ಭಾರತ್ ಹೆವಿ ಎಲೆಕ್ಟ್ರಿಕಲ್ಸ್ ಲಿಮಿಟೆಡ್
(ಭಾರತ ಸರಕಾರದ ಉದ್ಯಮ)
भारत हेवी इलेक्ट्रिकल्स लिमिटेड
(भारत सरकार का उपक्रम)
BHARAT HEAVY ELECTRICALS LIMITED
(A Government of India Undertaking)
INDUSTRIAL SYSTEMS GROUP

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Malleswaram, Bengaluru-560 012. India

Our Ref: 77/21/6099/VVN Dt: 18.01.2022

Subject: Regarding extension of due date from 18.01.2022 to 24.01.2022 for Enq.No: 77/21/6099/VVN.

With reference to the above enquiry for supplying pulleys for NSPCL Rourkela Project, we are extending the due date from 18.01.2022 to 24.01.2022

Thanking You,

Yours faithfully,

For BHARAT HEAVY ELECTRICALS LTD

(V V N S N Murthy /Manager, MM)

Rev.	Date	Description	Prepd.	Chkd.	Appd.
5	08-Dec-18	Revised as per approved conveyor GA drawings	JV	JSHETTY	RSP
4	06-Jun-17	Revised as per Mecon comments dated 10.01.17	JV	JSHETTY	RSP
3	29-Dec-16	Revised as per discussion with Mecon on 23.12.16	JV	JSHETTY	RSP
2	07-Dec-16	Revised as per Mecon comments dated 01.11.16	JV	JSHETTY	RSP
1	07-Oct-16	Revised as per Mecon comments dated 06.10.16	JV	JSHETTY	RSP
0	26-09-16	First Submission for Approval	JV	JSHETTY	RSP

	Project	**1 X 250 MW NSPCL Rourkela PP-II Expansion Project**		
	Customer	**NTPC-SAIL Power Company Pvt. Limited**		
	Customer's Consultant	**MECON Limited**		
	Contractor	**Bharat Heavy Electricals Limited Industrial Systems Group Bengaluru**		
	Document Title	**POWER & BELT TENSION CALCULATION FOR CONVEYORS, BELT FEEDERS & REVERSIBLE BELT FEEDERS, SELECTION OF DRIVE COMPONENTS & COASTING TIME CALCULATION**		
	Document No.	**IS-4-DC-708-101-M063**		
	Job No.	IS-1-16-2003		
Prepared	JISHNU V		Rev. No.	5
Checked	R S PUJARI		Date	08-Dec-18
Approved	V SAHADEVAN		Sheet No.	1 of 60

CUSTOMER : **NTPC SAIL Power Supply Company Pvt. Ltd.**				
PROJECT : **1X250 MW Rourkela Power Project PP-II**				
Sl. No.	**Comments zone**	**MECON/NSPCL comments dated 06.10.16**	**BHEL Compliance/Clarifications Dtd.**	**Remarks**
Comments marked on the attached Drg.				
Document Title : CONVEYOR POWER CALCULATION				
Document Number :**IS-4-DC-708-101-M063 Rev 05**				
1	GENERAL	Note: This calculation has been stamped in CAT-2 considering clearence on the final Motor, Belt rating etc. However many internal values are not matched with the CAT-2/CAT-1 G.A drawing of Conv already forwarded to BHEL. M/s BHEL is requested to submit the final calculation only after getting approval of all respective Conveyor G.A.	All the conveyor drawings are approved in Cat-I/II; Hence we are resubmitting the drawing inline with GA drawings	
2	GENERAL	Formula Updation for T1, T2,T1s	Formulaes updated as discussed during finalizing the GA drawings; T1= TE+T2; T2= Cw x TE; T1s= TE x ξ+T2	
3	GENERAL	Efficiency of gearbox and coupling	Updated as per the approved GA drawings	
4	1AB	6.55 degree	Incorporated	
5	3AB	Change in conveyor lift	Updated	
6	3AB	Distance of take up pulley from head pulley along belt	Updated	
7	3AB	Roller length of return idler	Updated	
8	3AB	Change in head pulley diameter	Updated	
9	5AB	Change in number of return rollers	Updated	
10	5AB	Inclination change	Updated	
11	6AB	Change in WP to WP distance	Updated	
12	6AB	Change in Vertical distance of belt from head pulley to take up	Updated	
13	8AB	Change in Distance of take up pulley from head pulley horizontally	Updated	
14	8AB	Change in WP to WP distance	Updated	
15	8AB	Change in Lift	Updated	
16	9	Change in Vertical distance of belt from head pulley to take up	Updated	
17	10	Change in Vertical distance of belt from head pulley to take up	Updated	

CONVEYOR POWER CALCULATION FOR BCN-1A/1B

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
			BASIC INPUTS		
1	Rated capacity of conveyor	Qr	1000	TPH	
2	Design capacity of conveyor	C	1200	TPH	
3	Belt width	B	1400	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m^3	
6	Lump size		(-) 250	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	28.602	m	
9	Material transportation length	Lt	26.102	m	
10	C-C distance between HP & TP (horizontal)	Lh	24.377	m	
11	Conveyor lift	H	2.8	m	
12	Vertical distance of belt from head pulley to take up pulley	Ht	0	m	NOT APPLICABLE (SCREW TAKE UP)
13	Distance of take up pulley from head pulley along belt	Lt	0	m	NOT APPLICABLE (SCREW TAKE UP)
14	Belt speed	V	2.8	m/s	
15	Conveyor slope	δ	6.55	degrees	
16	Number of feeding points	fp	2		
17	Length of skirt board per feed point	lsk'	4.5	m	
18	Total length of skirt board	Lsk	9	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	152.4	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	2		
24	Return idler tube diameter	Dri	152.4	mm	
25	Idler bearing diameter	db	30	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	1		
28	Pressure exerted by belt cleaner	P	50000	N/m^2	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	530	mm	
34	Roller length of return idler	lri	800	mm	
35	Weight of rotating parts of Carrying idler	mc	32	kg/m	
36	Mass of rotating parts of return idlers	mr	32	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		FR grade cover
41	Unit weight of carcass	w'	4.1	kg/m^2	**Assumed rating of 630/4; Reference- Catalogue of Pheonix Yule**
42	Unit weight of rubber	w"	1.26	kg/m^2 per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.26 kg/m^2
43	Unit weight of belt	mb	21.616	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w"
44	Number of trippers	nt	0		
45	Tripper slope	Tra	0	degrees	
46	Factor for extra power for tripper	β	0		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.28		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	1		
49	Number of tail pulleys	Ntp	1		
50	Number of bend pulleys	Nbp	0		
51	Number of take up pulleys	Ntup	0		
52	Number of snub pulleys	Nsp	1		
53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	792	TPH	Refer table 10, Page 12 of IS 11592; For denisty
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		Refer page 17 of IS 11592
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	2	degrees	
70	Length of conveyor equipped with tilted idlers	Li	28.602		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.55		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	94		

75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	95	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	340	mm	p= 0.5 x (B -2c - lci)
79	Slope reduction for area S1	K	0.95		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.22	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	0.933	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.666	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**1348.30**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.676		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	119.048	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.417	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	2310.75	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	3270.01	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	934.08	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	319.62	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}^{2} x $b1^2$]; Eqn 13 of IS 11592
92	Total wrap resistance for non-drive pulleys	Rw	315	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	100	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	1668.7	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	239.48	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	1079.81	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	2730	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	4049.29	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	0	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**11298.75**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	31.64	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	32.564	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	8624.46	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	3975.99	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	6485.4825	N	T2min= TE x Cw
109	Effective slackside tension	T2	6485.5	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	17784.2	N	T1= TE x (Cw + 1)
111	Component of main resistance of return belt	Rr	451.3	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	15.8	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	9488.1	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	6900.48	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	0	tons	AS THE TYPE OF TAKE UP IS SCREW
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	902.63	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	415	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	36.801	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	2766.80	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	4084.43	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	11.44	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	12.36	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	23998.55	N	T1s= Te x ξ+T2
124	Running tight side tension	T1	17784.23	N	
125	Running tight side tension per unit belt width	T1bw	12.70	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	15.24	kN/m	T1sbw= T1s/BW
127	Belt selected		**630/4**	kN/m	
128	RMBT of the belt selected	RMBT	70	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.181		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**
130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.218		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		630	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	Full thickness tensile strength (for normal running case)		127.03	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT. Hence selection is OK**

135	Full thickness tensile strength (for startingcase)		119.99	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
136	Minimum pulley diameters recommended:				Phoenix Yule catalogue
137	Head pulley/Tail pulley/Take up		500	mm	
138	Bend pulleys		400	mm	
139	Snub Pulley		315	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**500**	**mm**	
142	**Tail Pulley**		**400**	**mm**	
143	**Take up pulley**			**mm**	NOT APPLICABLE (SCREW TAKE UP)
144	**Bend pulleys**			**mm**	NOT APPLICABLE (SCREW TAKE UP)
145	**Snub pulley**		**315**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur		m	
147	Vertical distance between the curve point and head end	Hcur			
148	Maximum tension at curve point	Rc		N/m	Rc= {T1-α{f x Lcur x g x (mG + mb + mc)- (Hcur x (mG+mb) x g)}/BW
149	Minimum radius to avoid lift off	Rmin-1	NA	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es			As per annex G of IS 11592
151	Belt modulus	E		kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2		m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3		m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin			
	RADIUS CALCULATION (CONVEX)				
155	Minimum radius in relation to belt width	Rmin-1	16.8	m	Rmin-1=12 BW/1000
156	Horizontal distance between the curve point and head end	Lcur			
157	Vertical distance between the curve point and head end	Hcur			
158	Maximum unit tension at curve point	Tc	NA	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}- (Hcur x mG x g)
159	Minimum radius to avoid over stress at centre of belt	Rmin-2		m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
160	Minimum radius to avoid lack of stress at belt edge	Rmin-3		m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
161	Minimum radius selected	Rmin		m	
	POWER CALCULATION				
162	Required motor kW for loaded belt	Pm	35.71	kW	Pm= Pa/(ηg x ηc)
163	Required motor kW for empty belt	Pmo	13.556	kW	Pmo= Pdpo/(ηg x ηc)
164	Required motor power	Prm	42.86	kW	Prm= Pmo x (1+Fmp/100)
165	**MOTOR SELECTED**		**45**	**kW @ 1500 rpm**	

CONVEYOR POWER CALCULATION FOR CONV-2A/2B

DATE:-12-08-18

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
		BASIC INPUTS			
1	Rated capacity of conveyor	Qr	1000	TPH	
2	Design capacity of conveyor	C	1200	TPH	
3	Belt width	B	1400	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m³	
6	Lump size		(-) 250	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	365.92	m	
9	Material transportation length	Lt	366.395	m	
10	C-C distance between HP & TP (horizontal)	Lh	368.895	m	
11	Conveyor lift	H	55.5	m	
12	Vertical distance of belt from head pulley to take up pulley	Ht	3.5	m	
13	Distance of take up pulley from head pulley along belt	Lt	63.9	m	
14	Belt speed	V	2.8	m/s	
15	Conveyor slope	δ	10	degrees	
16	Number of feeding points	fp	2		
17	Length of skirt board per feed point	lsk'	4.5	m	
18	Total length of skirt board	Lsk	9	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	152.4	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	2		
24	Return idler tube diameter	Dri	152.4	mm	
25	Idler bearing diameter	db	30	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	1		
28	Pressure exerted by belt cleaner	P	50000	N/m²	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	530	mm	
34	Roller length of return idler	lri	800	mm	
35	Weight of rotating parts of Carrying idler	mc	32	kg/m	
36	Mass of rotating parts of return idlers	mr	32	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		FR grade cover
41	Unit weight of carcass	w'	7.7	kg/m²	Based on Phoenix Yule catalogue, assuming a rating of 1600/4
42	Unit weight of rubber	w''	1.26	kg/m² per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.26 kg/m²
43	Unit weight of belt	mb	26.656	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w''
44	Number of trippers	nt	0		
45	Tripper slope	Tra	0	degrees	
46	Factor for extra power for tripper	β	0		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.35		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	1		
49	Number of tail pulleys	Ntp	1		
50	Number of bend pulleys	Nbp	2		
51	Number of take up pulleys	Ntup	1		
52	Number of snub pulleys	Nsp	1		

CONVEYOR POWER CALCULATION FOR CONV-2A/2B

53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	792	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		Refer page 17 of IS 11592
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	2	degrees	
70	Length of conveyor equipped with tilted idlers	Li	365.92		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.2		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97		
75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	95	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	340	mm	p= 0.5 x (B -2c - lci)
79	Slope reduction for area S1	K	0.93		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.22	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	0.933	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.666	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**1319.92**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.676		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	119.048	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.417	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	33862.54	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	64816.28	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	934.08	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	319.62	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}^{2} x $b1^2$]; Eqn 13 of IS 11592

CONVEYOR POWER CALCULATION FOR CONV-2A/2B

92	Total wrap resistance for non-drive pulleys	Rw	735	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	250	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	2238.7	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	3145.83	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	1079.81	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	2730	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	6955.64	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	0	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**107873.16**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	302.04	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	302.964	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	8933.48	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	4903.04	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	61919.19384	N	T2min= TE x Cw
109	Effective slackside tension	T2	61919.2	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	169792.4	N	T1= TE x (Cw + 1)
111	Component of main resistance of return belt	Rr	6316.7	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	17.3	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	57437.9	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	63092.00	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	10.36	tons	CWt= 2 x Tt - 2.5 (assuming the weight of counter weight frame, take up pulley with frame adds out to be 2.5 ton
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	12633.36	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	985	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	575.518	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	3305.52	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	16923.88	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	47.39	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	48.31	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	191366.99	N	T1s= TE x ξ+T2
124	Running tight side tension	T1	169792.35		
125	Running tight side tension per unit belt width	T1bw	121.28	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	145.54	kN/m	T1sbw= T1s/BW
127	Belt selected		**1600/4**		
128	RMBT of the belt selected	RMBT	180	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.67		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**

