table 6-3. Corrected factor K_y values when other than tabular carrying idler spacings are used.

		Reference Values of K_y for Interpolation									
$W_b + W_m$ (lbs/ft)	S_i, (ft)	0.016	0.018	0.020	0.022	0.024	0.026	0.028	0.030	0.032	0.034
	3.0	0.0160	0.0160	0.0160	0.0168	0.0183	0.0197	0.0212	0.0227	0.0242	0.0257
Less than 50	3.5	0.0160	0.0160	0.0169	0.0189	0.0207	0.0224	0.0241	0.0257	0.0274	0.0291
	4.0	0.0160	0.0165	0.0182	0.0204	0.0223	0.0241	0.0259	0.0278	0.0297	0.0316
	4.5	**0.016**	**0.018**	**0.020**	**0.022**	**0.024**	**0.026**	**0.028**	**0.030**	**0.032**	**0.034**
	5.0	0.0174	0.0195	0.0213	0.0236	0.0254	0.0273	0.0291	0.0031	0.0329	0.0348
	3.0	0.0160	0.0162	0.0173	0.0186	0.0205	0.0221	0.0239	0.026	0.0274	0.029
	3.5	0.0160	0.0165	0.0185	0.0205	0.0222	0.024	0.0262	0.0281	0.030	0.0321
50 to 99	**4.0**	**0.016**	**0.018**	**0.020**	**0.022**	**0.024**	**0.026**	**0.028**	**0.030**	**0.032**	**0.034**
	4.5	0.0175	0.0193	0.0214	0.0235	0.0253	0.0272	0.0297	0.0316	0.0335	0.035
	5.0	0.0184	0.021	0.023	0.0253	0.027	0.029	0.0315	0.0335	0.035	0.035
	3.0	0.0160	0.0164	0.0186	0.0205	0.0228	0.0246	0.0267	0.0285	0.0307	0.0329
100 to 149	**3.5**	**0.016**	**0.018**	**0.020**	**0.022**	**0.024**	**0.026**	**0.028**	**0.030**	**0.032**	**0.034**
	4.0	0.0175	0.0197	0.0213	0.0234	0.0253	0.0277	0.0295	0.0312	0.033	0.035
	4.5	0.0188	0.0213	0.0232	0.0253	0.0273	0.0295	0.0314	0.033	0.0346	0.035
	5.0	0.0201	0.0228	0.0250	0.0271	0.0296	0.0316	0.0334	0.035	0.035	0.035
	3.0	**0.016**	**0.018**	**0.020**	**0.022**	**0.024**	**0.026**	**0.028**	**0.030**	**0.032**	**0.034**
150 to 199	3.5	0.0172	0.0195	0.0215	0.0235	0.0255	0.0271	0.0289	0.031	0.0333	0.0345
	4.0	0.0187	0.0213	0.0235	0.0252	0.0267	0.0283	0.0303	0.0325	0.0347	0.035
	4.5	0.0209	0.023	0.0253	0.0274	0.0289	0.0305	0.0323	0.0345	0.035	0.035
	5.0	0.0225	0.0248	0.0272	0.0293	0.0311	0.0328	0.0348	0.035	0.035	0.035
	3.0	**0.016**	**0.018**	**0.020**	**0.022**	**0.024**	**0.026**	**0.028**	**0.030**	**0.032**	**0.034**
200 to 249	3.5	0.0177	0.0199	0.0216	0.0235	0.0256	0.0278	0.0295	0.031	0.0327	0.0349
	4.0	0.0192	0.0216	0.0236	0.0256	0.0274	0.0291	0.0305	0.0322	0.0339	0.035
	4.5	0.021	0.0234	0.0253	0.0276	0.0298	0.0317	0.0331	0.0347	0.035	0.035
	5.0	0.0227	0.0252	0.0274	0.0298	0.0319	0.0338	0.035	0.035	0.035	0.035

To use this table to correct the value of K_y for idler spacing other than shown in bold type, apply the procedure shown in the two examples on page 91.

The resistance of the material load to flexure over idler rolls is a function of belt tension, type of material, shape of the load cross section, and idler spacing. Measurements indicate that the most important factor is belt tension, because this controls the amount of load flexure. Figure 6.2 shows this relationship for a typical idler spacing.

For a given weight per foot of belt and load, the running resistance, in pounds per ft of load, decreases with increases in belt tension. For a given belt tension, running resistance, in pounds per ft of load, increases with increases in the amount of load. However, the running resistance is not proportional to the weight of the load.

