

COMPANY NAME: Professional Designers & Engineers, Inc.  
 PROJECT NAME: PRO-BELT METRIC EXAMPLE  
 DESIGNED BY: Kent R. Rieske  
 DATE: January 24, 2009  
 CONVEYOR NO.: EXAMPLE HEAD DRIVE  
 PRODUCT: TYPICAL  
 LOAD CASE NUMBER: 1 - File Name: MEXPHEAD.HED

BELT WIDTH, mm	=	1524	HORIZONTAL LENGTH, m	=	517.581
CONVEYOR CAPACITY, MtpH	=	2178.7	VERTICAL LIFT, m	=	80.802
BULK DENSITY, kg/m <sup>3</sup>	=	801	ANGLE OF INCLINE, deg.	=	16.00
MAX. LUMP SIZE, mm	=	76	MIN. TEMPERATURE, C	=	-40
MAX. BELT LOADING, %	=	83	TEMPERATURE FACTOR, Kt	=	3.00
IDLER TROUGHING, deg.	=	35	IDLER ROLL SIZE, mm	=	152.4
NUMBER ROLLERS/IDLER	=	3	IDLER CEMA LOAD RATING	=	D
ANGLE OF REPOSE, deg.	=	35	TROUGH IDLER SPACE, m	=	1.219
SURCHARGE ANGLE, deg.	=	25	RETURN IDLER SPACE, m	=	3.048
FULL BELT AREA, m <sup>2</sup>	=	0.289	RETURN ROLLERS/IDLER,	=	1
MAXIMUM BELT SAG, %	=	2.0	IDLER FRICTION, Ai, N	=	6.67
MIN. BELT SPEED, m/s	=	3.154	IDLER FRICTION, Kx N/m	=	7.021
ACTUAL BELT SPEED, m/s	=	3.15	ROLLERS FACTOR, Kr	=	1.00
EST. FABRIC BELT, kg/m	=	24.0	Kx MULTIPLIER	=	1.00
EST. STEEL BELT, kg/m	=	36.0	ACTUAL IDLER LOAD, kg	=	283.2
ACTUAL BELT WT., kg/m	=	40.2	IDLER SERVICE FACTORS	=	1.15
MATERIAL WEIGHT, kg/m	=	192.1	IDLER LOAD W/S.F., kg	=	325.5
BELT EDGE DISTANCE, mm	=	156	MFG. IDLER RATING, kg	=	506
ENVIRONMENTAL FACTOR			RETURN IDLER LOAD, kg	=	122.5
1 = clean			DRIVE EFFICIENCY, %	=	94
2 = moderate			NO. OF DRIVE PULLEYS		
3 = dirty	=	2	(single = 1, dual = 2)	=	1
MAINTENANCE FACTOR			DRIVE WRAP FACTOR, Cw	=	0.38
1 = good			Ky MULTIPLIER	=	1.00
2 = fair			User Selected Take-up or		
3 = poor	=	2	Counterweight Location	=	2
DAILY OPERATION, hours	=	16	C1 REDUCED FRICTION	=	1.00

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**TAKE-UP or COUNTERWEIGHT DATA**

Minimum Required Take-up or Counterweight, N = 115381  
 User Selected Take-up or Counterweight, N = 133440  
 Stopping Take-up Tension Test Page 7 = OK  
 13.61 M-tons

**MOTOR POWER RESULTS**

Conveyor Power at the Drive Pulley, kW = 661.5  
 Drive Losses Based on Efficiency on Page 1, kW = 42.1  


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 Recommended Minimum Motor Power, kW = 703.6  
 Actual Motor Power and Run/Accel Test Page 7 = 750.0 OK  
 OK

**EFFECTIVE BELT TENSION RESULTS**

Effective Conveyor Belt Tension,  $T_e$ , N = 209192  
 Drive Pulley(s) Tension, N = 801  


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 Total Effective Conveyor Drive Tension, N = 209993

**PRIMARY BELT TENSION RESULTS**

Belt Tension at Drive Pulley,  $T_2$ , N = 88523  
 Belt Tension at Drive Pulley,  $T_1$ , N = 297715  
 Minimum Allowable Belt Tension,  $T_o$ , N = 17358  
 Belt Tension at Tail Pulley,  $T_t$ , N = 70771  
  
 Conveyor Belt Unit Stress @  $T_1$ , kN/m width = 195  
 Conveyor Belt Unit Stress @  $T_2$ , kN/m width = 58  
 Max. Conveyor Belt Unit Stress, kN/m width = 195

