SUMMARY OF OUTPUTS

The following document sets out the detailed design values required for the manufacture of a new minimum gauge railway track.

1	**GUIDANCE / LEGISLATION**				
	Title	**Description**		**Source**	**Relevant Issues**
1.1	HSG216 - PASSENGER CARRYING MINIATURE RAILWAYS - GUIDANCE ON SAFE PRACTICE	Useful guidance on standards / design practices / values for Commercial Miniature Railways (last updated 2001 but still relevant)		**HSE**	To include, but not exclusively: Clearance envelope, braking systems, signage, interaction with Public, design of vehicles, design of structures.
1.2	MACHINERY DIRECTIVE 2006/42/EC 95/16/EC (recast)	Regulations relating to the design and manufacture of equipment and the human interface / safety issues related to machinery.		**EU**	To include, but not exclusively: Noise exposure levels for operators / public. Enclosure / protection from injury by moving parts. Isolation (E-stop) of equipment including during maintenance.
1.3	BS13814 - FAIRGROUND AND AMUSEMENT PARK MACHINERY AND STRUCTURES - SAFETY	Standard for design and manufacture of equipment.		**BSI**	To include, but not exclusively: Operator Interface, structural design of vehicles, safety of control systems (E-stop, etc)

2	**Track materials**	**Item**	**value**	**Unit**	**Comments**
2.1		Rail	S10		
2.2		Sleepers	100x80x 600	mm	recycled plastic in Black or Brown
2.3		Fixings	Screw and clip		M12 coach screw; square, nibless clips
2.4		ballast	25-32	mm	clean (no fines) limestone.
2.5		geotextile	Terram 1000		or equivalent
2.6		geogrid	TRIAX 140		or equivalent
2.7					
2.8	**S10 rail**	rail head width	32	mm	
		foot width	79	mm	
		height	79	mm	
		mass/linear meter	10	Kg	
		steel grade	S275		
3	**Straight track**	**Item**	**value**	**Unit**	**Comments**
3.1		Gauge	312	mm	12.25"
3.2	Tolerance	maximum permitted undergauge	3	mm	
3.3		maximum permitted overgauge	5	mm	
3.4		max permitted vertical alignment tolerance +/-	10	mm	not to exceed twist / cant gradient ratio specified below
4	**Gradients**	**Item**	**value**	**Unit**	**Comments**
4.1		maximum permitted up-grade	2	%	1in50
4.2		maximum permitted down-grade	2	%	1in50
4.3		design vertical curve radius	45.75	m	
5	**Curvature and alignment**	**Item**	**value**	**Unit**	**Comments**
5.1		absolute minimum curve radius	13.5	m	
5.2		absolute maximum twist	1in300	ratio	

6	**Turnouts**	**Item**	**value**	**Unit**	**Comments**
6.1		Design:	Turnout detail design by manufacturer / supplier. Rails should not be welded to baseplates (to permit replacement of individual components in due course). Steel slide baseplates to be provided through switch. Steel baseplates can be fitted throughout turnout but not essential.		
6.2		Lever:	Weighted or snap-over type provided with secure locking mechanism to prevent tampering while train is in passenger operation.		
6.3		nominal radius	16	m	
6.4		crossing angle	1in8	ratio	
6.5	straight route	gauge	312	mm	
6.5.1		flangeway (wing and check)	15	mm	
6.5.2		check gauge	282	mm	
6.5.3		check clearance	297	mm	
6.5.4		B2B to check clearance	6	mm	
6.60	diverging route	gauge	312	mm	
6.6.1		nominal radius	16	m	
6.6.2		gauge widening	0	mm	
6.6.3		flangeway (wing)	15	mm	
6.6.4		flangeway (check)	15	mm	
6.6.5		check gauge	282	mm	
6.6.7		check clearance	297	mm	
6.6.8		B2B to check clearance	6	mm	
6.70	heel	heel divergence	47	mm	
6.80	switches	type	sprung		
6.8.1		open gap (switch throw)	30	mm	

inputs in yellow	
derived or copied values	
outputs in green	

wheel calc		
radius of tread	200	mm
max depth of flange 'd':	15.8	mm
radius to tip of flange 'r':	215.8	mm
L=Sqr:8dr:	165.2	27277.12
width of flange:	9.5	mm
Flangeway	15	

	nom track gauge gauge		Profile ID	B2B (mm)	B2B to check rail clearance (mm)	wheelset gauge (mm)	gauge widen value (mm)	actual gauge (mm)	S' (mm)	B' (mm)	L' (mm)		absolute min	recommended min
12.25"	312	carriage	TSUK	288	6	307	0	312	5	650	165	NOMINAL GAUG	10.7 M	11.8 M
	312	loco	TSUK	288	6	307	0	312	5	800	165	NOMINAL GAUG	13.2 M	14.5 M