Table 6-4. *A* **and** *B* **values for equation** $K_y = (W_m + W_b) \times A \times 10^{-4} + B \times 10^{-2}$

Average Belt Tension, lbs	Idler Spacing, ft									
	3.0		3.5		4.0		4.5		5.0	
	A	*B*	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*
1,000	2.150	1.565	2.1955	1.925	2.200	2.250	2.2062	2.584	2.1750	2.910
2,000	1.8471	1.345	1.6647	1.744	1.6156	1.982	1.5643	2.197	1.5429	2.331
3,000	1.6286	1.237	1.4667	1.593	1.4325	1.799	1.4194	1.991	1.4719	2.091
4,000	1.4625	1.164	1.3520	1.465	1.3295	1.659	1.3250	1.825	1.3850	1.938
5,000	1.2828	1.122	1.1926	1.381	1.1808	1.559	1.1812	1.714	1.2283	1.839
6,000	1.1379	1.076	1.0741	1.318	1.0625	1.472	1.0661	1.627	1.0962	1.761
7,000	1.0069	1.039	0.9448	1.256	0.9554	1.404	0.9786	1.549	1.0393	1.657
8,000	0.9172	0.998	0.8552	1.194	0.8643	1.337	0.8875	1.472	0.9589	1.583
9,000	0.8207	0.958	0.8000	1.120	0.7893	1.272	0.8339	1.388	0.8911	1.507
10,000	0.7241	0.918	0.7362	1.066	0.7196	1.216	0.7821	1.314	0.8268	1.430
11,000	0.6483	0.885	0.6638	1.024	0.6643	1.167	0.7375	1.238	0.7768	1.340
12,000	0.5828	0.842	0.5828	0.992	0.6232	1.100	0.6750	1.180	0.7411	1.242
13,000	0.5207	0.798	0.5241	0.938	0.5732	1.040	0.6179	1.116	0.6821	1.169
14,000	0.4690	0.763	0.4810	0.897	0.5214	0.996	0.5571	1.069	0.6089	1.123
15,000	0.4172	0.718	0.4431	0.841	0.4732	0.935	0.5179	1.006	0.5607	1.063
16,000	0.3724	0.663	0.3966	0.780	0.4232	0.875	0.4589	0.958	0.5054	1.009

A minimum K_y value of .016 should be used when tensions exceed 16,000 lbs. Refer to page 92 for further explanations.

Information similar to that in Figure 6.2 has been developed by analyzing a series of field tests on belt conveyors of different widths carrying different materials. Many investigators, both in the United States and abroad, have analyzed similar series of field tests and have obtained similar results. Although the exact expressions differ, all investigators agree that changes in belt tension affect the force required to flex the material over idler rolls to a substantially greater degree than changes in the material handled. The latter does have a noticeable effect, and thus appears to be of less importance in the overall calculation.

Compilation of Components of T_e

The preceding pages describe the methods and provide the data for calculating factors K_t, K_x, and K_y. These factors must be evaluated as the first step to calculating certain components of belt tension that will be summarized to determine the effective tension, T_e, required at the driving pulley.

6. T_{am} — from force to accelerate the material continuously as it is fed onto the belt

Table 6-5. Belt tension to rotate pulleys.

Location of Pulleys	Degrees Wrap of Belt	Pounds of Tension at Belt Line
Tight side	150° to 240°	200 lbs/pulley
Slack side	150° to 240°	150 lbs/pulley
All other pulleys	less than 150°	100 lbs/pulley
Note: Double the above values for pulley shafts that are not operating in antifriction bearings.		

When material is discharged from chutes or feeders to a belt conveyor, it cannot be assumed that the material is moving in the direction of belt travel, at belt speed, although this may be the case in some instances. Normally, the material loaded onto the belt is traveling at a speed considerably lower than belt speed. The direction of material flow may not be fully in the direction of belt travel. Therefore, the material must be accelerated to the speed of the belt in the direction of belt travel, and this acceleration requires additional effective tension.

The belt tension T_{am} can be derived from the basic equation $F = MV_c$

where:

$T_{am} = F = MV_c$

M = mass of material accelerated per second, slugs

W = weight of material accelerated

$= \frac{Q \times 2000}{3600}$, lbs/sec

Q = tph

g = 32.2 ft/sec^2

$$M = \frac{W}{g} = \frac{Q \times 2000}{3600 \times 32.2}$$

V_c = velocity change, fps

$$= \frac{V - V_o}{60}$$

V = design belt speed, fpm

V_o = initial velocity of material as it is fed onto belt, fpm

$$T_{am} = \frac{Q \times 2000}{3600 \times 32.2} \times \frac{V - V_0}{60}$$

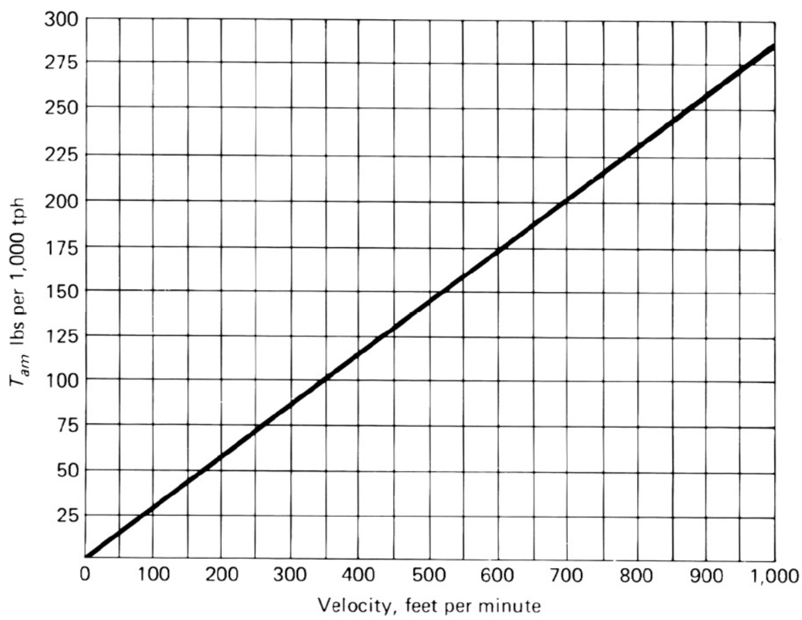
$$= 2.8755 \times 10^{-4} \times Q \times (V - V_0)$$

The graph in Figure 6.3 provides a convenient means of estimating the belt tension, T_{am} , for accelerating the material as it is fed onto the belt.

7. T_{ac}— from the resistance generated by conveyor accessories

Conveyor accessories such as trippers, stackers, plows, belt cleaning equipment, and skirtboards usually add to the effective tension, T_e . The additional belt tension requirements may come from frictional losses caused by the accessory. If the accessory lifts the conveyed material a force will be added to belt tension.

T_{tr}— from trippers and stackers



To use this chart:

- Enter chart at belt velocity and read T_{am} per 1,000 tph.
- Again enter chart at material velocity in direction of belt travel and read T_{am} per 1,000 tph. This may be positive, zero, or negative.
- Subtract the second T_{am} reading from the first T_{am} reading and convert the difference from 1,000 tph to the value for the actual tonnage. This will be the T_{am} desired, lbs.

Figure 6.3. Effective tension required to accelerate material as it is fed onto a belt conveyor.

The additional belt pull to flex the belt over the pulleys and rotate the pulleys in their bearings can be calculated from Table 6-5 or Tables C-l and C-2.

The force needed to lift the material over the unit can be calculated from the formula, $T_m = H \times W_m$ lbs.

Frictional resistance of the idlers, belt, and material should be included with that of the rest of the conveyor.

Today, conveyor belt covers will consist of compounds comprised of natural rubbers, styrene-butadiene rubber (SBR) blends of natural and other synthetics, nitriles, butyl, ethylene propylene-based polymer (EPDM), polychloroprene (neoprene), polybutadiene, polyvinyl chloride (PVC), urethanes and silicones, etc., and the list goes on and continues to grow. Each of these elastomers has specific usefulness for various ranges of properties and operating conditions from which manufacturers and end-users can choose.

Conveyor belting and its corresponding cover composition(s) can be designated as either (1) general purpose belting, or (2) special purpose belting. Each of these two broadly classified groups should be further defined depending upon the specific end use.

General Purpose Belting

General purpose covers and belting serve a broad range of industrial applications including mining, ore processing, lumber, paper/pulp, and agriculture, to name a few. By and large, these belts will have covers of either natural rubber, SBR, polybutadiene, and acrylonitrile or blends thereof. These cover compounds are further defined by the Rubber Manufacturers Association (RMA) and belting industry as either Grade I or Grade II.

General Purpose Rubber Covers

RMA Grade I — Will consist of natural or synthetic rubber or blends which will be characterized by high cut, gouge, and tear resistance and very good to excellent abrasion resistance. These covers are recommended for service involving sharp and abrasive materials, and for severe impact loading conditions.

RMA Grade II — The elastomeric composition will be similar to that of Grade I with good to excellent abrasion resistance in applications involving the conveyance of abrasive materials, but may not provide the degree of cut and gouge resistance of Grade I covers.

When covers are tested in accordance with ASTM D412, the tensile strength and elongation at break shall comply with the requirements of Table 7-1, for the grade of cover, as appropriate.

Table 7-1. Properties of covers.