**TOTAL BELT TENSION AT SECTION POINTS**

TROUGHING POINT NO.	BELT TENSION Newtons	TROUGHING POINT NO.	BELT TENSION Newtons	RETURN POINT NO.	BELT TENSION Newtons	RETURN POINT NO.	BELT TENSION Newtons
1	70771	14	293440	25	0	12	0
2	70917	15	295577	24	0	11	0
3	77834	16	297715	23	0	10	0
4	81154	17	0	22	0	9	0
5	128245	18	0	21	0	8	0
6	149521	19	0	20	0	7	0
7	170796	20	0	19	0	6	0
8	192072	21	0	18	0	5	88523
9	213348	22	0	17	0	4	91924
10	234623	23	0	16	0	3	66666
11	255899	24	0	15	0	2	66720
12	277174	25	0	14	0	1	70771
13	291302			13	0		

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SECTION BETWEEN POINTS	Ky	L*Kx*Kt	C1*		MAT'L ACC., SKIRTBOARDS		
			L*Ky* WB*Kt	C1* L*Ky*WM	H* (WM+WB)	PULLEYS & MISC.*C1	TOTAL Newtons
1-2	0.0161	77	70	0	0	0	147
2-3	0.0160	770	692	551	0	4902	6916
3-4	0.0160	514	461	735	0	1611	3321
4-5	0.0160	2568	2307	3675	38540	0	47091
5-6	0.0160	642	577	919	19138	0	21276
6-7	0.0160	642	577	919	19138	0	21276
7-8	0.0160	642	577	919	19138	0	21276
8-9	0.0160	642	577	919	19138	0	21276
9-10	0.0160	642	577	919	19138	0	21276
10-11	0.0160	642	577	919	19138	0	21276
11-12	0.0160	642	577	919	19138	0	21276
12-13	0.0160	770	692	1103	11563	0	14128
13-14	0.0160	642	577	919	0	0	2138
14-15	0.0160	642	577	919	0	0	2138
15-16	0.0160	642	577	919	0	0	2138
16-17	0.0000	0	0	0	0	0	0
17-18	0.0000	0	0	0	0	0	0
18-19	0.0000	0	0	0	0	0	0
19-20	0.0000	0	0	0	0	0	0
20-21	0.0000	0	0	0	0	0	0
21-22	0.0000	0	0	0	0	0	0
22-23	0.0000	0	0	0	0	0	0
23-24	0.0000	0	0	0	0	0	0
24-25	0.0000	0	0	0	0	0	0
<b>TOTALS</b>		11119	9990	15253	184069	6513	226944

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SECTION BETWEEN POINTS	C1* L*0.015* WB*Kt*R	H*WB	C1* PULLEYS	C1* BELT SCRAPER	C1* V-PLOW	MISC. TENSION *C1, N	TOTAL Newtons
25-24	0	0	0	0	0	0	0
24-23	0	0	0	0	0	0	0
23-22	0	0	0	0	0	0	0
22-21	0	0	0	0	0	0	0
21-20	0	0	0	0	0	0	0
20-19	0	0	0	0	0	0	0
19-18	0	0	0	0	0	0	0
18-17	0	0	0	0	0	0	0
17-16	0	0	0	0	0	0	0
16-15	0	0	0	0	0	0	0
15-14	0	0	0	0	0	0	0
14-13	0	0	0	0	0	0	0
13-12	0	0	0	0	0	0	0
12-11	0	0	0	0	0	0	0
11-10	0	0	0	0	0	0	0
10-9	0	0	0	0	0	0	0
9-8	0	0	0	0	0	0	0
8-7	0	0	0	0	0	0	0
7-6	0	0	0	0	0	0	0
6-5	0	0	0	0	0	0	0
5-4	1622	0	445	1334	0	0	3401
4-3	6597	-31854	0	0	0	0	-25258
3-2	1211	-2403	445	0	801	0	54
2-1	135	2403	1512	0	0	0	4051
<b>TOTALS</b>	<b>9565</b>	<b>-31854</b>	<b>2402</b>	<b>1334</b>	<b>801</b>	<b>0</b>	<b>-17752</b>

