



ENGINEERED CONCEPT DESIGN

THE BRITISH POSTAL MUSEUM & ARCHIVE

Version A4

The Transport Engineering Specialists

Design – Engineered Concept Design

Review and approval of...

- + Dimensions (although small changes may be made)
- + Visual Appearance including door and canopy arrangement
- + Performance Specification including duty cycle
- + Technical Specification

Colours, graphics, seat colours, floor colours etc will be agreed during detailed design.

Changes after this stage sign off are always possible but may be subject to cost or delivery implications.

NB Renderings are provided for illustrative purposes and the description takes precedence.

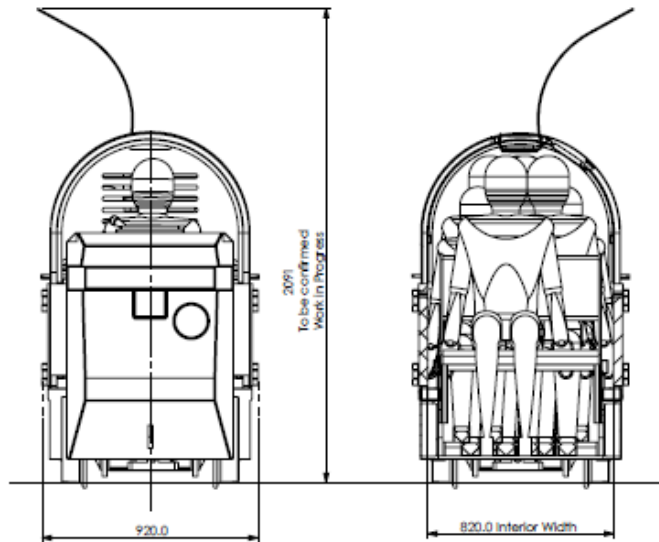
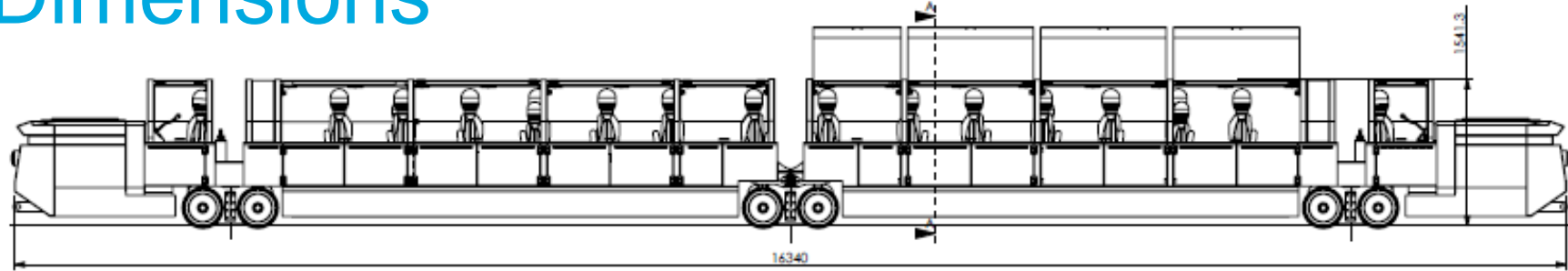
Design – Next Stage

Next stage...

Following discussions with the project team it has been agreed to introduce an informal mid design review stage. This will give the board an opportunity to review the detailed design mid way when further details will be available on the specifics and incorporation of the agreed options.

This will be for information purposes only.