CONVEYOR POWER CALCULATION FOR CONV-2A/2B

130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.809		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		1600	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	Full thickness tensile strength (for normal running case)		1212.80	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT.**
135	Full thickness tensile strength (for startingcase)		956.83	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
136	Minimum pulley diameters recommended:				Phoenix Yule catalogue
137	Head pulley/Tail pulley/Take up		630	mm	
138	Bend pulleys		500	mm	
139	Snub Pulley		400	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**800**	**mm**	
142	**Tail Pulley**		**630**	**mm**	
143	**Take up pulley**		**630**	**mm**	
144	**Bend pulleys**		**500**	**mm**	
145	**Snub pulley**		**500**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur	334.895	m	
147	Vertical distance between the curve point and head end	Hcur	50.5		
148	Maximum tension at curve point	Rc	52832.43	N/m	Rc= {T1max-α{f x Lcur x g x (mG + mb + mc)- (Hcur x (mG+mb) x g)}/BW
149	Minimum radius to avoid lift off	Rmin-1	282.86	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es	6.5		As per annex G of IS 11592
151	Belt modulus	E	1170	kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2	0.821	m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3	6.2815	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin	**282.86**		
	RADIUS CALCULATION (CONVEX)				
155	Minimum radius in relation to belt width	Rmin-1	16.8	m	Rmin-1=12* BW/1000
156	Horizontal distance between the curve point and head end	Lcur	25		
157	Vertical distance between the curve point and head end	Hcur	0		
158	Maximum unit tension at curve point	Tc	120.019	kN/m	Tc= T1-α{f x Lcur x g x (mG + mb + mc)}-(Hcur x mG x g)
159	Minimum radius to avoid over stress at centre of belt	Rmin-2	3.481	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
160	Minimum radius to avoid lack of stress at belt edge	Rmin-3	1.807	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
161	Minimum radius selected	Rmin	**50**	m	
	POWER CALCULATION				
162	Required motor kW for loaded belt	Pm	321.99	kW	Pm= Pa/(ηg x ηc)
163	Required motor kW for empty belt	Pmo	51.346	kW	Pmo= Pdpo/(ηg x ηc)
164	Required motor power	Prm	386.39	kW	
165	**MOTOR SELECTED**		**400 kW @ 1500 rpm**		

CONVEYOR POWER CALCULATION FOR CONV-3A/3B

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
	BASIC INPUTS				
1	Rated capacity of conveyor	Qr	1000	TPH	
2	Design capacity of conveyor	C	1200	TPH	
3	Belt width	B	1400	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m^3	
6	Lump size		(-) 250	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	76.454	m	
9	Material transportation length	Lt	79.329	m	
10	C-C distance between HP & TP (horizontal)	Lh	81.829	m	
11	Conveyor lift	H	12.3	m	
12	Vertical distance of belt from head pulley to take up pulley	Ht	7.8	m	
13	Distance of take up pulley from head pulley along belt	Lt	23	m	
14	Belt speed	V	2.8	m/s	
15	Conveyor slope	δ	14	degrees	
16	Number of feeding points	fp	2		
17	Length of skirt board per feed point	lsk'	4.5	m	
18	Total length of skirt board	Lsk	9	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	152.4	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	2		
24	Return idler tube diameter	Dri	152.4	mm	
25	Idler bearing diameter	db	30	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	1		
28	Pressure exerted by belt cleaner	P	50000	N/m^2	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	530	mm	
34	Roller length of return idler	lri	1600	mm	
35	Weight of rotating parts of Carrying idler	mc	32	kg/m	
36	Mass of rotating parts of return idlers	mr	32	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		FR grade
41	Unit weight of carcass	w'	4.1	kg/m^2	Assumed rating is 630/4; Reference- Phoenix Yule catalogue
42	Unit weight of rubber	w"	1.26	kg/m^2 per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.26 kg/m^2
43	Unit weight of belt	mb	21.616	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w"
44	Number of trippers	nt	0		
45	Tripper slope	Tra	0	degrees	
46	Factor for extra power for tripper	β	0		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.92		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	1		
49	Number of tail pulleys	Ntp	1		
50	Number of bend pulleys	Nbp	2		
51	Number of take up pulleys	Ntup	1		
52	Number of snub pulleys	Nsp	1		
53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	792	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		Refer page 17 of IS 11592
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		

CONVEYOR POWER CALCULATION FOR CONV-3A/3B

65	Coefficient of friction between carrying material and belt	μ1	0.6		
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	2	degrees	
70	Length of conveyor equipped with tilted idlers	Li	76.454		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.35		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97		
75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	95	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	340	mm	p= 0.5 x (B -2c - Ici)
79	Slope reduction for area S1	K	0.91		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.22	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	0.933	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.666	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**1291.53**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.676		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	119.048	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.417	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	9672.75	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	14364.69	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	934.08	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	319.62	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}^{2} x $b1^2$]; Eqn 13 of IS 11592
92	Total wrap resistance for non-drive pulleys	Rw	735	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	250	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	2238.7	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	625.192	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	1079.81	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	2730	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	4435.002	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	0	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**30711.14**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	85.99	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	86.914	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	8624.46	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	3975.99	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	17628.19	N	T2min= TE x Cw
109	Effective slackside tension	T2	17628.19	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	48339.33	N	T1= TE x (Cw + 1)
111	Component of main resistance of return belt	Rr	1206.382	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	15.779	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	19941.33	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	17322.10	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	2.03	tons	CWt= 2 x Tt - 1.5 (assuming the weight of counter weight frame, take up pulley with frame adds out to be 1.5 ton
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	2412.76	N	R0= f x g {(mc + mr + 2 x mb) x L}x α

117	Secondary resistance without material	Rso	985	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	96.074	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	2826.07	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	6223.84	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	17.43	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	18.35	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	59088.23	N	T1s= TE x ξ+T2
124	Running tight side tension	T1	48339.33		
125	Running tight side tension per unit belt width	T1bw	34.53	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	41.43	kN/m	T1sbw= T1s/BW
127	Belt selected		**630/4**		
128	RMBT of the belt selected	RMBT	70	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.493		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**
130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.592		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		630	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	Full thickness tensile strength(for normal running case)		345.28	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT. Hence selection is OK**
135	Full thickness tensile strength(for startingcase)		295.44	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
131	Minimum pulley diameters recommended:				Phoenix Yule catalogue
132	Head pulley/Tail pulley/Take up		400	mm	
133	Bend pulleys		315	mm	
134	Snub Pulley		250	mm	
135	**Pulley diameters selected:**				
136	**Head pulley**		**800**	**mm**	
137	**Tail Pulley**		**500**	**mm**	
138	**Take up pulley**		**500**	**mm**	
139	**Bend pulleys**		**400**	**mm**	
140	**Snub pulley**		**400**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
141	Horizontal distance between the curve point and head end	Lcur	57.5	m	
142	Vertical distance between the curve point and head end	Hcur	12.8		
143	Maximum tension at curve point	Rc	17904.64	N/m	Rc= {T1max-α{f x Lcur x g x (mG + mb + mc)- (Hcur x (mG+mb) x g)}/BW
144	Minimum radius to avoid lift off	Rmin-1	118.21	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
145	Belt specific modulus	Es	6.5		As per annex G of IS 11592
146	Belt modulus	E	455	kN/m	E= Es x RMBT
147	Minimum radius to avoid over stress at centre of belt	Rmin-2	0.779	m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
148	Minimum radius to avoid lack of stress at belt edge	Rmin-3	9.7952	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
149	Minimum radius to be selected	Rmin	**118.21**		
	RADIUS CALCULATION (CONVEX)				
150	Minimum radius in relation to belt width	Rmin-1	16.8	m	Rmin-1=12* BW/1000
151	Horizontal distance between the curve point and head end	Lcur			
152	Vertical distance between the curve point and head end	Hcur			
153	Maximum unit tension at curve point	Tc	NA	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}- (Hcur x mG x g)
154	Minimum radius to avoid over stress at centre of belt	Rmin-2		m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
155	Minimum radius to avoid lack of stress at belt edge	Rmin-3		m	Rmin-3= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
156	Minimum radius selected	Rmin		m	
	POWER CALCULATION				
157	Required motor kW for loaded belt	Pm	92.37	kW	Pm= Pa/(ηg x ηc)
158	Required motor kW for empty belt	Pmo	19.504	kW	Pmo= Pdpo/(ηg x ηc)
159	Required motor power	Prm	110.85	kW	
160	**MOTOR SELECTED**		**132**	**kW @ 1500 rpm**	

CONVEYOR POWER CALCULATION FOR CONV-4A (in reclaim mode)

DATE:- 08-12-18

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
		BASIC INPUTS			
1	Rated capacity of conveyor	Qr	600	TPH	
2	Design capacity of conveyor	C	720	TPH	
3	Belt width	B	1400	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m^3	
6	Lump size		(-) 20	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	426.18	m	
9	Material transportation length	Lt	385.18	m	
10	C-C distance between HP & TP (horizontal)	Lh	425	m	
11	Conveyor lift	H	8	m	
12	Vertical distance of belt from head pulley to take up pulley	Ht	8	m	
13	Distance of take up pulley from head pulley along belt	Lt	436	m	
14	Belt speed	V	2.8	m/s	
15	Conveyor slope	δ	9	degrees	
16	Number of feeding points	fp	2		
17	Length of skirt board per feed point	lsk'	4.5	m	
18	Total length of skirt board	Lsk	9	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	152.4	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	2		
24	Return idler tube diameter	Dri	152.4	mm	
25	Idler bearing diameter	db	30	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	2		
28	Pressure exerted by belt cleaner	P	50000	N/m^2	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	530	mm	
34	Roller length of return idler	lri	800	mm	
35	Weight of rotating parts of Carrying idler	mc	32	kg/m	
36	Mass of rotating parts of return idlers	mr	32	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		FR grade
41	Unit weight of carcass	w'	7.2	kg/m^2	Assumed rating is 1600/4; Reference- Phoenix Yule catalogue
42	Unit weight of rubber	w"	1.26	kg/m^2 per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.2 kg/m^2
43	Unit weight of belt	mb	25.956	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w"
44	Number of trippers	nt	1		
45	Tripper slope	Tra	14	degrees	
46	Factor for extra power for tripper	β	7		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.38		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	2		
49	Number of tail pulleys	Ntp	0		
50	Number of bend pulleys	Nbp	2		TYPE OF TAKE UP IS HGTU
51	Number of take up pulleys	Ntup	1		
52	Number of snub pulleys	Nsp	1		
53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	

CONVEYOR POWER CALCULATION FOR CONV-4A (in reclaim mode)

58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	792	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		Refer page 17 of IS 11592
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	0	degrees	Tilt is not applicable as the conveyor is reversible
70	Length of conveyor equipped with tilted idlers	Li	426.18		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.35		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97		
75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	95	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	340	mm	p= 0.5 x (B -2c - Ici)
79	Slope reduction for area S1	K	0.95		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.22	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	0.933	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.666	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**1348.30**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.406		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	71.429	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.25	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	30852.16	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	5605.75	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	560	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	114.88	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}^{2} x $b1^2$]; Eqn 13 of IS 11592
92	Total wrap resistance for non-drive pulleys	Rw	560	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	200	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	1434.88	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	0.00	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	388.11	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	3640	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	4028.11	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	2934.462854	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**44855.36**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	125.6	kW	Pdp= TE x V/1000

102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	126.52	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	5970.92	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	4774.28	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	25747	N	T2min= TE xCw
109	Effective slackside tension	T2	25747.0	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	70602.3	N	T1= TE x (Cw + 1)
111	Component of main resistance of return belt	Rr	7269.1	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	17.1	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	35379.1	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	31906.37	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	7.15	tons	CWt= 2 x Tt ; 10% considered for the additional friction arising out of HGTU trolley movement
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	14538.24	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	760	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	0	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	3640.00	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	18938.24	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	53.03	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	53.95	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	86301.71	N	T1s= TE x ξ+T2
124	Running tight side tension	T1	70602.34		
125	Running tight side tension per unit belt width	T1bw	50.43	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	60.52	kN/m	T1sbw= T1s/BW
127	Belt selected		**1600/4**		
128	RMBT of the belt selected	RMBT	180	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.28		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**
130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.336		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		1600	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	Full thickness tensile strength (for normal running case)		504.3	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT.**
135	Full thickness tensile strength(for startingcase)		431.5	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
136	Minimum pulley diameters recommended:				Phoenix Yule catalogue
137	Head pulley/Tail pulley/Take up		630	mm	
138	Bend pulleys		500	mm	
139	Snub Pulley		400	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**800**	**mm**	2 Nos (for dual drive)
142	**Tail Pulley**			**mm**	
143	**Take up pulley**		**630**	**mm**	
144	**Bend pulleys**		**500**	**mm**	
145	**Snub pulley**		**500**	**mm**	

CONVEYOR POWER CALCULATION FOR CONV-4A (in reclaim mode)

	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur	77.5	m	
147	Vertical distance between the curve point and head end	Hcur	7.7		
148	Maximum tension at curve point	Rc	42266.93	N/m	Rc= {T1max-α{f x Lcur x g x (mG + mb + mc)-(Hcur x (mG+mb) x g)}/BW
149	Minimum radius to avoid lift off	Rmin-1	232.39	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es	6.5		As per annex G of IS 11592
151	Belt modulus	E	1170	kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2	0.758	m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3	8.1268	m	Rmin-3= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin	**232.39**		
	RADIUS CALCULATION (CONVEX)				
155	Minimum radius in relation to belt width	Rmin-1	16.8	m	Rmin-1=12* BW/1000
156	Horizontal distance between the curve point and head end	Lcur	20		
157	Vertical distance between the curve point and head end	Hcur	0		
158	Maximum unit tension at curve point	Tc	49.68	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}-(Hcur x mG x g)
159	Minimum radius to avoid over stress at centre of belt	Rmin-2	1.602	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
160	Minimum radius to avoid lack of stress at belt edge	Rmin-3	4.621	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
161	Minimum radius selected	Rmin	**50**	m	
	POWER CALCULATION				
162	Required motor kW for loaded belt	Pm	134.47	kW	Pm= Pa/(ηg x ηc)
163	Required motor kW for empty belt	Pmo	57.34	kW	Pmo= Pdpo/(ηg x ηc)
164	Required motor power	Prm	161.3652	kW	
165	**MOTOR SELECTED**		**110 kW @ 1500 rpm (2 Nos); Dual drive**		