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SECTION BETWEEN POINTS	PERCENT FULL LOAD (decimal)	LENGTH "L" m	LIFT "H" m	SKIRT- BOARD LENGTH, m	NUMBER of Tripper & Head	PULLEYS Snub & Bend	MISC. TENSION Newtons
1-2	0.00	3.658	0.000	0.000	0	0	0
2-3	0.50	36.576	0.000	36.576	0	0	0
3-4	1.00	24.384	0.000	6.096	0	0	0
4-5	1.00	121.920	16.916	0.000	0	0	0
5-6	1.00	30.480	8.400	0.000	0	0	0
6-7	1.00	30.480	8.400	0.000	0	0	0
7-8	1.00	30.480	8.400	0.000	0	0	0
8-9	1.00	30.480	8.400	0.000	0	0	0
9-10	1.00	30.480	8.400	0.000	0	0	0
10-11	1.00	30.480	8.400	0.000	0	0	0
11-12	1.00	30.480	8.400	0.000	0	0	0
12-13	1.00	36.576	5.075	0.000	0	0	0
13-14	1.00	30.480	0.000	0.000	0	0	0
14-15	1.00	30.480	0.000	0.000	0	0	0
15-16	1.00	30.480	0.000	0.000	0	0	0
16-17	0.00	0.000	0.000	0.000	0	0	0
17-18	0.00	0.000	0.000	0.000	0	0	0
18-19	0.00	0.000	0.000	0.000	0	0	0
19-20	0.00	0.000	0.000	0.000	0	0	0
20-21	0.00	0.000	0.000	0.000	0	0	0
21-22	0.00	0.000	0.000	0.000	0	0	0
22-23	0.00	0.000	0.000	0.000	0	0	0
23-24	0.00	0.000	0.000	0.000	0	0	0
24-25	0.00	0.000	0.000	0.000	0	0	0
TOTALS		527.914	80.791	42.672	0	0	0

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SECTION BETWEEN POINTS	LENGTH "L" m	LIFT "H" m	NUMBER of PULLEYS		BELT SCRAPER	V-PLOW	MISC. TENSION Newtons
			Snub & Bend	Take-up & Tail			
25-24	0.000	0.000	0	0	0	0	0
24-23	0.000	0.000	0	0	0	0	0
23-22	0.000	0.000	0	0	0	0	0
22-21	0.000	0.000	0	0	0	0	0
21-20	0.000	0.000	0	0	0	0	0
20-19	0.000	0.000	0	0	0	0	0
19-18	0.000	0.000	0	0	0	0	0
18-17	0.000	0.000	0	0	0	0	0
17-16	0.000	0.000	0	0	0	0	0
16-15	0.000	0.000	0	0	0	0	0
15-14	0.000	0.000	0	0	0	0	0
14-13	0.000	0.000	0	0	0	0	0
13-12	0.000	0.000	0	0	0	0	0
12-11	0.000	0.000	0	0	0	0	0
11-10	0.000	0.000	0	0	0	0	0
10-9	0.000	0.000	0	0	0	0	0
9-8	0.000	0.000	0	0	0	0	0
8-7	0.000	0.000	0	0	0	0	0
7-6	0.000	0.000	0	0	0	0	0
6-5	0.000	0.000	0	0	0	0	0
5-4	91.440	0.000	1	0	1	0	0
4-3	371.856	-80.802	0	0	0	0	0
3-2	68.275	-6.096	1	0	0	1	0
2-1	7.620	6.096	1	2	0	0	0
<b>TOTALS</b>	<b>539.191</b>	<b>-80.802</b>	<b>3</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>0</b>

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**CONVEYOR ACCELERATION:**

ACTUAL DRIVE SIZE, kW = 750  
 ELECTRIC FREQUENCY, Hz = 60  
 MOTOR SPEED, rpm = 1750  
 LOCKED ROTOR TORQUE, % = 135  
 PULL-UP TORQUE, % = 125  
 BREAKDOWN TORQUE, % = 150  
 AVE. STARTING TORQUE, % = 140  
 (for time calculations)  
 RUNNING POWER TEST = OK  
 STARTING TORQUE TEST = OK  
 (125% running load)  
 ACCELERATION TIME, sec = 8.1

**CONVEYOR STOPPING:**

COASTING TIME, seconds = 4.0  
 (without brake)  
 TAIL BRAKE RATING, N = 0  
 (effective belt tension)  
 COASTING TIME, seconds = 4.0  
 (with brake)  
 COASTING DISTANCE, m = 6.31  
 MATERIAL DISCHARGED  
 DURING COASTING, kg = 1212.27  
 VOLUME DISCHARGED  
 DURING COASTING, m<sup>3</sup> = 1.51  
 STOP TAIL TENSION, N = 69970  
 STOP MIN. TROUGHING = 69927  
 STOPPING TENSION TEST = OK  
 BACKSTOP REQUIRED = YES  
 BACKSTOP LOAD, N = 139476  
 (Belt pull inclines loaded)

**BELT STRESS DATA:**

MAX. BELT STRESS, kN/m = 236  
 MIN. BELT RATING, kN/m = 195  
 ACTUAL RATING, kN/m = 340  
 (> min. or > max/150%)

**DRIVE INERTIA WK<sup>2</sup>, kg-m<sup>2</sup>**

MOTOR WK<sup>2</sup>, kg-m<sup>2</sup> = 29.37  
 REDUCER WK<sup>2</sup>, kg-m<sup>2</sup> = 5.87  
 COUPLINGS WK<sup>2</sup>, = 1.17  
 OTHER (+ or -) WK<sup>2</sup>, = 0  
 TOTAL EQUIPMENT WK<sup>2</sup> = 36.42