Dimensions



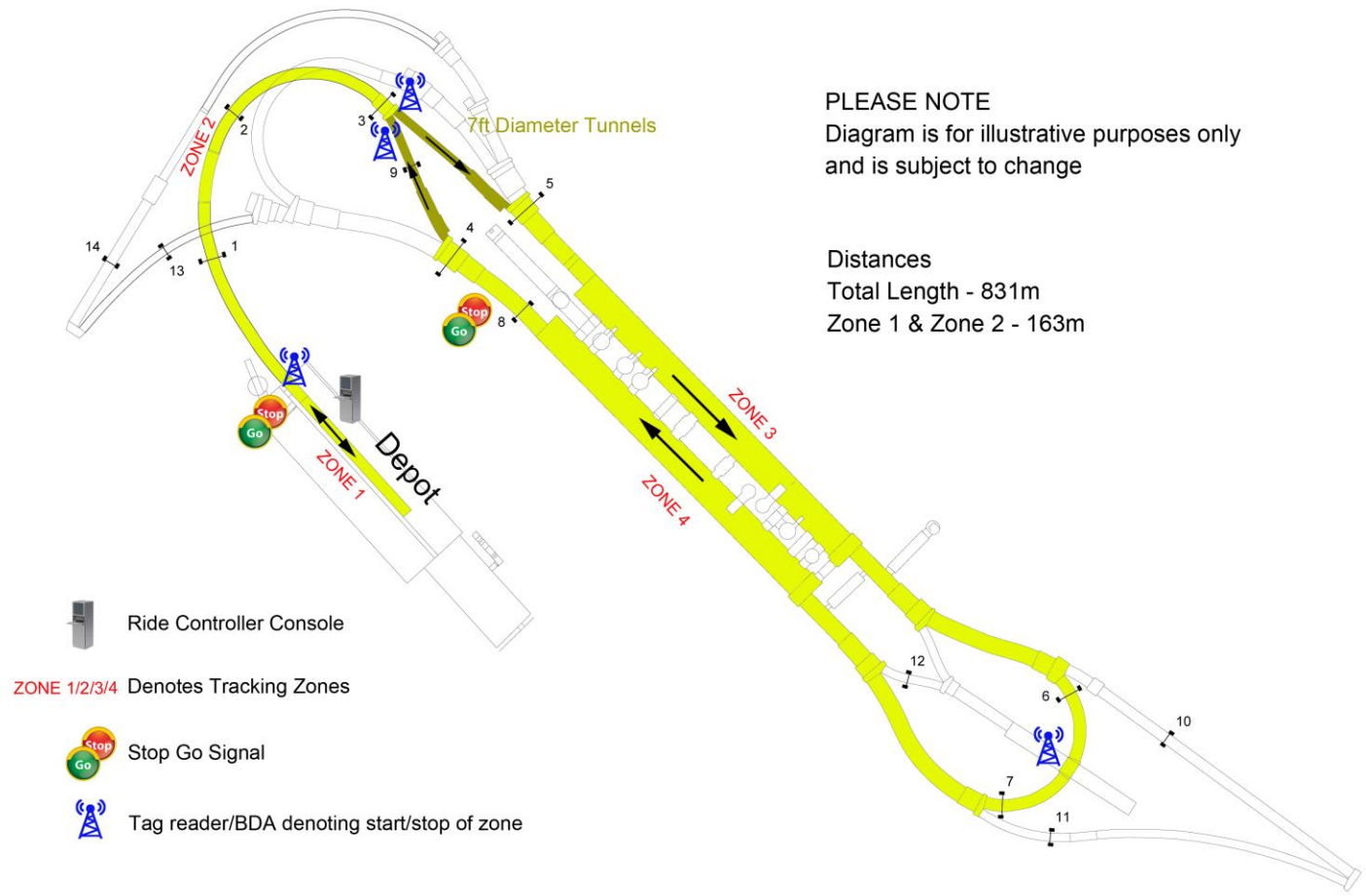
Length	16,340mm
Overall Width	920mm
Interior Width	820mm
Height (Canopy Open)	2,091mm (TBC)
Height (Over cab)	1,541mm
Approximate Gross Vehicle Weight	9,733kg
Approximate Tare Vehicle Weight	7,013Kg

External dimensions of the train's nose-cone/bodywork are likely to change to a degree to ensure clearance within the tunnels. These minimal changes will not compromise the performance of the train including housing the batteries in the nose, internal envelope of the driver's cabin, passenger capacity or overall look of the train and will be finalised following further surveying of the ride envelope.

MATERIAL:		TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: ± 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC PLACES: ± 0.1mm ANGULAR: ± 30'		SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS		TITLE:	
NEXT ASSEMBLY:		DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS				BORDER A3 X 1:1		LOCATION CODE:	
PROJECT TITLE:		FINISH:		THIS IS THE PROPERTY OF SEVERN-LAMB AND MAY NOT BE COPIED OR USED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF SEVERN-LAMB		DRAWN: DATE:		WEIGHT (kg):	
FINAL ASSEMBLY:						APPROVED: DATE:		DRAWING No:	
						PROJECTION:		PART No:	
								REV:	
								SHEET:	
								1 OF 1	

DO NOT SCALE - IF IN DOUBT - ASK!

Track Alignment



PLEASE NOTE
Diagram is for illustrative purposes only
and is subject to change

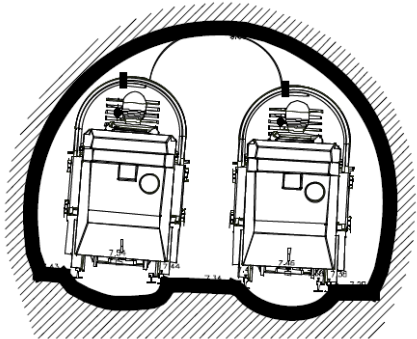
Distances
Total Length - 831m
Zone 1 & Zone 2 - 163m

- Ride Controller Console
- ZONE 1/2/3/4** Denotes Tracking Zones
- Stop Go Signal
- Tag reader/BDA denoting start/stop of zone

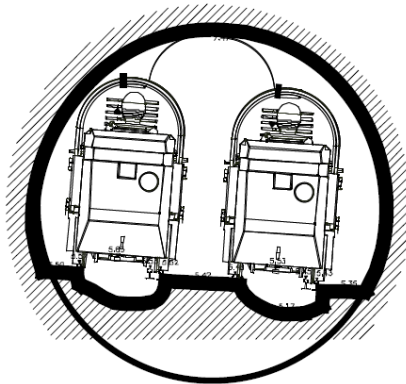
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							PART No:
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							1 OF 1

DRAWING NO. DO NOT SCALE - IF IN DOUBT - ASK!