CONVEYOR POWER CALCULATION FOR CONV-4A (in stacking mode)

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
			BASIC INPUTS		
1	Rated capacity of conveyor	Qr	1000	TPH	
2	Design capacity of conveyor	C	1200	TPH	
3	Belt width	B	1400	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m³	
6	Lump size		(-) 20	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	425.716	m	
9	Material transportation length	Lt	384.716	m	
10	C-C distance between HP & TP (horizontal)	Lh	425	m	
11	Conveyor lift	H	-3	m	Considering a tripper lift of 5m & Conveyor lift of 8m
12	Vertical distance of belt from head pulley to take up pulley	Ht	7.26	m	
13	Distance of take up pulley from head pulley along belt	Lt	436	m	
14	Belt speed	V	2.8	m/s	
15	Conveyor slope	δ	8	degrees	
16	Number of feeding points	fp	2		
17	Length of skirt board per feed point	lsk'	4.5	m	
18	Total length of skirt board	Lsk	9	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	152.4	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	2		
24	Return idler tube diameter	Dri	152.4	mm	
25	Idler bearing diameter	db	30	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	2		
28	Pressure exerted by belt cleaner	P	50000	N/m²	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	530	mm	
34	Roller length of return idler	lri	800	mm	
35	Weight of rotating parts of Carrying idler	mc	32	kg/m	
36	Mass of rotating parts of return idlers	mr	32	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		FR grade cover
41	Unit weight of carcass	w'	6.4	kg/m²	
42	Unit weight of rubber	w"	1.26	kg/m² per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.2 kg/m²
43	Unit weight of belt	mb	24.836	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w"
44	Number of trippers	nt	1		
45	Tripper slope	Tra	14	degrees	
46	Factor for extra power for tripper	β	7		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.38		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	2		
49	Number of tail pulleys	Ntp	0		
50	Number of bend pulleys	Nbp	2		TYPE OF TAKE UP IS HGTU
51	Number of take up pulleys	Ntup	1		
52	Number of snub pulleys	Nsp	1		
53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	792	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		Refer page 17 of IS 11592
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	0	degrees	Tilt is not applicable as the conveyor is reversible
70	Length of conveyor equipped with tilted idlers	Li	425.716		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.35		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97		
75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		

	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	95	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	340	mm	p= 0.5 x (B -2c - lci)
79	Slope reduction for area S1	K	0.95		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.22	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	0.933	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.666	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**1348.30**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.676		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	119.048	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.417	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	37882.15	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	-3503.58	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	934.08	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	319.62	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}^{2} x $b1^2$]; Eqn 13 of IS 11592
92	Total wrap resistance for non-drive pulleys	Rw	560	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	200	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	2013.7	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	0.00	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	1079.81	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	3640	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	4719.81	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	2877.845415	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**43989.92**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	123.17	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	124.09	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	8821.89	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	4568.27	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	34087.79	N	T2min= TE x ξ*Cw
109	Effective slackside tension	T2	34087.8	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	78077.7	N	T1= TE x (ξ x Cw + 1)
111	Component of main resistance of return belt	Rr	7120.9	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	16.7	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	46339.6	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	40371.93	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	9.053	tons	CWt= 2 x Tt ; 10% considered for the additional friction arising out of HGTU trolley movement
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	14241.76	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	760	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	0	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	3640.00	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	18641.76	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	52.20	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	53.12	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	93474.18	N	T1s= TE x ξ+T2
124	Running tight side tension	T1	78077.71		
125	Running tight side tension per unit belt width	T1bw	55.77	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	66.92	kN/m	T1sbw= T1s/BW
127	Belt selected		**1600/4**		
128	RMBT of the belt selected	RMBT	180	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.31		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**
130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.372		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		1600	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	Full thickness tensile strength (for normal running case)		557.70	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT. Hence selection is OK**
135	Full thickness tensile strength (for startingcase)		467.37	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**

136	Minimum pulley diameters recommended:				Phoenix Yule catalogue
137	Head pulley/Tail pulley/Take up		630	mm	
138	Bend pulleys		500	mm	
139	Snub Pulley		400	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**800**	**mm**	2 Nos (for dual drive)
142	**Tail Pulley**			**mm**	
143	**Take up pulley**		**630**	**mm**	
144	**Bend pulleys**		**500**	**mm**	
145	**Snub pulley**		**500**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur	77.5	m	
147	Vertical distance between the curve point and head end	Hcur	7.7		
148	Maximum tension at curve point	Rc	44052.21	N/m	Rc= {T1max-α{f x Lcur x g x (mG + mb + mc)- (Hcur x (mG+mb) x g)}/BW
149	Minimum radius to avoid lift off	Rmin-1	253.13	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es	6.5		As per annex G of IS 11592
151	Belt modulus	E	1170	kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2	0.768	m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3	7.7424	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin	**253.13**		
	RADIUS CALCULATION (CONVEX)				
155	Minimum radius in relation to belt width	Rmin-1	16.8	m	Rmin-1=12* BW/1000
156	Horizontal distance between the curve point and head end	Lcur	20		
157	Vertical distance between the curve point and head end	Hcur	0		
158	Maximum unit tension at curve point	Tc	54.749	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}- (Hcur x mG x g)
159	Minimum radius to avoid over stress at centre of belt	Rmin-2	1.667	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
160	Minimum radius to avoid lack of stress at belt edge	Rmin-3	4.155	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
161	Minimum radius selected	Rmin	**50**	m	
	POWER CALCULATION				
162	Required motor kW for loaded belt	Pm	131.89	kW	Pm= Pa/(ηg x ηc)
163	Required motor kW for empty belt	Pmo	56.458	kW	Pmo= Pdpo/(ηg x ηc)
164	Required motor power	Prm	158.2668	kW	
165	**MOTOR SELECTED**		**110 kW @ 1500 rpm (2 Nos); Dual drive**		

CONVEYOR POWER CALCULATION FOR CONV-5A/5B

DATE:-08-12-18

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
		BASIC INPUTS			
1	Rated capacity of conveyor	Qr	600	TPH	
2	Design capacity of conveyor	C	720	TPH	
3	Belt width	B	1000	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m^3	
6	Lump size		(-) 20	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	76.454	m	
9	Material transportation length	Lt	81.779	m	
10	C-C distance between HP & TP (horizontal)	Lh	83.279	m	
11	Conveyor lift	H	8.3	m	
12	Vertical distance of belt from head pulley to take up pulley	Ht	8.3	m	
13	Distance of take up pulley from head pulley along belt	Lt	87.5	m	
14	Belt speed	V	3.2	m/s	
15	Conveyor slope	δ	12.5	degrees	
16	Number of feeding points	fp	3		
17	Length of skirt board per feed point	lsk'	4	m	
18	Total length of skirt board	Lsk	12	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	152.4	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	1		
24	Return idler tube diameter	Dri	139.7	mm	
25	Idler bearing diameter	db	25	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	1		
28	Pressure exerted by belt cleaner	P	50000	N/m^2	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	380	mm	
34	Roller length of return idler	lri	1200	mm	
35	Weight of rotating parts of Carrying idler	mc	25.6	kg/m	
36	Mass of rotating parts of return idlers	mr	17	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		FR grade cover
41	Unit weight of carcass	w'	4.1	kg/m^2	Assumed rating is 630/4; Reference-Belt catalogue of Phoenix Yule
42	Unit weight of rubber	w''	1.26	kg/m^2 per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.26 kg/m^2
43	Unit weight of belt	mb	15.44	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w''
44	Number of trippers	nt	0		
45	Tripper slope	Tra	0	degrees	
46	Factor for extra power for tripper	β	0		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.8		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	1		
49	Number of tail pulleys	Ntp	1		Type of take up is HGTU
50	Number of bend pulleys	Nbp	0		
51	Number of take up pulleys	Ntup	0		
52	Number of snub pulleys	Nsp	1		

53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	399	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		Refer page 17 of IS 11592
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	2	degrees	
70	Length of conveyor equipped with tilted idlers	Li	76.454		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.55		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97		
75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	75	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	235	mm	p= 0.5 x (B -2c - lci)
79	Slope reduction for area S1	K	0.97		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.111	m^2	As per IS:11592:2000, Table-7
81	Skirt board width	b1	0.667	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.87	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**792.64**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.704		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	62.5	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.25	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	5548.87	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	5088.94	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	640	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	224.81	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}^{2} x $b1^2$]; Eqn 13 of IS 11592

92	Total wrap resistance for non-drive pulleys	Rw	315	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	100	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	1279.81	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	348.55	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	775.21	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	1950	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	3073.76	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	0	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**14991.38**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	47.97	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	49.026	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	4778.7	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	2840	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	8605.05	N	T2min= TE *Cw
109	Effective slackside tension	T2	8605.1	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	23596.4	N	T1= TE x (ξ x Cw + 1)
111	Component of main resistance of return belt	Rr	729.9	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	9.5	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	10442.8	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	8598.24	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	1.925	tons	CWt= 2 x Tt; Here HGTU is used; Hence additional 10% is considered for trolley movement resistance
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	1653.33	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	415	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	69.049	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	2019.05	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	4087.38	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	13.08	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	14.14	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	31841.69	N	T1s= TE x ξ+T2
124	Running tight side tension	T1	23596.43		
125	Running tight side tension per unit belt width	T1bw	23.60	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	28.32	kN/m	T1sbw= T1s/BW
127	Belt selected		**630/4**		
128	RMBT of the belt selected	RMBT	70	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.337		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**

130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.405		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		630	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	Full thickness tensile strength (for normal running case)		235.96	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT.**
135	Full thickness tensile strength (for startingcase)		222.89	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
136	Minimum pulley diameters recommended:				Phoenix Yule catalogue
137	Head pulley/Tail pulley/Take up		500	mm	
138	Bend pulleys		400	mm	
139	Snub Pulley		315	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**500**	**mm**	
142	**Tail Pulley**		**400**	**mm**	
143	**Take up pulley**		**0**	**mm**	
144	**Bend pulleys**		**0**	**mm**	
145	**Snub pulley**		**315**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur	48.85	m	
147	Vertical distance between the curve point and head end	Hcur	6.9		
148	Maximum tension at curve point	Rc	23886.60	N/m	Rc= {T1s-α{f x Lcur x g x (mG + mb + mc)- (Hcur x (mG+mb) x g)}/BW
149	Minimum radius to avoid lift off	Rmin-1	157.7	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es	6.5		As per annex G of IS 11592
151	Belt modulus	E	455	kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2	0.629	m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3	2.9915	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin	**157.7**		
	RADIUS CALCULATION (CONVEX)				
155	Minimum radius in relation to belt width	Rmin-1	12	m	Rmin-1=12* BW/1000
156	Horizontal distance between the curve point and head end	Lcur	0		
157	Vertical distance between the curve point and head end	Hcur	0		
158	Maximum unit tension at curve point	Tc	23.596	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}-(Hcur x mG x g)
159	Minimum radius to avoid over stress at centre of belt	Rmin-2	1.25	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
160	Minimum radius to avoid lack of stress at belt edge	Rmin-3	3.037	m	Rmin-3= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
161	Minimum radius selected	Rmin	**50**	m	
	POWER CALCULATION				
162	Required motor kW for loaded belt	Pm	52.11	kW	Pm= Pa/(ηg x ηc)
163	Required motor kW for empty belt	Pmo	15.024	kW	Pmo= Pdpo/(ηg x ηc)
164	Required motor power	Prm	62.53	kW	
165	**MOTOR SELECTED**		**75 kW @ 1500 rpm**		

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
	BASIC INPUTS				
1	Rated capacity of conveyor	Qr	600	TPH	
2	Design capacity of conveyor	C	720	TPH	
3	Belt width	B	1000	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m^3	
6	Lump size		(-) 20	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	332.901	m	
9	Material transportation length	Lt	331.15	m	
10	C-C distance between HP & TP (horizontal)	Lh	330.062	m	
11	Conveyor lift	H	16.6	m	
12	Vertical distance of belt from head pulley to take up pulley	Ht	3.3	m	
13	Distance of take up pulley from head pulley along belt	Lt	9.625	m	
14	Belt speed	V	3.2	m/s	
15	Conveyor slope	δ	9	degrees	
16	Number of feeding points	fp	4		
17	Length of skirt board per feed point	lsk'	4.5	m	
18	Total length of skirt board	Lsk	18	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	139.7	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	1		
24	Return idler tube diameter	Dri	139.7	mm	
25	Idler bearing diameter	db	25	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	1		
28	Pressure exerted by belt cleaner	P	50000	N/m^2	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	380	mm	
34	Roller length of return idler	lri	1150	mm	
35	Weight of rotating parts of Carrying idler	mc	25.6	kg/m	
36	Mass of rotating parts of return idlers	mr	17	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		
41	Unit weight of carcass	w'	5.6	kg/m^2	Assumed rating is 1000/4; Ref-Catalogue of Phoenix Yule.
42	Unit weight of rubber	w''	1.26	kg/m^2 per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.26 kg/m^2
43	Unit weight of belt	mb	16.94	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w''
44	Number of trippers	nt	0		
45	Tripper slope	Tra	0	degrees	
46	Factor for extra power for tripper	β	0		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.65		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	1		
49	Number of tail pulleys	Ntp	1		
50	Number of bend pulleys	Nbp	2		
51	Number of take up pulleys	Ntup	1		
52	Number of snub pulleys	Nsp	1		