**ACCELERATION EQUIVALENT WEIGHT:**

DRIVE EQUIV. WT., kg = 123275  
 DRIVE PULLEY(s), kg = 714  
 WEIGHT OF PULLEYS, kg = 1058  
 WEIGHT OF BELT, kg = 42898  
 TROUGHING IDLERS, kg = 13437  
 RETURN IDLERS, kg = 5489  
 OTHER (+ or -) WT, kg = 0  
 TOTAL CONVEYOR WT, kg = 186870  
 MATERIAL LOAD, kg = 97209  
 TOTAL LOAD, kg = 284080  
 ACCEL. Te TENSION, N = 109968  
 (Average above running)  
 KINETIC ENERGY, joule = 1409389  
 FRICTION & GRAVITY  
 FORCES, Newtons = 223365

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<----- TROUGHING BELT -----><----- RETURN BELT ----->

TROUGHING POINT NO.	Run Newton	Accel Newton	Stop Newton	RETURN POINT NO.	Run Newton	Accel Newton	Stop Newton
1	70771	71251	69970	25	0	0	0
2	70917	71510	69927	24	0	0	0
3	77834	81212	72193	23	0	0	0
4	81154	87493	70572	22	0	0	0
5	128245	149384	92951	21	0	0	0
6	149521	174359	108049	20	0	0	0
7	170796	199335	123146	19	0	0	0
8	192072	224310	138244	18	0	0	0
9	213348	249286	153342	17	0	0	0
10	234623	274262	168440	16	0	0	0
11	255899	299237	183538	15	0	0	0
12	277174	324213	198635	14	0	0	0
13	291302	342781	205350	13	0	0	0
14	293440	348618	201309	12	0	0	0
15	295577	354456	197269	11	0	0	0
16	297715	360294	193229	10	0	0	0
17	0	0	0	9	0	0	0
18	0	0	0	8	0	0	0
19	0	0	0	7	0	0	0
20	0	0	0	6	0	0	0
21	0	0	0	5	88523	75712	109912
22	0	0	0	4	91924	81383	109525
23	0	0	0	3	66666	64947	69537
24	0	0	0	2	66720	66720	66720
25	0	0	0	1	70771	71251	69970

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**CONCAVE VERTICAL CURVE:**

**CONVEX VERTICAL CURVE:**

POINT NO. BEFORE CURVE = 4  
 ACCELERATION TENSION @ POINT BEFORE CURVE, N = 87493  
 TOTAL CURVE ANGLE, deg = 16  
 IDLER SPACING, m = 1.219  
 NUMBER OF IDLER SPACES = 100 (in curve section)  
 MINIMUM CONCAVE CURVE RADIUS, m  
 Based on idler layout = 436.5  
 Based on belt lift = 246.3  
 Total modulus, kN/m = 84000  
 Belt modulus of elasticity, kN/m/ply times number of plies.  
 Fabric belt stress = 28.4  
 Fabric belt buckling = 339.5  
 Steel cable stress = 28.4  
 Steel cable buckling = 135.7  
 Min. FABRIC BELT radius = 436.5  
 Min. STEEL CABLE radius = 436.5

POINT NUMBER @ CURVE = 13 (highest tension point)  
 TENSION @ CURVE, N = 291302  
 TOTAL CURVE ANGLE, deg = 16  
 IDLER SPACING, m = 1.219  
 NUMBER OF IDLER SPACES = 30 (in curve section)  
 IDLER CEMA @ CURVE = E  
 IDLER ROLL SIZE, mm = 152.4  
 IDLER LOAD, kg = 560  
 IDLER LOAD W/S.F., kg = 643  
 MFG. LOAD RATING, kg = 816  
 MINIMUM CONVEX CURVE RADIUS, m  
 Based on idler layout = 131.0  
 Fabric belt stress = 109.4  
 Fabric belt buckling = 43.8  
 Steel belt stress = 109.4  
 Steel belt buckling = 43.8

NOTE: The actual concave radius is the largest for any load case. Check with all sections loaded before the curve and empty after. Check with all sections empty before the curve and full after for downhill regeneration. Check the lowest tension load case for buckling. Check motor inertia on Page 8 against actual.

Min. FABRIC BELT radius = 131.0  
 Min. STEEL CABLE radius = 131.0

The maximum convex vertical curve idler loads occur at maximum belt tension. Check load cases with sections empty and fully loaded. Check lowest tension load case for buckling radius.

**Idler Vertical Misalignment Load Check**

Location Point No.	CEMA Load Rating	Roll Diameter mm	Vertical Misalignment mm	Idler Spacing meters	Load W/S.F. kg.	Idler Load Test
3	D	152.4	0	1.000	267.1	OK