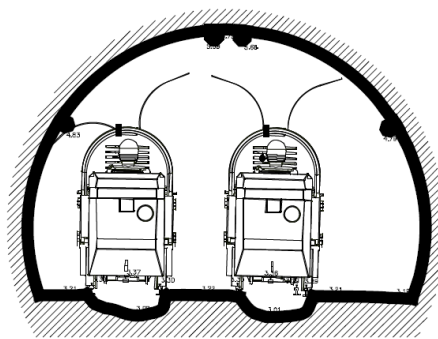
Tunnel & Canopy/Door Arrangement



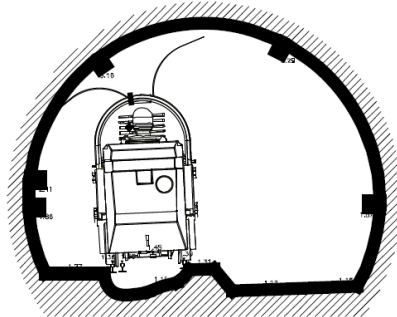
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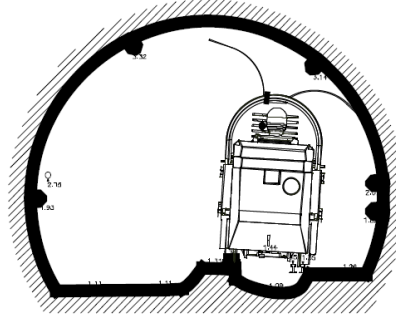
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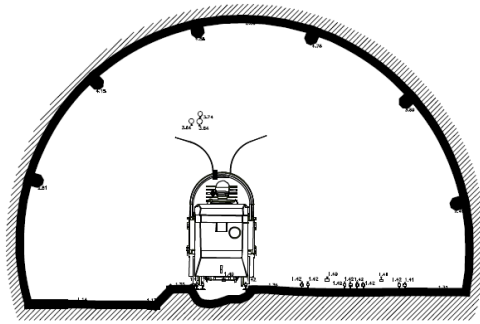
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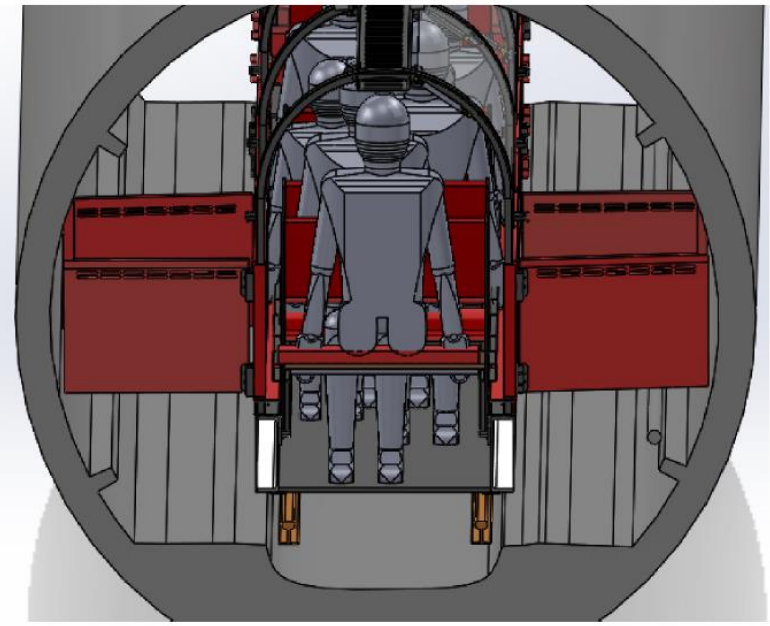
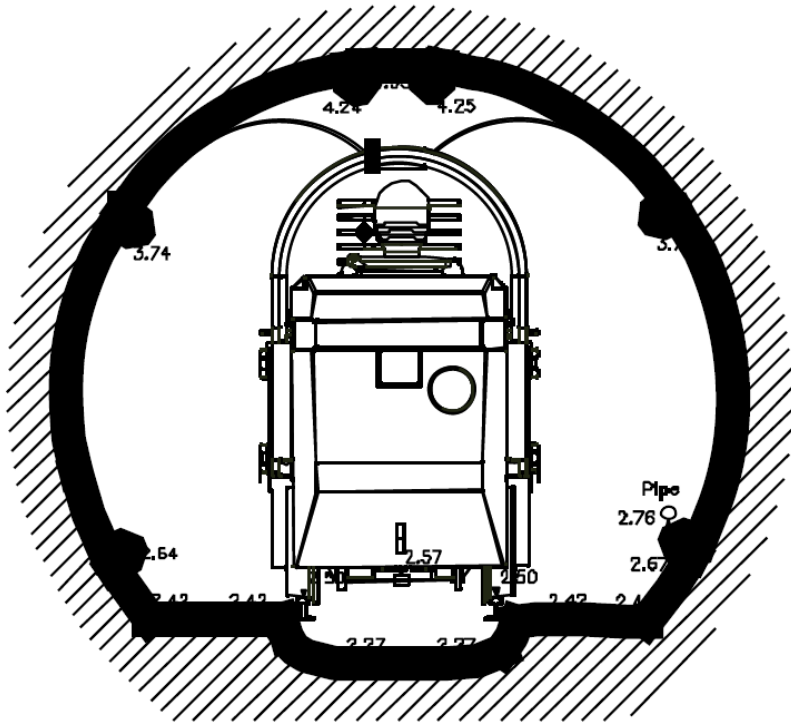