53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	399	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		Refer page 17 of IS 11592
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	2	degrees	
70	Length of conveyor equipped with tilted idlers	Li	332.901		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.2		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97.5		
75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	75	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	235	mm	p= 0.5 x (B -2c - lci)
79	Slope reduction for area S1	K	0.95		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.11	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	0.667	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.87	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**776.29**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.71		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	62.5	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.25	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	22137.73	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	10177.88	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	640	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	224.81	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}^{2} x $b1^2$]; Eqn 13 of IS 11592

92	Total wrap resistance for non-drive pulleys	Rw	735	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	250	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	1849.81	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	1564.95	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	1162.82	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	1950	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	4677.77	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	0	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**38843.19**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	124.3	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	125.356	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	4870.67	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	3115.9	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	22296.0	N	T2min= TE x ξ*Cw
109	Effective slackside tension	T2	22296.0	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	61139.2	N	T1= TE x (ξ x Cw + 1)
111	Component of main resistance of return belt	Rr	3325.2	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	10.0	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	25797.6	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	22828.74	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	3.15	tons	CWt= 2 x Tt - 1.5 (assuming the weight of counter weight frame, take up pulley with frame adds out to be 1.5 ton)
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	7492.96	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	985	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	333.714	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	2283.71	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	10761.67	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	34.44	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	35.49	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	68907.82	N	T1s= T1 x ξ
124	Running tight side tension	T1	61139.18		
125	Running tight side tension per unit belt width	T1bw	61.14	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	73.37	kN/m	T1sbw= T1s/BW
127	Belt selected		**1000/4**		
128	RMBT of the belt selected	RMBT	110	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.556		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**

130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.667		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		1000	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	Full thickness tensile strength(for normal running case)		611.39	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT.**
135	Full thickness tensile strength (for startingcase)		482.35	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
136	Minimum pulley diameters recommended:				
137	Head pulley/Tail pulley/Take up		630	mm	
138	Bend pulleys		500	mm	
139	Snub Pulley		400	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**630**	**mm**	
142	**Tail Pulley**		**500**	**mm**	
143	**Take up pulley**		**500**	**mm**	
144	**Bend pulleys**		**400**	**mm**	
145	**Snub pulley**		**400**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur	147.65	m	
147	Vertical distance between the curve point and head end	Hcur	28		
148	Maximum tension at curve point	Rc	31787.40	N/m	Rc= {T1max-α{f x Lcur x g x (mG + mb + mc)- (Hcur x (mG+mb) x g)}/BW
149	Minimum radius to avoid lift off	Rmin-1	191.28	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es	6.5		As per annex G of IS 11592
151	Belt modulus	E	715	kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2	0.583	m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3	3.3398	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin	**191.28**		
	RADIUS CALCULATION (CONVEX)				
155	Minimum radius in relation to belt width	Rmin-1	12	m	Rmin-1=12* BW/1000
156	Horizontal distance between the curve point and head end	Lcur	15.625		
157	Vertical distance between the curve point and head end	Hcur	0		
158	Maximum unit tension at curve point	Tc	60.342	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}-(Hcur x mG x g)
159	Minimum radius to avoid over stress at centre of belt	Rmin-2	1.835	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
160	Minimum radius to avoid lack of stress at belt edge	Rmin-3	1.632	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
161	Minimum radius selected	Rmin	**50**	m	
	POWER CALCULATION				
162	Required motor kW for loaded belt	Pm	132.55	kW	Pm= Pa/(ηg x ηc)
163	Required motor kW for empty belt	Pmo	37.529	kW	Pmo= Pdpo/(ηg x ηc)
164	Required motor power	Prm	159.0564	kW	
165	**MOTOR SELECTED**		**170 kW @ 1500 rpm**		

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
		BASIC INPUTS			
1	Rated capacity of conveyor	Qr	600	TPH	
2	Design capacity of conveyor	C	720	TPH	
3	Belt width	B	1000	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m^3	
6	Lump size		(-) 20	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	61.365	m	
9	Material transportation length	Lt	57.865	m	
10	C-C distance between HP & TP (horizontal)	Lh	61.365	m	
11	Conveyor lift	H	7.05	m	
12	Vertical distance of belt from head pulley to take up pulley	Ht	5.55	m	
13	Distance of take up pulley from head pulley along belt	Lt	10	m	
14	Belt speed	V	3.2	m/s	
15	Conveyor slope	δ	13	degrees	
16	Number of feeding points	fp	2		
17	Length of skirt board per feed point	lsk'	4.5	m	
18	Total length of skirt board	Lsk	9	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	139.7	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	1		
24	Return idler tube diameter	Dri	139.7	mm	
25	Idler bearing diameter	db	25	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	1		
28	Pressure exerted by belt cleaner	P	50000	N/m^2	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	380	mm	
34	Roller length of return idler	lri	1150	mm	
35	Weight of rotating parts of Carrying idler	mc	25	kg/m	
36	Mass of rotating parts of return idlers	mr	12	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		
41	Unit weight of carcass	w'	4.1	kg/m^2	Assumed belt rating is 630/4. Ref-Phoenix Yule catalogue
42	Unit weight of rubber	w''	1.26	kg/m^2 per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.2 kg/m^2
43	Unit weight of belt	mb	15.44	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w''
44	Number of trippers	nt	0		
45	Tripper slope	Tra	0	degrees	
46	Factor for extra power for tripper	β	0		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.8		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	1		
49	Number of tail pulleys	Ntp	1		
50	Number of bend pulleys	Nbp	2		
51	Number of take up pulleys	Ntup	1		
52	Number of snub pulleys	Nsp	1		

53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	399	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		Refer page 17 of IS 11592
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.6		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	2	degrees	
70	Length of conveyor equipped with tilted idlers	Li	61.365		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.55		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97.5		
75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	75	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	235	mm	p= 0.5 x (B -2c - lci)
79	Slope reduction for area S1	K	0.95		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.11	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	0.667	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.87	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**776.29**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.71		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	62.5	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.25	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	4016.79	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	4322.53	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	640	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	224.81	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}² x $b1^2$]; Eqn 13 of IS 11592

92	Total wrap resistance for non-drive pulleys	Rw	735	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	250	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	1849.81	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	279.21	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	581.41	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	1800	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	2660.62	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	0	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**12849.75**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	41.12	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	42.176	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	4778.7	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	2840	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	7375.7565	N	T2min= TE x Cw
109	Effective slackside tension	T2	7375.8	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	20225.5	N	T1= TE x (Cw + 1)
111	Component of main resistance of return belt	Rr	495.6	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	8.1	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	9588.5	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	7600.88	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	0.05	tons	CWt= 2 x Tt - 1.5 (assuming the weight of counter weight frame, take up pulley with frame adds out to be 1.5 ton
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	1225.89	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	985	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	55.312	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	1855.31	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	4066.21	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	13.01	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	14.07	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	27292.87	N	T1s= TE x ξ+T2
124	Running tight side tension	T1	20225.51		
125	Running tight side tension per unit belt width	T1bw	20.23	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	24.27	kN/m	T1sbw= T1s/BW
127	Belt selected		**630/4**		
128	RMBT of the belt selected	RMBT	70	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.289		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**

130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.347		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		630	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	% of belt rating as per IS-11592 (for normal running case)		202.26	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT.**
135	% of belt rating as per IS-11592 (for startingcase)		191.05	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
136	Minimum pulley diameters recommended:				
137	Head pulley/Tail pulley/Take up		500	mm	
138	Bend pulleys		400	mm	
139	Snub Pulley		315	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**500**	**mm**	
142	**Tail Pulley**		**400**	**mm**	
143	**Take up pulley**		**400**	**mm**	
144	**Bend pulleys**		**315**	**mm**	
145	**Snub pulley**		**315**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur	36	m	
147	Vertical distance between the curve point and head end	Hcur	4.2		
148	Maximum tension at curve point	Rc	15051.10	N/m	Rc= {T1-α{f x Lcur x g x (mG + mb + mc)-(Hcur x (mG+mb) x g)}/BW
149	Minimum radius to avoid lift off	Rmin-1	99.37	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es	6.5		As per annex G of IS 11592
151	Belt modulus	E	455	kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2	0.528	m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3	5.497	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin	**99.37**		
	RADIUS CALCULATION (CONVEX)				
155	Minimum radius in relation to belt width	Rmin-1	12	m	Rmin-1=12* BW/1000
156	Horizontal distance between the curve point and head end	Lcur			
157	Vertical distance between the curve point and head end	Hcur			
158	Maximum unit tension at curve point	Tc	NA	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}-(Hcur x mG x g)
159	Minimum radius to avoid over stress at centre of belt	Rmin-2		m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
160	Minimum radius to avoid lack of stress at belt edge	Rmin-3		m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
161	Minimum radius selected	Rmin		m	
	POWER CALCULATION				
162	Required motor kW for loaded belt	Pm	44.60	kW	Pm= Pa/(ηg x ηc)
163	Required motor kW for empty belt	Pmo	14.875	kW	Pmo= Pdpo/(ηg x ηc)
164	Required motor power	Prm	53.514	kW	
165	**MOTOR SELECTED**		**55 kW @ 1500 rpm**		

CONVEYOR POWER CALCULATION FOR CONV-7A/7B

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
	BASIC INPUTS				
1	Rated capacity of conveyor	Qr	600	TPH	
2	Design capacity of conveyor	C	720	TPH	
3	Belt width	B	1000	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m^3	
6	Lump size		(-) 20	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	449.487	m	
9	Material transportation length	Lt	446.94	m	
10	C-C distance between HP & TP (horizontal)	Lh	447.555	m	
11	Conveyor lift	H	25	m	
12	Vertical distance of belt from head pulley to take up pulley	Ht	3.3	m	
13	Distance of take up pulley from head pulley along belt	Lt	7.525	m	
14	Belt speed	V	3.2	m/s	
15	Conveyor slope	δ	11	degrees	
16	Number of feeding points	fp	2		
17	Length of skirt board per feed point	lsk'	4.5	m	
18	Total length of skirt board	Lsk	9	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	139.7	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	1		
24	Return idler tube diameter	Dri	139.7	mm	
25	Idler bearing diameter	db	25	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	1		
28	Pressure exerted by belt cleaner	P	50000	N/m^2	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	380	mm	
34	Roller length of return idler	lri	1150	mm	
35	Weight of rotating parts of Carrying idler	mc	25.6	kg/m	
36	Mass of rotating parts of return idlers	mr	17	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		
41	Unit weight of carcass	w'	6.54	kg/m^2	Assumed belt rating is 1000/4; Reference- Belt catalogue of Oriental Rubber
42	Unit weight of rubber	w''	1.26	kg/m^2 per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.2 kg/m^2
43	Unit weight of belt	mb	17.88	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w''
44	Number of trippers	nt	0		
45	Tripper slope	Tra	0	degrees	
46	Factor for extra power for tripper	β	0		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.3		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	1		
49	Number of tail pulleys	Ntp	1		
50	Number of bend pulleys	Nbp	2		
51	Number of take up pulleys	Ntup	1		

52	Number of snub pulleys	Nsp	1		
53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	399	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		Refer page 17 of IS 11592
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	2	degrees	
70	Length of conveyor equipped with tilted idlers	Li	449.487		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.2		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97.5		
75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	75	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	235	mm	p= 0.5 x (B -2c - Ici)
79	Slope reduction for area S1	K	0.93		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.11	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	0.667	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.87	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**759.95**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.71		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	62.5	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.25	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	23718.75	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	15328.13	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	640	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	224.81	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}^{2} x $b1^2$]; Eqn 13 of IS 11592

92	Total wrap resistance for non-drive pulleys	Rw	735	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	250	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	1849.81	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	2124.90	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	581.41	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	1950	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	4656.31	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	0	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**45552.99**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	145.77	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	146.826	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	4928.3	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	3288.8	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	26147.4	N	T2min= TE xCw
109	Effective slackside tension	T2	26147.4	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	71700.4	N	T1= TE x (ξ x Cw + 1)
111	Component of main resistance of return belt	Rr	4614.1	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	10.3	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	29311.4	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	26630.83	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	3.93	tons	CWt= 2 x Tt - 1.5 (assuming the weight of counter weight frame, take up pulley with frame adds out to be 1.5 ton
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	10365.78	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	985	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	472.669	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	2422.67	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	13773.45	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	44.08	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	45.13	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	80811.00	N	T1s= TE x ξ+T2
124	Running tight side tension	T1	71700.41		
125	Running tight side tension per unit belt width	T1bw	71.70	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	86.04	kN/m	T1sbw= T1s/BW
127	Belt selected		**1000/4**		
128	RMBT of the belt selected	RMBT	110	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.652		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**

130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.782		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		1000	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	Full thickness tensile strength (for normal running case)		717.00	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT.**
135	Full thickness tensile strength (for startingcase)		565.68	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
136	Minimum pulley diameters recommended:				Oriental Rubber catalogue
137	Head pulley/Tail pulley/Take up		630	mm	
138	Bend pulleys		500	mm	
139	Snub Pulley		400	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**630**	**mm**	
142	**Tail Pulley**		**500**	**mm**	
143	**Take up pulley**		**500**	**mm**	
144	**Bend pulleys**		**400**	**mm**	
145	**Snub pulley**		**400**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur	147.65	m	
147	Vertical distance between the curve point and head end	Hcur	28		
148	Maximum tension at curve point	Rc	43634.90	N/m	Rc= {T1-α{f x Lcur x g x (mG + mb + mc)-(Hcur x (mG+mb) x g)}/BW
149	Minimum radius to avoid lift off	Rmin-1	248.77	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es	6.5		As per annex G of IS 11592
151	Belt modulus	E	715	kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2	0.687	m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3	2.3287	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin	**248.77**		
	RADIUS CALCULATION (CONVEX)				
155	Minimum radius in relation to belt width	Rmin-1	12	m	Rmin-1=12* BW/1000
156	Horizontal distance between the curve point and head end	Lcur	15.625		
157	Vertical distance between the curve point and head end	Hcur	0		
158	Maximum unit tension at curve point	Tc	71.067	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}-(Hcur x mG x g)
159	Minimum radius to avoid over stress at centre of belt	Rmin-2	2.341	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
160	Minimum radius to avoid lack of stress at belt edge	Rmin-3	1.369	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
161	Minimum radius selected	Rmin	**50**	m	
	POWER CALCULATION				
162	Required motor kW for loaded belt	Pm	155.25	kW	Pm= Pa/(ηg x ηc)
163	Required motor kW for empty belt	Pmo	47.72	kW	Pmo= Pdpo/(ηg x ηc)
164	Required motor power	Prm	186.2976	kW	
165	**MOTOR SELECTED**		**200 kW @ 1500 rpm**		