Grade	Minimum Tensile Strength (p.s.i.)	Minimum Tensile Strength (MPa)	Minimum Elongation @ Break (%)
I	2500	17	400
II	2000	14	400

The tensile strength and elongation at break values are not always sufficient in themselves to determine the suitability of the belt cover for a particular service. The values in the above table should only be specified for conveyors or materials with a known history of performance and where it is known that compliance with the value will not adversely affect other in-service properties.

Fire/Flame Resistance

Belting requiring flame resistance is engineered to meet underground mining regulations and specifications. Currently, belt and belt compounds using SBR, nitrite, polychloroprene (neoprene), and PVC are routinely utilized.

Low Temperature Environments

Generally, most general purpose (Grades I and II) belting and compounds will resist stiffening down to -40°F/°C. For most general purpose belting, when there are prolonged periods of downtime during which the belt is exposed to -40° for several days or weeks, hard starts may be difficult or deleterious to the belt because of cold-set. When these conditions are expected, belts can be obtained which have suitable low temperature plasticizers and low glass-transition polymers or blends incorporated to permit maximum flexibility and operation.

Chemical Exposure

Conveyor belting manufacturers should be consulted when systems are being operated in specific chemical environments. The condition in which the conveyor belt is operating should be clearly defined. Consideration of the chemical concentration and temperature, as well as the possible presence of incidental processing chemicals or oils should also be taken into account.

Table 7-3. Conveyor belt cover quality selection.

	Major Advantages			
Cover Grade	Cut & Tear Resistance	Abrasion Resistance	Oil Resistance	General Applications
General Service				
Grade I	Excellent	Excellent	Not recommended	Large size ore, sharp cutting materials. For extremely rugged service.
Grade II	Good	Good to Excellent	Not recommended	Sized materials with limited cutting action--primarily abrasion. For heavy duty service.
Oil and Chemical Service				
Chloroprene (Neoprene) oil resistant	Good	Very Good	Very good for petroleum oils. Fair for vegetable and animal oils.	Heavily oil sprayed coal (petroleum oil up to 20% aromatics, No. 2 diesel fuel). Any material treated with or containing large amounts of petroleum oil.
Buna N Nitrile oil resistant	Good	Good	Very good for petroleum, vegetable, and animal oils.	Oily grain or seed service (soybeans, crushed corn, etc.) Food handling. Greasy, oil-sprayed coal (petroleum oil up to 40% aromatics. No. 2 heating oil.)
Medium oil resistant	Good	Good	Limited for petroleum, vegetable, and animal oils.	Lightly sprayed coal, mildly oily grains and feeds, wood chips, phosphates.

Cover Considerations

The covers should be of sufficient thickness and quality to protect the carcass. Covers for general service applications are listed in Tables 7-4 and 7-5, which list suggested minimum thickness for carrying and pulley side covers, respectively.

The cover gauge required for a specific belt is a function of the material conveyed and the handling methods used. Increased cover thickness is required as the following conditions become more severe: material abrasiveness, maximum material lump size, material weight, height of material drop onto the belt, loading angle, belt speed, and frequency of loading as determined by the frequency factor.

Table 7-4. Suggested minimum carry thickness for normal conditions: RMA—Grade II belting.

Class of Material	Examples	Thickness (inches)*
Package handling	Cartons, food products	Friction to 1/32
Light or fine, nonabrasive	Wood chips, pulp, grain, bituminous coal, potash ore	1/16 to 1/8
Fine and abrasive	Sharp sand, clinker	1/8 to 3/16
Heavy, crushed to 3" (76 mm)	Sand and gravel, crushed stone	1/8 to 3/16
Heavy, crushed to 8" (203 mm)	R.O.M. coal, rock, ores	3/16 to 1/4
Heavy, large lumps	Hard ores, slag	1/4 to 5/16

*Note: Cover thicknesses are nominal values subject to manufacturers' tolerances.

Table 7-5. Suggested minimum pulley cover thickness: RMA—Grade II belting.

Operating Conditions	Thickness (inches)*
Non-abrasive materials	1/32
Abrasive materials	1/16
Impact loading**	3/32

*Note: Cover thicknesses are nominal values subject to manufacturers' tolerances.

**While an increased cover gauge helps protect the carcass, if impact is severe, a correct system design that includes carcass design, top cover thickness, and impact-absorbing belt support in the conveyor loading zone is the preferred method of handling.

Deteriorating Conditions

Table 7-6 establishes the basis for determining cover quality for conditions which attack or cause deterioration in the belt. The actual cover thickness generally should follow the guidelines for a Grade II cover in Table 7-4. For all special materials not listed, or where extreme concentrations of chemical solutions are likely to be encountered, a belt manufacturer should be consulted to determine appropriate cover quality and thickness.