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NEXT ASSEMBLY: PROJECT TITLE:	FINAL ASSEMBLY:		THIS IS THE PROPERTY OF SEVERN-LAMB AND MAY NOT BE COPIED OR USED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF SEVERN-LAMB		1 OF 1

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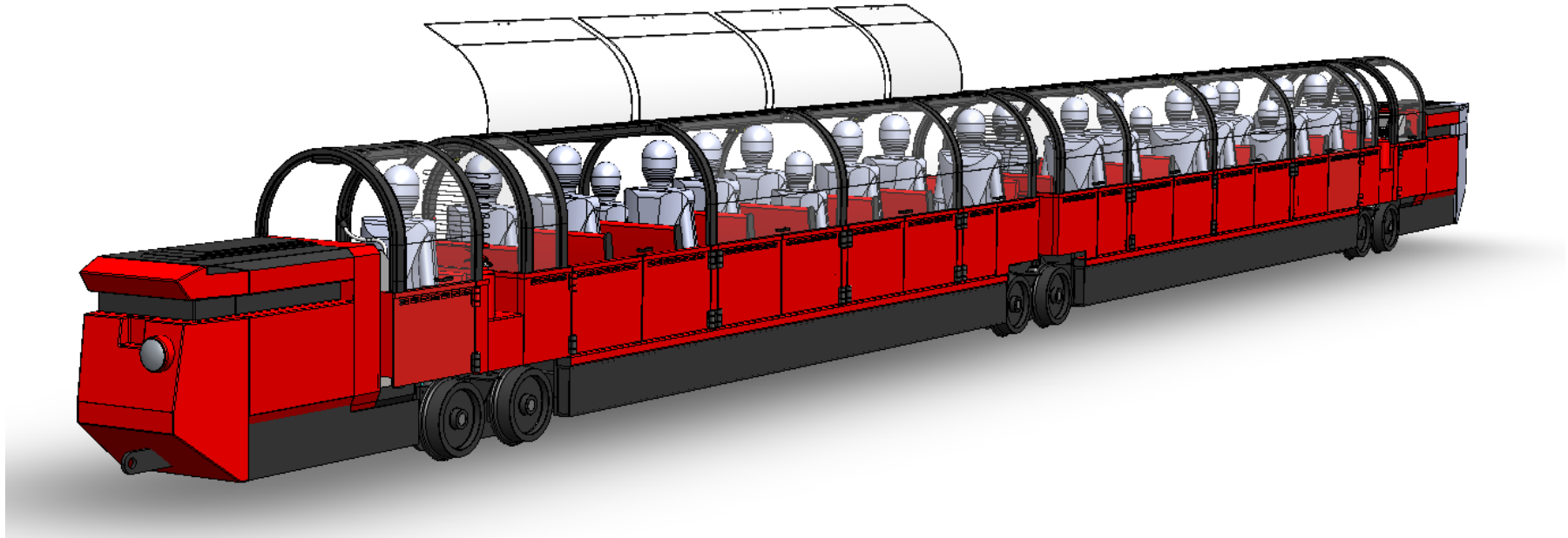
Tunnel & Canopy/Door Arrangement