CONVEYOR POWER CALCULATION FOR CONV-8A/8B

DATE:-08.12.18

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
		BASIC INPUTS			
1	Rated capacity of conveyor	Qr	600	TPH	
2	Design capacity of conveyor	C	720	TPH	
3	Belt width	B	1000	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m^3	
6	Lump size		(-) 20	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	179.042	m	
9	Material transportation length	Lt	176.542	m	
10	C-C distance between HP & TP (horizontal)	Lh	182.917	m	
11	Conveyor lift	H	35.3	m	
12	Vertical distance of belt from head pulley to take up pulley	Ht	5.3	m	
13	Distance of take up pulley from head pulley along belt	Lt	19.375	m	
14	Belt speed	V	3.2	m/s	
15	Conveyor slope	δ	13	degrees	
16	Number of feeding points	fp	2		
17	Length of skirt board per feed point	lsk'	4.5	m	
18	Total length of skirt board	Lsk	9	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	139.7	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	1		
24	Return idler tube diameter	Dri	139.7	mm	
25	Idler bearing diameter	db	25	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	1		
28	Pressure exerted by belt cleaner	P	50000	N/m^2	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	380	mm	
34	Roller length of return idler	lri	1150	mm	
35	Weight of rotating parts of Carrying idler	mc	25.6	kg/m	
36	Mass of rotating parts of return idlers	mr	12	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		
41	Unit weight of carcass	w'	5.6	kg/m^2	Assuming a belt rating of 1000/4: Ref-Oriental Rubber catalogue
42	Unit weight of rubber	w''	1.26	kg/m^2 per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.26 kg/m^2
43	Unit weight of belt	mb	16.94	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w''
44	Number of trippers	nt	0		
45	Tripper slope	Tra	0	degrees	
46	Factor for extra power for tripper	β	0		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.8		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	1		
49	Number of tail pulleys	Ntp	1		
50	Number of bend pulleys	Nbp	2		
51	Number of take up pulleys	Ntup	1		
52	Number of snub pulleys	Nsp	1		

53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	399	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		Refer page 17 of IS 11592
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	2	degrees	
70	Length of conveyor equipped with tilted idlers	Li	179.042		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.2		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97		
75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	75	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	235	mm	p= 0.5 x (B -2c - lci)
79	Slope reduction for area S1	K	0.91		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.11	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	0.667	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.87	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**743.61**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.71		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	62.5	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.25	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	12301.09	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	21643.31	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	640	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	224.81	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}² x $b1^2$]; Eqn 13 of IS 11592

92	Total wrap resistance for non-drive pulleys	Rw	735	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	250	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	1849.81	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	830.32	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	581.41	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	1950	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	3361.73	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	0	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**39155.94**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	125.3	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	126.356	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	4870.67	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	3115.9	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	22475.51	N	T2min= TE *Cw
109	Effective slackside tension	T2	22475.5	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	61631.4	N	T1= TE x (Cw + 1)
111	Component of main resistance of return belt	Rr	1524.9	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	8.5	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	21069.2	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	22744.77	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	3.14	tons	CWt= 2 x Tt - 1.5 (assuming the weight of counter weight frame, take up pulley with frame adds out to be 1.5 ton
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	3766.43	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	985	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	177.059	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	2127.06	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	6878.49	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	22.01	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	23.07	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	69462.64	N	T1s= TE x ξ+T2
124	Running tight side tension	T1	61631.45		
125	Running tight side tension per unit belt width	T1bw	61.63	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	73.96	kN/m	T1sbw= T1s/BW
127	Belt selected		**1000/4**		
128	RMBT of the belt selected	RMBT	110	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.56		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**

130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.672		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		1000	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	Full thickness tensile strength (for normal running case)		616.31	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT.**
135	Full thickness tensile strength (for startingcase)		486.24	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
136	Minimum pulley diameters recommended:				Phoenix Yule catalogue
137	Head pulley/Tail pulley/Take up		630	mm	
138	Bend pulleys		500	mm	
139	Snub Pulley		400	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**630**	**mm**	
142	**Tail Pulley**		**500**	**mm**	
143	**Take up pulley**		**500**	**mm**	
144	**Bend pulleys**		**400**	**mm**	
145	**Snub pulley**		**400**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur	159	m	
147	Vertical distance between the curve point and head end	Hcur	26.524		
148	Maximum tension at curve point	Rc	32113.70	N/m	Rc= {T1-α{f x Lcur x g x (mG + mb + mc)-(Hcur x (mG+mb) x g)}/BW
149	Minimum radius to avoid lift off	Rmin-1	193.24	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es	6.5		As per annex G of IS 11592
151	Belt modulus	E	715	kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2	0.585	m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3	3.3004	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin	**193.24**		
	RADIUS CALCULATION (CONVEX)				
155	Minimum radius in relation to belt width	Rmin-1	12	m	Rmin-1=12* BW/1000
156	Horizontal distance between the curve point and head end	Lcur	7		
157	Vertical distance between the curve point and head end	Hcur	0		
158	Maximum unit tension at curve point	Tc	61.242	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}-(Hcur x mG x g)
159	Minimum radius to avoid over stress at centre of belt	Rmin-2	1.869	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
160	Minimum radius to avoid lack of stress at belt edge	Rmin-3	1.606	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
161	Minimum radius selected	Rmin	**50**	m	
	POWER CALCULATION				
162	Required motor kW for loaded belt	Pm	134.29	kW	Pm= Pa/(ηg x ηc)
163	Required motor kW for empty belt	Pmo	24.516	kW	Pmo= Pdpo/(ηg x ηc)
164	Required motor power	Prm	161.1516	kW	
165	**MOTOR SELECTED**		**170 kW @ 1500 rpm**		

CONVEYOR POWER CALCULATION FOR CONV-8C/8D (tripper conveyors)

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
	BASIC INPUTS				
1	Rated capacity of conveyor	Qr	600	TPH	
2	Design capacity of conveyor	C	720	TPH	
3	Belt width	B	1000	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m^3	
6	Lump size		(-) 20	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	80.09	m	
9	Material transportation length	Lt	77.994	m	
10	C-C distance between HP & TP (horizontal)	Lh	80.494	m	
11	Conveyor lift	H	7.743	m	Considering a conveyor lift of 2.943m & Tripper lift of 4.8m
12	Vertical distance of belt from head pulley to take up pulley	Ht	6	m	
13	Distance of take up pulley from head pulley along belt	Lt	76	m	
14	Belt speed	V	3.2	m/s	
15	Conveyor slope	δ	14	degrees	
16	Number of feeding points	fp	2		
17	Length of skirt board per feed point	lsk'	4.5	m	
18	Total length of skirt board	Lsk	9	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	139.7	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	1		
24	Return idler tube diameter	Dri	139.7	mm	
25	Idler bearing diameter	db	25	mm	
26	Number of external scrappers	Ns (ex)	3		
27	Number of internal scrappers	Ns (in)	1		
28	Pressure exerted by belt cleaner	P	50000	N/m^2	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	380	mm	
34	Roller length of return idler	lri	1150	mm	
35	Weight of rotating parts of Carrying idler	mc	25.6	kg/m	
36	Mass of rotating parts of return idlers	mr	12	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		
41	Unit weight of carcass	w'	4.1	kg/m^2	Assuming a belt rating of 630/4: Reference- Belt catalogue of Phoenix Yule
42	Unit weight of rubber	w''	1.26	kg/m^2 per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.26 kg/m^2
43	Unit weight of belt	mb	15.44	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w''
44	Number of trippers	nt	1		
45	Tripper slope	Tra	15	degrees	
46	Factor for extra power for tripper	β	7		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.85		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	1		
49	Number of tail pulleys	Ntp	1		
50	Number of bend pulleys	Nbp	1		

CONVEYOR POWER CALCULATION FOR CONV-8C/8D (tripper conveyors)

51	Number of take up pulleys	Ntup	1		
52	Number of snub pulleys	Nsp	1		
53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	399	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		Refer page 17 of IS 11592
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	2	degrees	
70	Length of conveyor equipped with tilted idlers	Li	80.09		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.5		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97		
75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	75	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	235	mm	p= 0.5 x (B -2c - lci)
79	Slope reduction for area S1	K	0.91		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.11	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	0.667	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.87	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**743.61**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.71		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	62.5	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.25	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	5472.58	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	4747.43	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	640	N	Ra= Q x 1000 x ρ x (V-Vo);

91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	224.81	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}² x $b1^2$]; Eqn 13 of IS 11592
92	Total wrap resistance for non-drive pulleys	Rw	595	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	200	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	1659.81	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	362.89	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	581.41	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	2600	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	3544.30	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	1079.687831	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**16503.8**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	52.81	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	53.866	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	4778.7	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	2840	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	9473.2	N	T2min= TE xCw
109	Effective slackside tension	T2	9473.2	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	25977.0	N	T1= TE x (Cw + 1)
111	Component of main resistance of return belt	Rr	646.8	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	8.1	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	12342.2	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	9973.16	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	0.53	tons	CWt= 2 x Tt - 1.5 (assuming the weight of counter weight frame, take up pulley with frame adds out to be 1.5 ton
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	1614.11	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	795	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	71.888	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	2671.89	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	5080.99	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	16.26	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	17.32	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	34228.88	N	T1s= TE x ξ+T2
124	Running tight side tension	T1	25976.98		
125	Running tight side tension per unit belt width	T1bw	25.98	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	31.17	kN/m	T1sbw= T1s/BW
127	Belt selected		**630/4**		
128	RMBT of the belt selected	RMBT	70	kN/m	

129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.371		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**
130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.445		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		630	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	% of belt rating as per IS-11592 (for normal running case)		259.77	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT.**
135	% of belt rating as per IS-11592 (for startingcase)		239.60	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
136	Minimum pulley diameters recommended:				
137	Head pulley/Tail pulley/Take up		500	mm	
138	Bend pulleys		400	mm	
139	Snub Pulley		315	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**500**	**mm**	
142	**Tail Pulley**		**400**	**mm**	
143	**Take up pulley**		**400**	**mm**	
144	**Bend pulleys**		**315**	**mm**	
145	**Snub pulley**		**315**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur	67	m	
147	Vertical distance between the curve point and head end	Hcur	2		
148	Maximum tension at curve point	Rc	20670.80	N/m	Rc=
149	Minimum radius to avoid lift off	Rmin-1	136.47	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es	6.5		As per annex G of IS 11592
151	Belt modulus	E	455	kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2	0.588	m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3	3.5864	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin	**136.47**	m	
	RADIUS CALCULATION (CONVEX)				
155	Horizontal distance between the curve point and head end	Lcur	67.34		
156	Vertical distance between the curve point and head end	Hcur	6.7		
157	Maximum unit tension at curve point	Tc	18.073	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}-(Hcur x mG x g)
158	Minimum radius to avoid over stress at centre of belt	Rmin-2	1.117	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
159	Minimum radius to avoid lack of stress at belt edge	Rmin-3	4.273	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
160	Minimum radius selected	Rmin	**50**	m	
	POWER CALCULATION				
161	Required motor kW for loaded belt	Pm	57.25	kW	Pm= Pa/(ηg x ηc)
162	Required motor kW for empty belt	Pmo	18.403	kW	Pmo= Pdpo/(ηg x ηc)
163	Required motor power	Prm	68.70	kW	
164	**MOTOR SELECTED**		**75 kW @ 1500 rpm**		

CONVEYOR POWER CALCULATION FOR CONV-9

DATE:- 08-12-18

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
		BASIC INPUTS			
1	Rated capacity of conveyor	Qr	600	TPH	
2	Design capacity of conveyor	C	720	TPH	
3	Belt width	B	1000	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m^3	
6	Lump size		(-) 20	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	139.395	m	
9	Material transportation length	Lt	134.935	m	
10	C-C distance between HP & TP (horizontal)	Lh	137.375	m	
11	Conveyor lift	H	21.3	m	
12	Vertical distance of belt from head pulley to take up pulley	Ht	3.5	m	
13	Distance of take up pulley from head pulley along belt	Lt	7.91	m	
14	Belt speed	V	3.2	m/s	
15	Conveyor slope	δ	12	degrees	
16	Number of feeding points	fp	2		
17	Length of skirt board per feed point	lsk'	4.5	m	
18	Total length of skirt board	Lsk	9	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	139.7	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	1		
24	Return idler tube diameter	Dri	139.7	mm	
25	Idler bearing diameter	db	25	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	1		
28	Pressure exerted by belt cleaner	P	50000	N/m^2	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	380	mm	
34	Roller length of return idler	lri	1150	mm	
35	Weight of rotating parts of Carrying idler	mc	25.6	kg/m	
36	Mass of rotating parts of return idlers	mr	17	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		FR grade
41	Unit weight of carcass	w'	4.1	kg/m^2	Assumed belt rating is 630/4; As per Phoenix Yule catalogue
42	Unit weight of rubber	w''	1.26	kg/m^2 per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.2 kg/m^2
43	Unit weight of belt	mb	15.44	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w''
44	Number of trippers	nt	0		
45	Tripper slope	Tra	0	degrees	
46	Factor for extra power for tripper	β	0		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.65		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	1		
49	Number of tail pulleys	Ntp	1		
50	Number of bend pulleys	Nbp	2		
51	Number of take up pulleys	Ntup	1		
52	Number of snub pulleys	Nsp	1		