inputs in yellow		
derived or copied	values	
outputs in green		

track gauge	0.312	m
rail length:	6.000	m
gauge face to centre line:	0.156	m

CURVES			VEHICLE		GAUGE WIDENING				SUPERELEVATION				TRANSITION CURVES						
ID	radius (m)	radius (ft)	velocity (km/h)	velocity (mph)	gauge widening applied (m)	widened gauge (m)	inner rail radius (m)	outer rail radius (m)	cant (m)	deficiency	deficient cant value (m)	rationalised value to be applied (mm)	length of transition 'L' (m) {calculated from rationalised value}	half length (m)	shift 'S' at 'A' (m)	distance to 'x' (m)	offset 'h' at 'x' (m)	radius at 'x' (m)	offset at 'c' (m)
A	13.5	43	10.0	6	0.000	13.500	13.344	13.656	0.018	66%	0.012	**12**	3.586	1.793	**0.040**	1.195	0.006	40.500	0.159
B	14.5	47	10.0	6	0.000	14.500	14.344	14.656	0.017	66%	0.011	**11**	3.339	1.669	**0.032**	1.113	0.005	43.500	0.128
C	16.5	53	10.0	6	0.000	16.500	16.344	16.656	0.015	66%	0.010	**10**	2.934	1.467	**0.022**	0.978	0.003	49.500	0.087
D	21.0	67	10.0	6	0.000	21.000	20.844	21.156	0.012	66%	0.008	**8**	2.305	1.153	**0.011**	0.768	0.002	63.000	0.042
E	40.0	128	10.0	6	0.000	40.000	39.844	40.156	0.006	66%	0.004	**0**	1.210	0.605	**0.002**	0.403	0.000	120.000	0.006

inputs in yellow			outputs in green		
	track gauge	0.31	m		
	rail length:	6.00	m		
	gauge face to centre line:	0.16	m		
	MINIMUM VERTICAL CURVE CALCULATION:				L2 - B2
					8(x-y)
distance between lowest points of veh:		**L**	3.500	**m**	
clearance above rail level of lowest points on level:		**x**	0.025	**m**	
clearance above rail level of lowest points on vert. curve:		y	0.010	m	
	wheelbase of vehicle:	B	2.600	m	
	radius of vert. curve:	R	45.750	m	
	VERTICAL CURVE LENGTH CALCULATION: A=				Pi R C
					180.000
	angle of gradient:	**C**	2.290	**deg**	
	radius of vert. curve:	**R**	45.750	**m**	
	length of vert curve:	A	1.828	M	
	VERTICAL CURVE HEIGHT CALCULATION: B=				A2
					2R
	length of vert. Curve:	**A**	0.000	**deg**	
	radius of vert. curve:	**R**	45.750	**m**	
	height of vert curve:	B	0.000	M	