9
7ft Diameter Tunnels

MATERIAL: TREATMENT: FINISH:		TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: ± 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC PLACES: ± 0.1mm ANGULARS: ± 30' DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS		SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS BORDER A3 X 1:1 LOCATION CODE: _____ DRAWN: _____ DATE: _____ APPROVED: _____ DATE: _____ PROJECTION:		TITLE: Track Alignment		WEIGHT (kg): _____ DRAWING No: _____ PART No: _____ REV: _____ SHEET: _____	
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Visual Appearance



NEXT ASSEMBLY:	FINAL ASSEMBLY:
PROJECT TITLE:	

MATERIAL:	
TREATMENT:	
FINISH:	

TOLERANCES:
 UNLESS OTHERWISE STATED
 OPEN DIMS: ± 1.0mm
 ONE DEC. PLACE: ± 0.5mm
 TWO DEC PLACES: ± 0.1mm
 ANGULARS: ± 30'


**DIMENSIONS IN MILLIMETRES (mm)
 SURFACE TEXTURE VALUES IN (µm)
 MACHINE WHERE MARKED: ✓
 REMOVE ALL SHARP EDGES AND
 BURRS**

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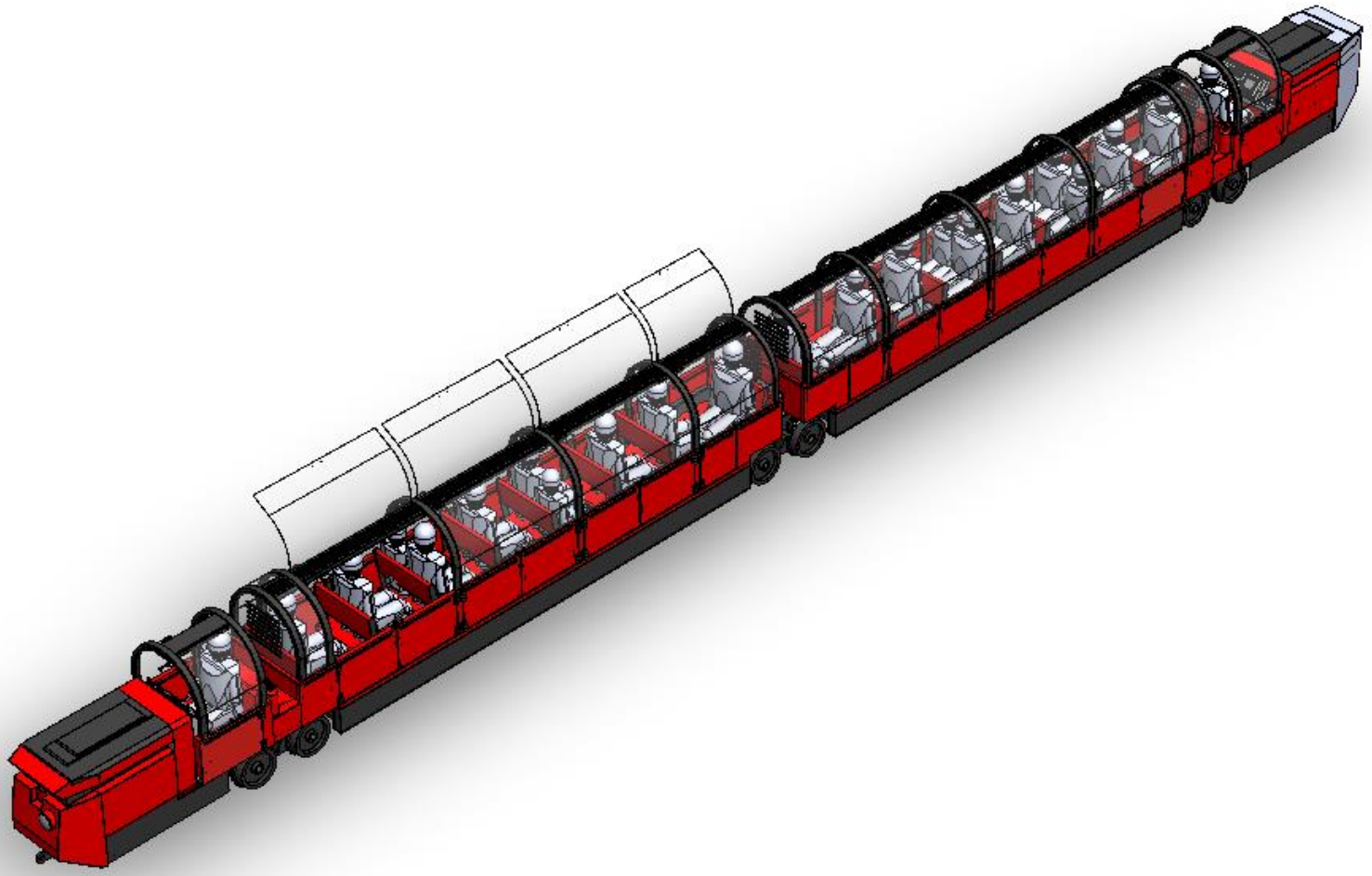


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BORDER A3 X 1:1	
LOCATION CODE: .	
DRAWN: DATE:	
APPROVED: DATE:	
PROJECTION:	<input checked="" type="checkbox"/> 

TITLE: Visual Appearance				
WEIGHT (kg):	DRAWING No:	PART No:	REV:	SHEET: 1 OF 1

DRAWING No. DO NOT SCALE - IF IN DOUBT - ASK!