53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	399	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		Refer page 17 of IS 11592
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	2	degrees	
70	Length of conveyor equipped with tilted idlers	Li	139.395		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.35		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97.5		
75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	75	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	235	mm	p= 0.5 x (B -2c - lci)
79	Slope reduction for area S1	K	0.94		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.11	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	0.667	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.87	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**768.12**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.71		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	62.5	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.25	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	8870.88	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	13059.56	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	640	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	224.81	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}^{2} x $b1^2$]; Eqn 13 of IS 11592

92	Total wrap resistance for non-drive pulleys	Rw	735	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	250	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	1849.81	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	636.71	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	581.41	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	1950	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	3168.12	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	0	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**26948.37**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	86.23	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	87.286	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	4778.7	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	2840	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	15468.36	N	T2min= TE x Cw
109	Effective slackside tension	T2	15468.4	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	42416.7	N	T1= TE x (Cw + 1)
111	Component of main resistance of return belt	Rr	1330.8	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	9.5	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	16507.9	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	15998.75	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	3.52	tons	CWt= 2 x Tt - 1.5 (assuming the weight of counter weight frame, take up pulley with frame adds out to be 1.5 ton). Double take up pulley arrangement
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	3014.44	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	985	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	126.132	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	2076.13	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	6075.57	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	19.44	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	20.50	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	51848.66	N	T1s= TE x ξ+T2
124	Running tight side tension	T1	42416.73	N	
125	Running tight side tension per unit belt width	T1bw	42.42	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	50.90	kN/m	T1sbw= T1s/BW
127	Belt selected		**630/4**		
128	RMBT of the belt selected	RMBT	70	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.606		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**

130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.727		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		630	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	Full thickness tensile strength(for normal running case)		424.17	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT.**
135	Full thickness tensile strength (for startingcase)		362.94	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
136	Minimum pulley diameters recommended:				Oriental Rubber catalogue
137	Head pulley/Tail pulley/Take up		400	mm	
138	Bend pulleys		315	mm	
139	Snub Pulley		250	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**630**	**mm**	
142	**Tail Pulley**		**500**	**mm**	
143	**Take up pulley**		**500**	**mm**	
144	**Bend pulleys**		**400**	**mm**	
145	**Snub pulley**		**400**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur	57.5	m	
147	Vertical distance between the curve point and head end	Hcur	12.8		
148	Maximum tension at curve point	Rc	29739.00	N/m	Rc= {T1max-α{f x Lcur x g x (mG + mb + mc)- (Hcur x (mG+mb) x g)}/BW
149	Minimum radius to avoid lift off	Rmin-1	196.34	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es	6.5		As per annex G of IS 11592
151	Belt modulus	E	455	kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2	0.72	m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3	2.2978	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin	**196.34**		
	RADIUS CALCULATION (CONVEX)				
155	Minimum radius in relation to belt width	Rmin-1	12	m	Rmin-1=12* BW/1000
156	Horizontal distance between the curve point and head end	Lcur	23		
157	Vertical distance between the curve point and head end	Hcur	2		
158	Maximum unit tension at curve point	Tc	40.034	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}-(Hcur x mG x g)
159	Minimum radius to avoid over stress at centre of belt	Rmin-2	1.935	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
160	Minimum radius to avoid lack of stress at belt edge	Rmin-3	1.632	m	Rmin-3= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
161	Minimum radius selected	Rmin	**50**	m	
	POWER CALCULATION				
162	Required motor kW for loaded belt	Pm	92.29	kW	Pm= Pa/(ηg x ηc)
163	Required motor kW for empty belt	Pmo	21.674	kW	Pmo= Pdpo/(ηg x ηc)
164	Required motor power	Prm	110.7516	kW	
165	**MOTOR SELECTED**		**132 kW @ 1500 rpm**		

CONVEYOR POWER CALCULATION FOR CONV-10

DATE:- 08-12-18

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
		BASIC INPUTS			
1	Rated capacity of conveyor	Qr	600	TPH	
2	Design capacity of conveyor	C	720	TPH	
3	Belt width	B	1000	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m^3	
6	Lump size		(-) 20	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	139.395	m	
9	Material transportation length	Lt	134.935	m	
10	C-C distance between HP & TP (horizontal)	Lh	137.375	m	
11	Conveyor lift	H	21.3	m	
12	Vertical distance of belt from head pulley to take up pulley	Ht	3.5	m	
13	Distance of take up pulley from head pulley along belt	Lt	7.91	m	
14	Belt speed	V	3.2	m/s	
15	Conveyor slope	δ	12	degrees	
16	Number of feeding points	fp	2		
17	Length of skirt board per feed point	lsk'	4.5	m	
18	Total length of skirt board	Lsk	9	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	139.7	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	1		
24	Return idler tube diameter	Dri	139.7	mm	
25	Idler bearing diameter	db	25	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	1		
28	Pressure exerted by belt cleaner	P	50000	N/m^2	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	380	mm	
34	Roller length of return idler	lri	1150	mm	
35	Weight of rotating parts of Carrying idler	mc	25.6	kg/m	
36	Mass of rotating parts of return idlers	mr	17	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	6	mm	
39	Bottom cover thickness of belt	BCW	3	mm	
40	Carcass material		Nylon/Nylon		FR grade
41	Unit weight of carcass	w'	4.1	kg/m^2	Assumed belt rating is 630/4; As per Phoenix Yule catalogue
42	Unit weight of rubber	w''	1.26	kg/m^2 per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.2 kg/m^2
43	Unit weight of belt	mb	15.44	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w''
44	Number of trippers	nt	0		
45	Tripper slope	Tra	0	degrees	
46	Factor for extra power for tripper	β	0		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1.65		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	1		
49	Number of tail pulleys	Ntp	1		
50	Number of bend pulleys	Nbp	2		
51	Number of take up pulleys	Ntup	1		
52	Number of snub pulleys	Nsp	1		

53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	399	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		Refer page 17 of IS 11592
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		
66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	2	degrees	
70	Length of conveyor equipped with tilted idlers	Li	139.395		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.35		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97.5		
75	Drive efficiency of coupling	ηc	97		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	75	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	235	mm	p= 0.5 x (B -2c - lci)
79	Slope reduction for area S1	K	0.94		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.11	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	0.667	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.87	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**768.12**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.71		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	62.5	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.25	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	8870.88	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	13059.56	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	640	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	224.81	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}^{2} x $b1^2$]; Eqn 13 of IS 11592

92	Total wrap resistance for non-drive pulleys	Rw	735	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	250	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	1849.81	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	636.71	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	581.41	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	1950	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	3168.12	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	0	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**26948.37**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	86.23	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	87.286	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	4778.7	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	2840	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	15468.4	N	T2min= TE x Cw
109	Effective slackside tension	T2	15468.4	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	42416.7	N	T1= TE x (Cw + 1)
111	Component of main resistance of return belt	Rr	1330.8	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	9.5	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	16507.9	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	15998.75	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	3.52	tons	CWt= 2 x Tt - 1.5 (assuming the weight of counter weight frame, take up pulley with frame adds out to be 1.5 ton). Double take up pulley arrangement
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	3014.44	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	985	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	126.132	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	2076.13	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	6075.57	N	Teo= Ro + Rso + Rspo
121	Power required to overcome the resistance for empty belt	Pdpo	19.44	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	20.50	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	51848.66	N	T1s= TE X ξ+T2
124	Running tight side tension	T1	42416.73	N	
125	Running tight side tension per unit belt width	T1bw	42.42	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	50.90	kN/m	T1sbw= T1s/BW
127	Belt selected		**630/4**		
128	RMBT of the belt selected	RMBT	70	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.606		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**

130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.727		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		630	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	Full thickness tensile strength(for normal running case)		424.17	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT.**
135	Full thickness tensile strength (for startingcase)		362.94	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
136	Minimum pulley diameters recommended:				Phoenix Yule catalogue
137	Head pulley/Tail pulley/Take up		400	mm	
138	Bend pulleys		315	mm	
139	Snub Pulley		250	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**630**	**mm**	
142	**Tail Pulley**		**500**	**mm**	
143	**Take up pulley**		**500**	**mm**	
144	**Bend pulleys**		**400**	**mm**	
145	**Snub pulley**		**400**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur	57.5	m	
147	Vertical distance between the curve point and head end	Hcur	12.8		
148	Maximum tension at curve point	Rc	29739.00	N/m	Rc= {T1max-α{f x Lcur x g x (mG + mb + mc)- (Hcur x (mG+mb) x g)}/BW
149	Minimum radius to avoid lift off	Rmin-1	196.34	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es	6.5		As per annex G of IS 11592
151	Belt modulus	E	455	kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2	0.72	m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3	2.2978	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin	**196.34**		
	RADIUS CALCULATION (CONVEX)				
155	Minimum radius in relation to belt width	Rmin-1	12	m	Rmin-1=12* BW/1000
156	Horizontal distance between the curve point and head end	Lcur	23		
157	Vertical distance between the curve point and head end	Hcur	2		
158	Maximum unit tension at curve point	Tc	40.034	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}-(Hcur x mG x g)
159	Minimum radius to avoid over stress at centre of belt	Rmin-2	1.935	m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
160	Minimum radius to avoid lack of stress at belt edge	Rmin-3	1.632	m	Rmin-3= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
161	Minimum radius selected	Rmin	**50**	m	
	POWER CALCULATION				
162	Required motor kW for loaded belt	Pm	92.29	kW	Pm= Pa/(ηg x ηc)
163	Required motor kW for empty belt	Pmo	21.674	kW	Pmo= Pdpo/(ηg x ηc)
164	Required motor power	Prm	110.7516	kW	
165	**MOTOR SELECTED**		**132 kW @ 1500 rpm**		

SL NO	DESCRIPTION	SYMBOL	VALUE	UNIT	REMARK/REFERENCE
			BASIC INPUTS		
1	Rated capacity of conveyor	Qr	600	TPH	
2	Design capacity of conveyor	C	720	TPH	
3	Belt width	B	1800	mm	
4	Material conveyed		Coal		
5	Bulk density	ρ	0.8	t/m³	
6	Lump size		(-) 250	mm	
7	Surcharge angle of the material	Ψ	20	degrees	
8	W.P to W.P distance along the conveyor belt	L	8	m	
9	Material transportation length	Lt	7.3	m	
10	C-C distance between HP & TP (horizontal)	Lh	8.3	m	
11	Conveyor lift	H	0	m	
12	Vertical distance of belt from head pulley to take up pulley	Ht	0	m	NOT APPLICABLE (SCREW TAKE UP)
13	Distance of take up pulley from head pulley along belt	Lt	0	m	NOT APPLICABLE (SCREW TAKE UP)
14	Belt speed	V	1	m/s	
15	Conveyor slope	δ	0	degrees	
16	Number of feeding points	fp	2		
17	Length of skirt board per feed point	lsk'	7	m	
18	Total length of skirt board	Lsk	9	m	
19	Recommended filling factor	Ff	80	%	
20	Idler troughing angle	λ	35	degrees	
21	Carrying idler tube diameter	Dci	152.4	mm	
22	Number of rollers per set in carrying idlers	Nci	3		
23	Number of rollers per set in return idlers	Nri	2		
24	Return idler tube diameter	Dri	152.4	mm	
25	Idler bearing diameter	db	30	mm	
26	Number of external scrappers	Ns (ex)	2		
27	Number of internal scrappers	Ns (in)	1		
28	Pressure exerted by belt cleaner	P	50000	N/m²	
29	Carrying idler pitch	Pc	1	m	
30	Return idler picth	Pr	3	m	
31	ERW pipe thickness of carrying idler	Tci	5.4	mm	
32	ERW pipe thickness of return idler	Tri	5.4	mm	
33	Roller length of carrying idler	lci	670	mm	
34	Roller length of return idler	lri	2000	mm	
35	Weight of rotating parts of Carrying idler	mc	52	kg/m	
36	Mass of rotating parts of return idlers	mr	32	kg/m	
37	Duty range of belt selected		HD		
38	Top cover thickness of belt	TCW	8	mm	
39	Bottom cover thickness of belt	BCW	4	mm	
40	Carcass material		Nylon/Nylon		
41	Unit weight of carcass	w'	5.92	kg/m²	
42	Unit weight of rubber	w''	1.26	kg/m² per mm cover	Nominal carcass weight per mm thickness of cover may be taken as 1.26 kg/m²
43	Unit weight of belt	mb	37.872	kg/m	mb= (w' x B)/1000 + (TCW + BCW) x B/1000 x w''
44	Number of trippers	nt	0		
45	Tripper slope	Tra	0	degrees	
46	Factor for extra power for tripper	β	0		Table 13 of table 14 of IS 11592
47	Conveyor coeficient which is a function of length	α	1		Ref fig 6 page 17 of IS 11592
48	Number of drive pulleys	Ndp	1		
49	Number of tail pulleys	Ntp	1		
50	Number of bend pulleys	Nbp	0		
51	Number of take up pulleys	Ntup	0		
52	Number of snub pulleys	Nsp	1		
53	Wrap resistance for each drive pulley	Wrdp	230	N	
54	Wrap resistance for each tail pulley	Wrtp	175	N	
55	Wrap resistance for each bend pulley	Wrbp	140	N	
56	Wrap resistance for each take up pulley	Wrtup	140	N	
57	Wrap resistance for each snub pulley	Wrsp	140	N	
58	Permissible sag	s	2	%	
59	Wrap angle	ϕ	210	degrees	
60	Trough factor	Ci	0.5		Refer page 17 of IS 11592
61	Maximum capacity of conveyor for given belt width and surcharge angle of material	Cmax'	1382	TPH	Refer table 10, Page 12 of IS 11592
62	Artificial friction coeficient	f	0.03		
63	Coefficient of friction between pulley and belt	μ	0.275		
64	Coefficient of friction between carrying idlers and belt	μ0	0.35		
65	Coefficient of friction between carrying material and belt	μ1	0.6		Refer page 17 of IS 11592