TRACK SYSTEMS UK

BCP Council

BUILDING CAPITAL TEAM

*All units metres

Location	Reference	Distance from Station (m)	Distance interval (m)	V-r (m/s)	Time interval (s) at 7kph	Elevation EGL (m)	Adjustment (m)	Elevation PST (proposed sleeper top) (m)	change (m)	Grade (%)
Station	**1**	0				1.89	0.000	1.89		
	2	5	5	1.00	5.00	1.83	0.000	1.83	-0.06	-1.20%
	3	15	10	1.95	5.13	1.66	0.050	1.71	-0.12	-1.20%
	4	25	10	1.95	5.13	1.61	0.000	1.61	-0.10	-1.00%
	5	35	10	1.95	5.13	1.53	0.000	1.53	-0.08	-0.80%
	6	45	10	1.95	5.13	1.43	0.000	1.43	-0.10	-1.00%
	7	55	10	1.95	5.13	1.35	0.000	1.35	-0.08	-0.80%
	8	65	10	1.95	5.13	1.29	0.000	1.29	-0.06	-0.60%
	9	75	10	1.95	5.13	1.19	0.050	1.24	-0.05	-0.50%
	10	85	10	1.95	5.13	1.19	0.050	1.24	0.00	0.00%
	11	95	10	1.45	6.90	1.17	0.100	1.27	0.03	0.30%
	12	105	10	1.45	6.90	1.24	0.125	1.37	0.10	0.95%
Bridge	**13**	115	10	1.45	6.90	1.42	0.125	1.55	0.18	1.80%
	14	125	10	1.45	6.90	1.28	0.125	1.41	-0.14	-1.40%
Loop	**15**	135	10	1.95	5.13	1.20	0.200	1.40	-0.01	-0.05%
	16	145	10	1.95	5.13	1.28	0.250	1.53	0.13	1.30%
	17	155	10	1.95	5.13	1.32	0.300	1.62	0.09	0.90%
	18	165	10	1.95	5.13	1.37	0.250	1.62	0.00	0.00%
	19	175	10	2.70	3.70	1.32	0.175	1.50	-0.13	-1.25%
	20	185	10	2.70	3.70	1.18	0.200	1.38	-0.12	-1.15%
	21	195	10	2.70	3.70	1.19	0.175	1.37	-0.01	-0.15%
	22	205	10	2.70	3.70	1.25	0.100	1.35	-0.01	-0.15%
	23	215	10	2.70	3.70	1.28	0.025	1.31	-0.05	-0.45%
LC (prop)	**24**	222	7	1.95	3.59	1.08	0.100	1.18	-0.13	-1.79%
	25	232	10	1.95	5.13	1.12	0.075	1.20	0.01	0.15%
	26	242	10	2.70	3.70	1.15	0.050	1.20	0.00	0.05%
	27	252	10	2.70	3.70	1.17	0.050	1.22	0.02	0.20%
	28	262	10	2.70	3.70	1.14	0.125	1.27	0.04	0.45%
	29	272	10	2.70	3.70	1.26	0.075	1.34	0.07	0.70%
	30	282	10	2.70	3.70	1.29	0.075	1.37	0.03	0.30%
	31	292	10	2.70	3.70	1.21	0.125	1.34	-0.03	-0.30%
(flush)	**32**	302	10	2.70	3.70	1.29	0.025	1.32	-0.02	-0.20%
	33	312	10	2.70	3.70	1.22	0.050	1.27	-0.04	-0.45%
	34	322	10	2.70	3.70	1.25	0.000	1.25	-0.02	-0.20%
	35	332	10	2.70	3.70	1.24	0.000	1.24	-0.01	-0.10%
	36	342	10	2.70	3.70	1.23	0.000	1.23	-0.01	-0.10%
	37	352	10	2.70	3.70	1.23	0.000	1.23	0.00	0.00%
LC (prop)	**38**	362	10	1.95	5.13	1.22	0.000	1.22	-0.01	-0.10%
	39	372	10	1.95	5.13	1.40	0.000	1.40	0.18	1.80%
	40	382	10	2.70	3.70	1.36	0.075	1.44	0.04	0.35%
	41	392	10	2.70	3.70	1.44	0.025	1.47	0.03	0.30%
	42	402	10	2.70	3.70	1.48	0.000	1.48	0.02	0.15%
	43	412	10	2.70	3.70	1.43	0.000	1.43	-0.05	-0.50%
	44	422	10	2.70	3.70	1.39	0.000	1.39	-0.04	-0.40%
	45	432	10	2.70	3.70	1.36	0.000	1.36	-0.03	-0.30%
	46	442	10	2.70	3.70	1.30	0.000	1.30	-0.06	-0.60%
LC (prop)	**47**	452	10	1.95	5.13	1.30	0.000	1.30	0.00	0.00%
	48	462	10	1.95	5.13	1.28	0.000	1.28	-0.02	-0.20%
	49	472	10	2.70	3.70	1.34	0.050	1.39	0.11	1.10%
	50	482	10	2.70	3.70	1.39	0.125	1.52	0.13	1.25%
	51	492	10	2.70	3.70	1.62	0.100	1.72	0.21	2.05%
	52	502	10	2.70	3.70	1.84	0.075	1.92	0.20	1.95%
	53	512	10	2.70	3.70	1.99	0.050	2.04	0.13	1.25%
LC (prop)	**54**	522	10	1.95	5.13	2.10	0.000	2.10	0.06	0.60%
	55	532	10	1.95	5.13	2.15	0.000	2.15	0.05	0.50%
	56	542	10	1.95	5.13	2.07	0.000	2.07	-0.08	-0.80%
LC (prop)	**57**	552	10	1.95	5.13	2.06	0.000	2.06	-0.01	-0.10%
	58	562	10	1.95	5.13	1.92	0.000	1.92	-0.14	-1.40%
	59	572	10	1.95	5.13	1.90	0.000	1.90	-0.02	-0.20%
Station	**1**	**582**	10	1.95	5.13	1.89	0.000	1.89	-0.01	-0.10%

Zone	Reference	Track Length Approx. (m)
A	**01 - 11**	95
B	**11 - 15**	40
C	**15 - 19**	40
D	**19 - 24**	47
E	**24 - 32**	80
F	**32 - 48**	160
G	**48 - 53**	50
H	**53 - 58**	50
J	**58 - 01**	20
	Check total	**582**

	Construction Type A on or near existing alignment	Construction Type B Tramway	Construction Type C new alignment	Construction Type D Pedestrian Crossing	
	95				
		40			
			40		
			42	5	
			80		
	150			10	
			50		
	40			10	
	20				
Qtys	**305**	**40**	**212**	**25**	**582**