Visual Appearance



NEXT ASSEMBLY:	FINAL ASSEMBLY:
PROJECT TITLE:	

MATERIAL:	
TREATMENT:	
FINISH:	

TOLERANCES:
 UNLESS OTHERWISE STATED
 OPEN DIMS: ± 1.0mm
 ONE DEC. PLACE: ± 0.5mm
 TWO DEC PLACES: ± 0.1mm
 ANGULAR: ± 30'



**DIMENSIONS IN MILLIMETRES (mm)
 SURFACE TEXTURE VALUES IN (µm)
 MACHINE WHERE MARKED: ✓
 REMOVE ALL SHARP EDGES AND
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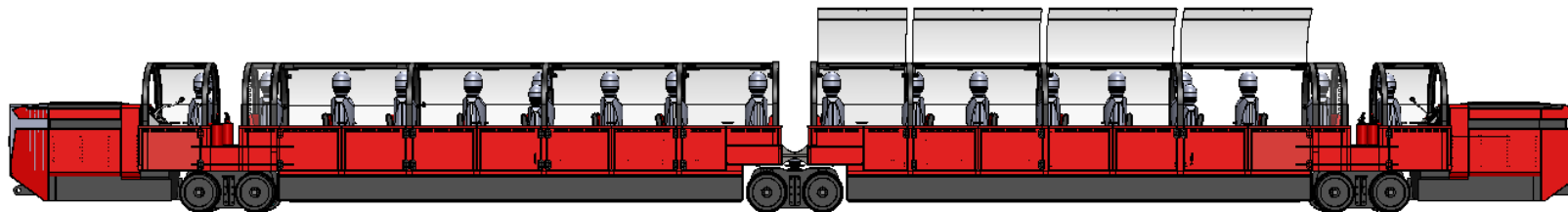


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BORDER A3 X 1:1	
LOCATION CODE:	
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APPROVED: DATE:	
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TITLE: Visual Appearance				
WEIGHT (kg):	DRAWING No:	PART No:	REV:	SHEET: 1 OF 1

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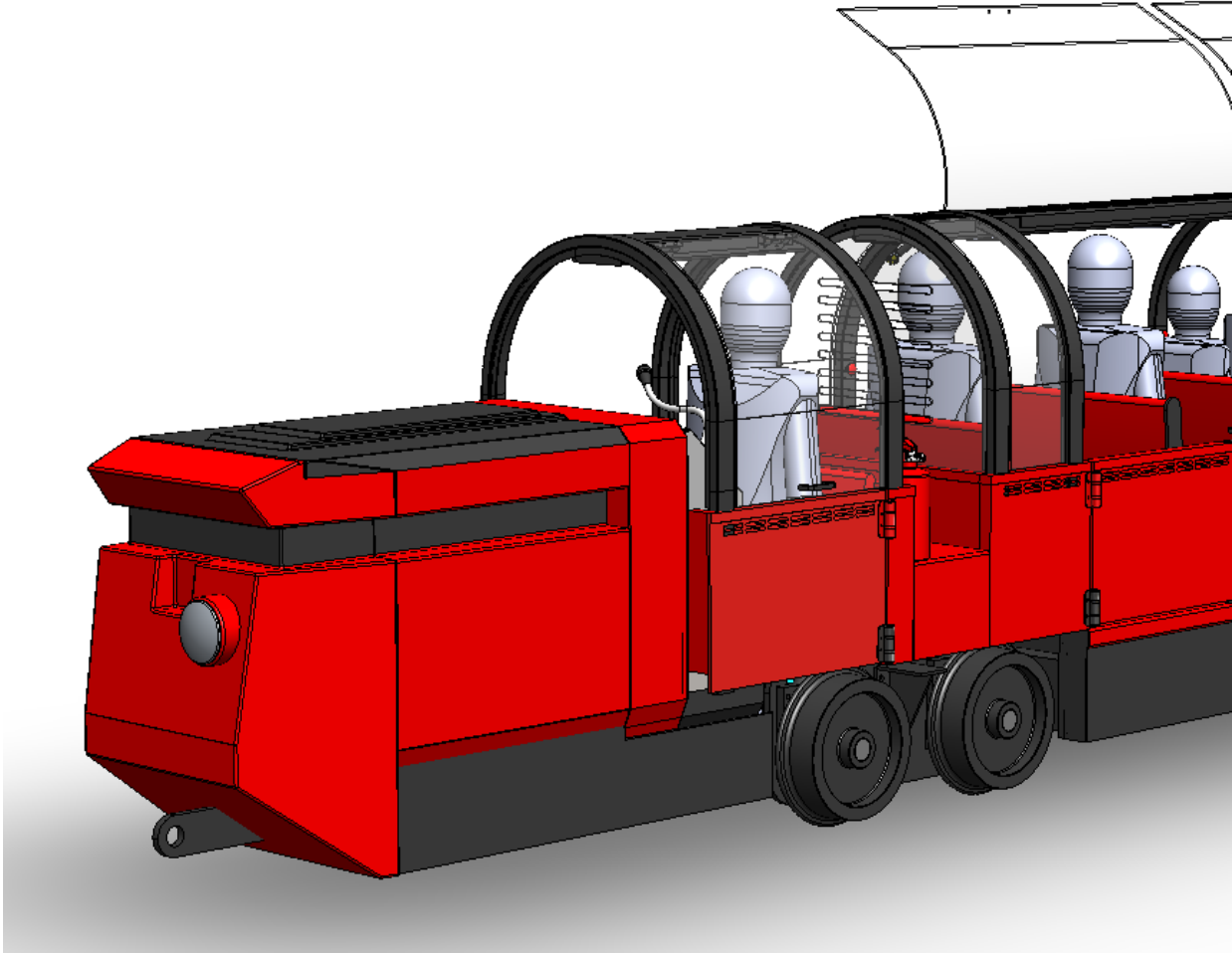
Visual Appearance