66	Coefficient of friction between carrying material and skirt board	μ2	0.6		
67	Coefficient of friction between belt and belt cleaner	μ3	0.65		
68	Coefficient of idler tilting	μ4	0.5		
69	Angle of carrying idler tilting in forward direction	i	2	degrees	
70	Length of conveyor equipped with tilted idlers	Li	8		
71	Thickness of cleaning tip of scrapper	tc	20	mm	
72	Material speed component in belt direction	Vo	0	m/s	To consider the case with maximum acceleration
73	Drive coeficient	ξ	1.5		Refer table 15 of IS 11592
74	Drive efficiency of gearbox	ηg	97		
75	Drive efficiency of coupling	ηc	94		
76	Minimum margin over shaft power	Fmp	20		
	PRELIMINARY CALCULATIONS				
77	Edge clearance on belt	c	115	mm	c= 0.05B + 25
78	Material contact portion on troughed portion of belt	p	450	mm	p= 0.5 x (B -2c - lci)
79	Slope reduction for area S1	K	1		As per IS:11592:2000, page -11, Table-9
80	Area of cross section	A	0.324	m^2	As per IS:11592:2000, page -11, Table-7
81	Skirt board width	b1	1.2	m	b1= (2/3) x (B/1000)
82	Acceleration length at loading point	la	0.085	m	la= (v^2 - vo^2)/(2 x g x μ1)
83	Fill factor	Ff	0.8		As per tender specification
84	Maximum capacity of conveyor	Cmax	**884.48**	TPH	**Cmax= Cmax' x v x ρ x K x Ff; The value obtained is more than the design capacity**
85	Actual filling factor	Af	0.772		Af= (C/(3600 x ρ x A x v)
86	Unit weight of material	mG	200	kg/m	mG= C/(3.6 x V)
87	Volumetric conveyor capacity	Q	0.25	m^3/s	Q= (mG x v)/ρ
	CALCULATION FOR LOADED CONDITION				
88	Main resistance	R	805.78	N	R=[f x g x {(mc+m+2mb) x L + (mg x Lt)}] x α x cosδ; Refer clause 8.5.1.1 of IS 11592
89	Slope resistance	Rsl	0.00	N	Rsl= mG x H x g; Equation 7 of IS 11592
90	Inertial and frictional resistance at the loading point in the acceleration zone between belt and material	Ra	200	N	Ra= Q x 1000 x ρ x (V-Vo);
91	Frictional resistance between the material and skirt plate in the acceleration area	Rska	69.49	N	Rska= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/[{(V+Vo)/2}^{2} x $b1^2$]; Eqn 13 of IS 11592
92	Total wrap resistance for non-drive pulleys	Rw	315	N	Rw= (Ntp x Wrtp+Nbp x Wrbp + Ntup x Wrtup + Nsp x Wrsp); Page 17 of IS 11592
93	Pulley bearing resistance	Rb	100	N	Rb= 50 x (Ntp + Nbp + Ntup + Nsp); 50 N is the bearing resistance per pulley
94	Secondary resistance	Rs	684.49	N	Rs= Ra + Rska + Rw + Rb; Refer eqn.11 of IS-11592
95	Resistance due to carrying idler tilting	Ric	114.01	N	Ric= g*Ci*μ0*L*(Mb+Mg)*cosδ*sin i
96	Resistance due to friction between handled material and skirt plate	Rsk	1839.38	N	Rsk= (μ2 x Q^2 x 1000 x ρ x 9.81 x la)/(V^2 x $b1^2$)
97	Resistance due to belt cleaners	Rbc	3510	N	Rbc= A1 x μ3 x P x (Ns (ex) + Ns (in))
98	Special resistance	Rsp	5463.39	N	Rsp= Ric + Rsk + Rbc
99	Resistance offered by tripper	Rt	0	N	Rt= (R + Rsl + Rs + Rsp) x nt x Btp
100	Effective tension	TE	**6953.66**	N	TE= R + Rsl + Rs + Rsp + Rt
101	Power required to overcome the resistance for loaded condition	Pdp	6.95	kW	Pdp= TE x V/1000
102	Drive pulley bearing resistance	Rbd	100	N	
103	Wrap resistance of drive pulley	Rwd	230	N	
104	Absorbed power at pulley shaft	Pa	13.082615	kW	Pa= Pdp + {(Rbd + Rwd)/1000} x V+Power to over come shear (Annexure-1)
105	Minimum tensile force to limit the belt sag at carrying side	Tcmin	14584.53	N	Tcmin= Pc x (mb + mG) x 9.81/(8 x s)
106	Minimum tensile force to limit the belt sag at the return side	Trmin	6966.08	N	Trmin= Pr x (mb + mG) x 9.81/(8 x s)
107	Wrap factor	Cw	0.574		Cw= 1/(e^μ*ϕ - 1)
108	Slackside tension at drive pulley for transmission	T2min	3991.40	N	T2min= TE x Cw
109	Effective slackside tension	T2	6966.1	N	T2= Max(Trmin, T2min)
110	Tight side tension	T1	13919.7	N	T1= TE x (Cw + 1)
111	Component of main resistance of return belt	Rr	164.5	N	Rr= f x 9.81 x (mb + mr) x L
112	Component of main resistance of return belt per unit length	Rrs	20.6	N/m	Rrs= Rr/L
113	Tail pulley tension	T3	11055.6	N	T3= T2+ Rrs - (mB x g x H) + Rw + Rb +Rbc
114	Take up pulley tension	Tt	7381.08	N	Tt= T2 + Lt x Rrs- (mb x g x Ht) + 0.8 x (Rw + Rb) + Rbc
115	Tonnage of counter weights required	CWt	0	tons	CWt= 2 x Tt - 1.5 (assuming the weight of counter weight frame, take up pulley with frame adds out to be 1.5 ton
	CALCULATION FOR EMPTY CONDITION				
116	Main resistance without material	R0	376.10	N	R0= f x g {(mc + mr + 2 x mb) x L}x α
117	Secondary resistance without material	Rso	415	N	Rso= Rw + Rb
118	Resistance due to carrying idler tilting	Rio	18.152	N	Rio= g*Ci*μ0*L*(Mb)*cosδ*sin i
119	Special resistance without material	Rspo	3528.15	N	Rspo= Rio + Rbc
120	Effective tension without material	Teo	4319.25	N	Teo= Ro + Rso + Rspo

121	Power required to overcome the resistance for empty belt	Pdpo	4.32	kW	Pdpo= Teo x V/1000
122	Power absorbed at pulley shaft for empty belt	Pao	4.65	kW	Pao= Pdpo + {(Rbd + Rwd)/1000 x V}
	BELT & PULLEY SELECTION				
123	Starting tight side tension	T1s	17396.57	N	T1s= TEx ξ+T2
124	Running tight side tension	T1	13919.74		
125	Running tight side tension per unit belt width	T1bw	7.73	kN/m	T1bw= T1/BW
126	Starting belt tension per unit belt width	T1sbw	9.28	kN/m	T1sbw= T1s/BW
127	Belt selected		**1000/4**	kN/m	
128	RMBT of the belt selected	RMBT	110	kN/m	
129	Ratio of Running tight side tension per unit belt width to RMBT	R1	0.07		**R1= T1bw/ RMBT; R1<80%. Hence belt selected is OK for running conditions**
130	Ratio of starting tight side tension per unit belt width to RMBT	R2	0.084		**R2= T1sbw/ RMBT; R2<150%. Hence belt selected is OK for starting conditions**
131	Maximum belt rating		500	kN/m	
132	Factor of safety for normal operating case (as per 11592 belt selection procedure)	SF1	10		
133	Factor of safety for starting case (as per 11592 belt selection procedure)	SF2	7		
134	Full thickness tensile strength (for normal running case)		77.33	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width). The value is less than RMBT. Hence selection is OK**
135	Full thickness tensile strength (for startingcase)		67.65	kN/m	**As per clause no. 8.6.2.2. (Factor of safety x Maximum tension) / (belt width).The value is less than RMBT.Hence selection is OK**
136	Minimum pulley diameters recommended:				Phoenix Yule catalogue
137	Head pulley/Tail pulley/Take up		400	mm	
138	Bend pulleys		315	mm	
139	Snub Pulley		250	mm	
140	**Pulley diameters selected:**				
141	**Head pulley**		**500**	**mm**	
142	**Tail Pulley**		**400**	**mm**	
143	**Take up pulley**			**mm**	NOT APPLICABLE (SCREW TAKE UP)
144	**Bend pulleys**			**mm**	NOT APPLICABLE (SCREW TAKE UP)
145	**Snub pulley**		**315**	**mm**	
	RADIUS CALCULATION (CONCAVE)				
146	Horizontal distance between the curve point and head end	Lcur		m	
147	Vertical distance between the curve point and head end	Hcur			
148	Maximum tension at curve point	Rc		N/m	Rc= {T1-α{f x Lcur x g x (mG + mb + mc)- (Hcur x (mG+mb) x g)}/BW
149	Minimum radius to avoid lift off	Rmin-1	NA	m	Rc= (Tc x BW)/(9.81 x mb); As per IS 11592 eqn 41
150	Belt specific modulus	Es			As per annex G of IS 11592
151	Belt modulus	E		kN/m	E= Es x RMBT
152	Minimum radius to avoid over stress at centre of belt	Rmin-2		m	Rmin-2= B x E x sinλ/{1000 x 9 x (Tm - Tc)}
153	Minimum radius to avoid lack of stress at belt edge	Rmin-3		m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
154	Minimum radius to be selected	Rmin			
	RADIUS CALCULATION (CONVEX)				
155	Minimum radius in relation to belt width	Rmin-1	21.6	m	Rmin-1=12 BW/1000
156	Horizontal distance between the curve point and head end	Lcur			
157	Vertical distance between the curve point and head end	Hcur			
158	Maximum unit tension at curve point	Tc	NA	kN/m	Rc= T1-{f x Lcur x g x (mG + mb + mc)}- (Hcur x mG x g)
159	Minimum radius to avoid over stress at centre of belt	Rmin-2		m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tm - Tc)}
160	Minimum radius to avoid lack of stress at belt edge	Rmin-3		m	Rmin-2= B x E x sinλ/{1000 x 4.5 x (Tc-4.5)}
161	Minimum radius selected	Rmin		m	
	POWER CALCULATION				
162	Required motor kW for loaded belt	Pm	14.35	kW	Pm= Pa/(ηg x ηc)
163	Required motor kW for empty belt	Pmo	5.099	kW	Pmo= Pdpo/(ηg x ηc)
164	Required motor power	Prm	17.22	kW	Prm= Pmo x (1+Fmp/100)
165	**MOTOR SELECTED**		**22**	**kW @ 1500 rpm**	

ANNEXURE-1: POWER TO OVERCOME SHEAR CALCULATION					
1	Material conveyed		Coal		
2	Bulk density	ρ	0.8	t/m³	
3	Coefficient of internal friction of material	μ	0.65		
4	Angle of internal friction of material	ϕ	32.75	degrees	ϕ=tan-1(μ)
5	Length of feeding chute/hopper	Lh	3.5	m	
6	Width of feeding chute/hopper	b	1	m	
7	Height of surcharge material	h	0.325	m	h= (tanϕ x b)/2
8	Volume of surcharge material	V	0.56875	m³	V= 1/22 x (b x h x Lh)
9	Belt speed	v	1	m/s	
10	Number of chutes feeding to the belt feeder	n	2	nos	
11	Total volume of surcharge material	Vfs	1.1375	m³	Vfs= 2 x V; Considering chutes filled completely
12	Total weight of surcharge material	Q	0.91	tons	Q= Vfs x ρ
13	Resistance to shearing the material	Tq	5802.615	N	Tq= Q x 9810 N
14	Power required for material shearing	Pshear	5.802615	kW	Pshear= Tq x v/1000

TYPICAL GEARBOX SELECTION (CONV-7AB)

Date:-08-12-18

SL NO	DESCRIPTION	SYMBOL	UNIT	VALUE	REMARK
		INPUTS			
1	Motor kW rating	M	kW	200	
2	Absorbed power	Pa	kW	155.248	
3	Belt speed	V	m/s	3.2	
4	Rated speed of motor	N	RPM	1475	
5	Pulley diameter	D	mm	654	
		OUTPUTS			
6	Pulley RPM for attaining required belt speed	Np	RPM	93.45	Np=(V x 60)/(D x ∏ xN)
7	Required speed ratio	SR		15.8	SR=N/Np
8	Mechanical rating (Case-1)	MR-1	kW	250	MR-1=M x 1.5
9	Mechanical rating (Case-2)	MR-2	kW	232.87	MR-2=Pa x 1.8
10	Minimum required mechanical rating	MR	kW	250	MR= maximum of MR-1 & MR-2
11	Thermal rating at 20C operating conditions	TR	kW	285.71	TR=M/0.7
12	**Mechanical rating of the model selected**	**MRs**	**kW**	**276**	**MRs>MR**
13	**Thermal rating of the model selected at 20C**	**TRs**	**kW**	**470**	**TRs >TR**
14	**Speed ratio of the model selected**	**SRs**		**16.0:1**	**OK**
	HENCE THE MODEL__CKB315_ WITH FAN COOLING & RHB SELECTED IS OK (NAW)				

SL NO	DESCRIPTION	SYMBOL	UNIT	VALUE	REMARK
INPUTS					
1	Motor kW rating	M	kW	200	
2	Type of fluid coupling	SCOOP TYPE FLUID COUPLING			
3	If scoop type, type of cooling required	AIR COOLED			
4	Syn.speed of motor	N	RPM		1500
OUTPUTS					
5	**Maximum power that can be transmitted at the syn.speed of motor of model selected**	**MRs**	**kW**	**205**	**MRs>MR**
HENCE THE MODEL_SC-9(FLUIDOMAT MAKE)___ SELECTED IS OK					

TYPICAL SELECTION OF GEAR COUPLING (CONV 7A/B)