PROJECT TITLE: NEXT ASSEMBLY: FINAL ASSEMBLY:		MATERIAL: TREATMENT: FINISH:	TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: ± 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC PLACES: ± 0.1mm ANGULAR: ± 30' DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS	SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com) THIS IS THE PROPERTY OF SEVERN-LAMB AND MAY NOT BE COPIED OR USED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF SEVERN-LAMB	DRAWING SCALE: NTS BORDER A3 X 1:1 LOCATION CODE: DRAWN: APPROVED: PROJECTION:	TITLE: Visual Appearance WEIGHT (kg): DRAWING No: PART No: REV: SHEET: 1 OF 1
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DRAWING NO. DO NOT SCALE - IF IN DOUBT - ASK!

Visual Appearance



NEXT ASSEMBLY:	FINAL ASSEMBLY:
PROJECT TITLE:	

MATERIAL:
TREATMENT:
FINISH:

TOLERANCES:
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 TWO DEC. PLACES: ± 0.1mm
 ANGULAR: ± 30'

DIMENSIONS IN MILLIMETRES (mm)
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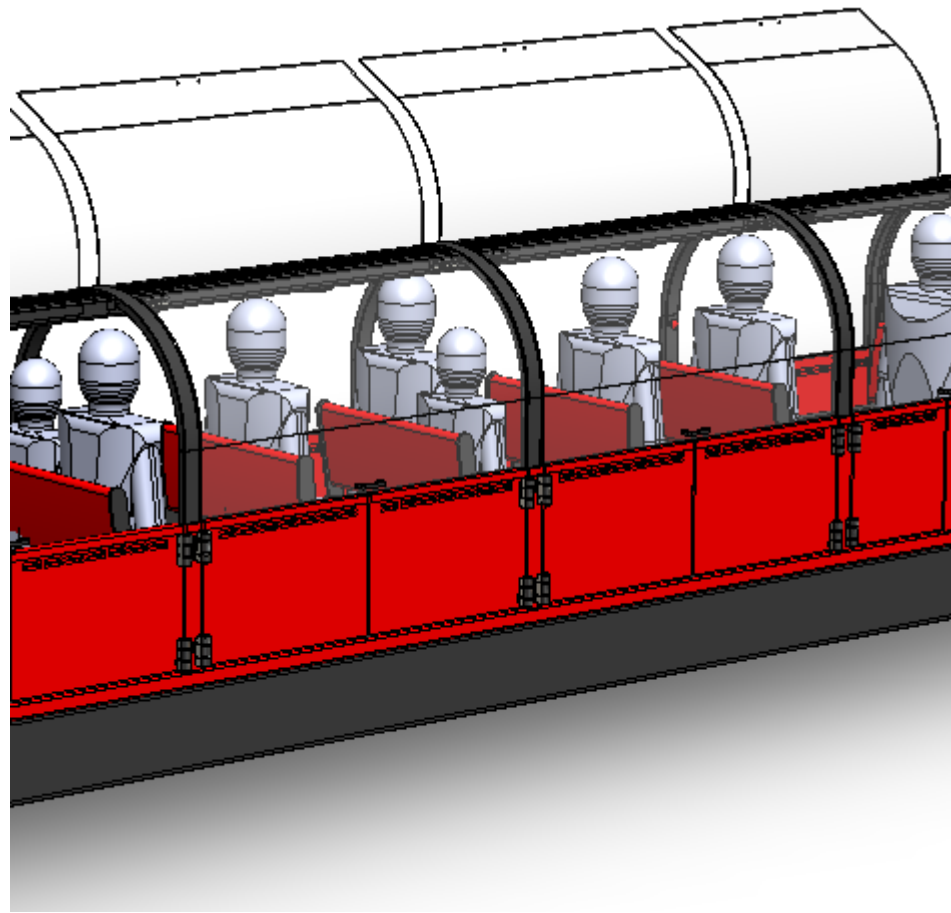