Date:- 08-12-18

SL NO	DESCRIPTION	SYMBOL	UNIT	VALUE	REMARK
		INPUTS			
1	Motor kW rating	M	kW	200	
2	Power in HP	M'	HP	266.67	
3	Service factor	SF		1.5	
4	Pulley RPM	Np	RPM	93.45	
5	Pulley shaft diameter	Dp	mm	180	
		OUTPUTS			
6	kW per 100 RPM	kW/100 RPM	kW/100 RPM	321.03	HP/100 RPM= M' x SF x100/Np
7	Maximum torque in kg-m	Tmax	kg-m	2145.91	Tmax=M x 60000/(2∏Np x 9.81) kg-m
12	**Kw per 100 RPM of model selected**	**kW/100 RPMs**	**kW/100 RPM**	**390**	
13	**Maximum torque in kg-m of model selected**	**Tmaxs**	**kg-m**	**3725**	
14	**Hub inner diameter of the model selected**	**Dps**	**mm**	**130**	
		HENCE THE MODEL__FGC-7(FENNER)_ SELECTED IS OK			

COASTING TIME CALCULATION-NSPCL TPP

SL NO	DESCRIPTION	SYMBOL	FORMULA	UOM	REF	1A/B	2A/B	3A/B	4A	9	10	5A/B	6A/B	7A/B	8A/B	8C/D	4B	6C
1	GD^2 value of the motor at sync.speed	MG		kg-m^2	17	1.85	56	8.1	14.77	8.1	8.1	4.44	23	36	23	4.44	7.385	2.252
2	Type of HS coupling				Scoop type	Delayed fill chamber type	Scoop type	Delayed fill chamber type	Delayed fill chamber type	Delayed fill chamber type	Delayed fill chamber type	Delayed fill chamber type	Scoop type	Scoop type	Scoop type	Delayed fill chamber type	Delayed fill chamber type	Delayed fill chamber type
3	Fluid coupling primary side GD^2 value at motor RPM	FG1		kg-m^2	13.57	10.44	40.9	12.24	24.48	12.24	12.24	10.44	17.7	17.7	17.7	10.44	10.44	10.44
4	Fluid coupling secondary side GD^2 value	FG2		kg-m^2	6.35	2.88	19.47	3.72	7.44	3.72	3.72	2.88	14.27	14.27	14.27	2.88	2.88	2.88
5	Gear box GD^2 value at motor rpm	GG		kg-m^2	1.1725	0.0688	1.736	0.3076	0.6152	0.3076	0.3076	0.112	0.6988	0.6988	0.6988	0.112	0.112	0.112
6	Gear coupling GD^2 value at pulley rpm	CG1		kg-m^2	2.45	5.25	28.67	5.25	10.5	5.25	5.25	5.25	8.52	8.52	8.52	5.25	5.25	5.25
7	Motor rpm	MR		RPM	1441	1441	1480	1441	1441	1441	1441	1441	1480	1480	1480	1441	1441	1441
8	Actual belt speed	BS		m/min	187.2	171.58	167.82	167.84	167.84	192.52	192.52	194.597	192.521	192.521	192.521	194.597	194.597	194.597
9	Unit Weight of belt	WB		kg/m	33.32	26.91	32	21.616	32	15.44	15.44	15.44	17.88	17.88	17.88	15.44	15.44	15.44
10	Design capacity of conveyor	T		tph	1800	1200	1200	1200	1200	720	720	720	720	720	720	720	720	720
11	Drive pulley diameter	PD		mm	824	524	824	824	824	654	654	524	654	654	654	524	524	524
12	Number of drive pulley	DP		nos.	1	1	1	1	2	1	1	1	1	1	1	1	1	1
13	Actual weight of drive pulley	Aw		kgf.	1900	2000	2200	2200	2200	1700	1700	1500	1500	1500	1500	1500	1500	1500
14	No. of non driving pulleys in tight side having wrap angle 150 deg. To 240.deg	NPA		nos.	0	1	1	1	1	1	1	1	1	1	1	1	1	1
15	Wt of each non driving pulleys in tight side having wrap angle 150 deg. To 240. deg	WNPA		kgf.	0	1500	1800	1500	1800	1300	1300	1300	1000	1000	1000	1000	1000	1000
16	No. of non driving pulleys in slack side having wrap angle 150 deg. To 240.deg	NPB		nos.	2	0	1	1	2	1	1	0	1	1	1	1	1	1
17	Wt of each non driving pulleys in slack side having wrap angle 150 deg. To 240. deg	WNPB		kgf.	1100	1200	1800	1500	1500	1100	1100	1100	1000	1000	1000	1000	1000	1000
18	No. of remaining non driving pulleys	NPC		nos.	2	1	3	3	2	3	3	1	3	3	3	2	3	3
19	Wt of each remaining non driving pulleys	WNPC		kgf.	800	1200	1200	1200	1200	1100	1100	1100	1000	1000	1000	1000	1000	1000
20	Weight of rotating parts of each carrying idler	W1		kg/m	45	32	32	26	32	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6
21	Weight of rotating parts of each return idler	W2		kg/m	13.33	32	32	32	32	12	12	12	12	12	12	12	12	12
22	Total belt length	L1		m	242	51.78	780	180.576	888	180.576	180.576	182.6	682.3	922	390	180	206	131.07
23	Length along belt (profile length)	L2		m	117	24.55	378.062	82.945	430	82.945	82.945	84.216	331.15	449.5	186.581	91.1	94	61.365
24	Scoop coupling disengagement time	DT		sec	3	0	3	0	0	0	0	0	3	3	3	0	0	0
25	Motor output power required at conveyor running condition	MOPR		kW	152.85	36.1	321.95	105	156	93	93	54.06	135.57	160.92	139.05	57.25	68.08	45.65
26	Unit weight of material	WM	WM=(T x 60)/(3.6 xBS)	kg/m	160.26	116.56	119.18	119.16	119.16	62.33	62.33	61.67	62.33	62.33	62.33	61.67	61.67	61.67
27	**GD^2 equivalent weight**																	
28	Pulley RPM	PR	PR=BSx1000/(∏xPD)	rpm	72.315	104.227	64.829	64.837	64.837	93.702	93.702	118.210	93.702	93.702	93.702	118.210	118.210	118.210
29	Gear coupling GD^2 value at motor rpm	CG2	CG2= CG1x (PR/MR)^2	kg-m^2	0.006	0.027	0.055	0.011	0.021	0.022	0.022	0.035	0.034	0.034	0.034	0.035	0.035	0.035
30	**Total GD^2 value of the drive system at motor rpm**																	
31	Including GD^2 value of motor and primary side of HS coupling	TG1	TG1=MG+FG2+FG1+GG+CG2	kg-m^2	38.10	15.27	118.16	24.38	47.33	24.39	24.39	17.91	55.70	68.70	55.70	17.91	20.85	15.72
32	Excluding GD^2 value of motor and primary side of HS coupling	TG2	TG2=FG2+GG+CG2	kg-m^2	7.529	2.976	21.261	4.038	8.076	4.050	4.050	3.027	15.003	15.003	15.003	3.027	3.027	3.027
33	**Equivalent weight of drive system at belt line**	**ED**																
34	Total GD^2 of drive system including the GD^2 value of motor and primary side of HS coupling	ED1	ED1=(TG1)/4x(2x∏xMR/BS)^2	kg-m^2	22280.55	10627.63	90700.55	17734.88	34429.46	13485.86	13485.86	9691.42	32489.58	40072.02	32489.58	9691.42	11285.25	8507.28
35	Total GD^2 of drive system exduding the GD^2 value of motor and primary side of HS coupling	ED2	ED2=(TG2)/4x(2x∏xMR/BS)^2	kg-m^2	4402.85	2071.93	16319.98	2937.77	5875.53	2239.26	2239.26	1638.39	8750.70	8750.70	8750.70	1638.39	1638.39	1638.39
36	Equivalent weight of drive pulley	EW	EW=(2/3) x AW x DP	kg-m^2	1266.7	1333.3	1466.7	1466.7	2933.3	1133.3	1133.3	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0
37	**Total equivalent weight of drive system including drive pulley**																	
38	Including GD^2 value of motor and primary side of HS coupling	TED1	TED1=EW+ED1	kg-m^2	23547.21	11960.97	92167.22	19201.55	37362.79	14619.19	14619.19	10691.42	33489.58	41072.02	33489.58	10691.42	12285.25	9507.28
39	Excluding GD^2 value of motor and primary side of HS coupling	TED2	TED2=EW+ED2	kg-m^2	5669.521	3405.265	17786.647	4404.432	8808.864	3372.590	3372.590	2638.387	9750.695	9750.695	9750.695	2638.387	2638.387	2638.387
40	Total weight of non drive pulley	NW	NW=NPA x WNPA+NPB x WNPB+NPCx WNPC	kg-m^2	3800	2700	7200	6600	7200	5700	5700	2400	5000	5000	5000	4000	5000	5000
41	Equivalent weight of non drive pulley	ENW	ENW=(2/3) x NW	kg-m^2	2534.6	1800.9	4802.4	4402.2	4802.4	3801.9	3801.9	1600.8	3335	3335	3335	2668	3335	3335
42	Total weight of belt	TB	TB=WB x L1	kgf.	8063	1393.3998	24960	3903.33	28416	2788.09	2788.09	2819.34	12199.52	16485.36	6973.20	2779.20	3180.64	2023.72
43	Total weight of material	TM	TM= WM x L2	kgf.	18750	2862	45056	9884	51239	5170	5170	5193	20641	28018	11630	5618	5797	3784
44	Total weight of idlers	IW	IW= L2 x W1+(L2/3) x W2	kgf.	5784.87	1047.467	16131	3041	18347	2455	2455	2493	9802	13305	5523	2697	2782	1816
45	Total equivalent weight of moving parts including material	TMW	TMW=ENW+TB+TM+IW	kgf.	35132.91	7103.436361	90948.7002	21230.5	102803.72	14215.2	14215.2	12106.2	45977.4	61143.2	27460.7	13761.5	15094.6	10959.3
46	**Total equivalent weight of drive system including drive system**																	
47	Including GD^2 value of motor and primary side of HS coupling	WE1	WE1=TMW+TED1	kgf.	58680.123	19064.404	183115.920	40432.095	140166.510	28834.384	28834.384	22797.622	79466.978	102215.266	60950.313	24452.953	27379.894	20466.537
48	Excluding GD^2 value of motor and primary side of HS coupling	WE2	WE2=TMW+TED2	kgf.	40802.43	10508.70	108735.35	25634.98	111612.58	17587.78	17587.78	14744.59	55728.10	70893.94	37211.43	16399.92	17733.03	13597.64
49	**Natural coasting time**																	
50	Required deceleration time (Case-1)	t1	t1= WE1 x (BS/60)^2/(MOPR x 1000)	sec	3.737	4.319	4.450	3.013	7.031	3.192	3.192	4.436	6.035	6.540	4.513	4.493	4.230	4.716

COASTING TIME CALCULATION-NSPCL TPP

51	Reduced belt speed when the secondary section of scoop coupling is going to be disengaged	BSR	BSR=BS-(60x1000xMOPRxDT)/(WE1x(BS/60))	m/min	36.923	171.578	54.673	167.842	167.842	192.521	192.521	194.597	96.819	104.205	64.542	194.597	194.597	194.597
52	Required deceleration time (Case-2)	t2	t2=WE2 x (BSR/60)x(BS/60)/((MOPRx1000)+DT	sec	3.513	2.380	3.861	1.910	5.599	1.947	1.947	2.869	5.128	5.455	3.924	3.013	2.740	3.133
53	Natural coasting time	T	T=maximum of t1 & t2	sec	3.74	4.32	4.45	3.01	7.03	3.19	3.19	4.44	6.04	6.54	4.51	4.49	4.23	4.72

SEQUENCE OF FEEDING & COASTING TIME COMPARISON

SL NO	CONV NO.	BELT WIDTH	DESIGN TPH	DECELERATION TIME (t1) in sec	SUCCEEDING CONVEYOR NO	DECELERATION TIME		COASTING TIME		VOLUME OF MATERIAL ACCUMULATED			ALLOWABLE VOLUME OF MATERIAL ACCUMULATION	BRAKE REQUIRED	REMARKS
						1ST CONV t2a sec	2nd CONV t2b sec	Ta= t1-t2a in se	Tb= t1-t2b in s	Va (m^3)	Vb(m^3)	Max V (m^3)		YES/NO	
1	1A/B	1400	1200	0.00	2A/B	0.00		0.00					1.98	NO	
2	2A/B	1400	1200	0.00	Vibrating screen	30							0	NO	
3	3A/B	1400	1200	0.00	4A	0.00		0.00					1.95	NO	
4	4A (reclaim)	1400	720	0.00	5A/B	0.00		0.00		0.0000	0	0	1.3936	YES	Coasting time is more than 5 seconds
5	9	1000	720	0.00	5A/B	0.00		0.00					1.3936	NO	
6	10	1000	720	0.00	5A/B	0.00		0.00					1.3936	NO	
7	5AB	1000	720	0.00	6A/B	0.00		0.00					1.3936	NO	
8	6A/B	1000	720	0.00	7A/B/6C	0.00	0.00	0.00	0.00		0	0	1.3936	YES	Coasting time is more than 5 seconds
9	7A/B	1000	720	0.00	8A/B	0.00		0.00		0.0000	0	0	1.3936	YES	Coasting time is more than 5 seconds
10	8A/B	1000	720	0.00	8C/D	0.00		0.00		0.0000	0	0	1.3936	NO	The volume of material accumulated is less than allowablevolume
11	8C/D	1000	720	0.00	Bunker					0	0	0		NO	Feeding to bunker
12	4B	1000	720	0.00	Yard					0	0	0		NO	Feeding to yard
13	6C	1000	720	0.00	Yard					0	0	0		NO	Feeding to yard

BELT WIDTH (in mm)	INTER SKIRT (mm)	ALLOWABLE VOLUME
1000	670	1.3936
1400	950	1.98