DRAWING SCALE: NTS
BORDER A3 X 1:1
LOCATION CODE:
DRAWN: DATE:
APPROVED: DATE:
PROJECTION:

TITLE: Visual Appearance				
WEIGHT (kg):	DRAWING No:	PART No:	REV:	SHEET: 1 OF 1

DRAWING No. DO NOT SCALE - IF IN DOUBT - ASK!

Visual Appearance



PROJECT TITLE:	FINAL ASSEMBLY:
NEXT ASSEMBLY:	

MATERIAL:
TREATMENT:
FINISH:

TOLERANCES:
 UNLESS OTHERWISE STATED
 OPEN DIMS: ± 1.0mm
 ONE DEC. PLACE: ± 0.5mm
 TWO DEC PLACES: ± 0.1mm
 ANGULARS: ± 30'

**DIMENSIONS IN MILLIMETRES (mm)
 SURFACE TEXTURE VALUES IN (µm)
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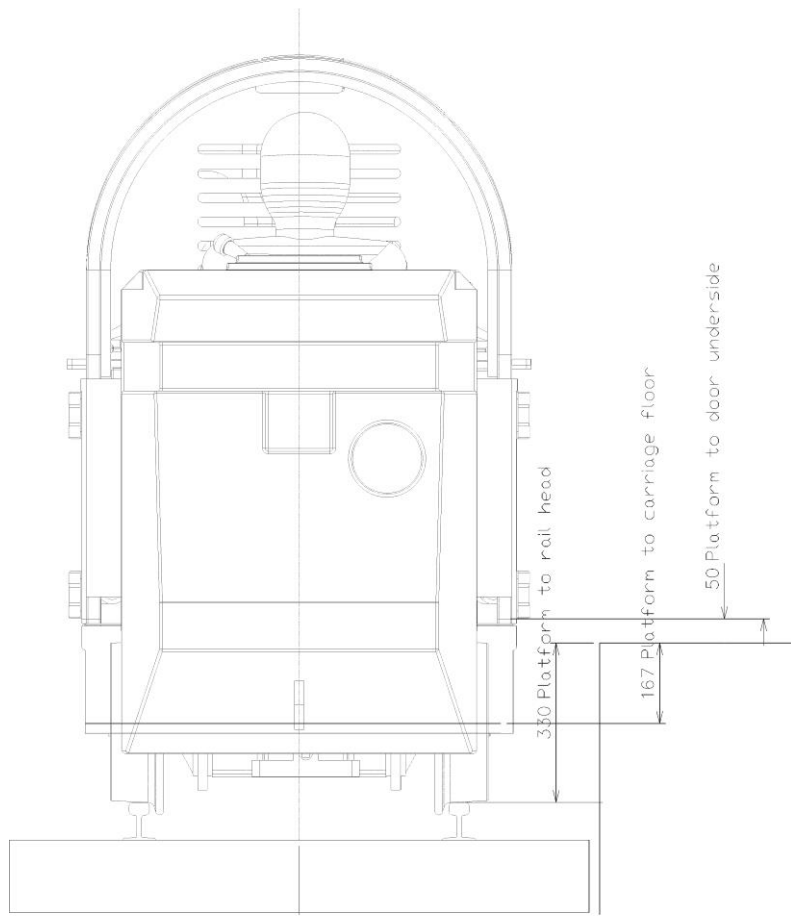


DRAWING SCALE: NTS
BORDER A3 X 1:1
LOCATION CODE:
DRAWN: DATE:
APPROVED: DATE:
PROJECTION:

TITLE: Visual Appearance				
WEIGHT (kg):	DRAWING No:	PART No:	REV:	SHEET: 1 OF 1

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Platform Interface Heights



PROJECT TITLE:		MATERIAL:	TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: ± 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC. PLACES: ± 0.1mm ANGULAR: ± 30'	SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS	TITLE:	
NEXT ASSEMBLY:	FINAL ASSEMBLY:	TREATMENT:	DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS			BORDER A3 X 1:1	Platform Interface Height	
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Performance Specification

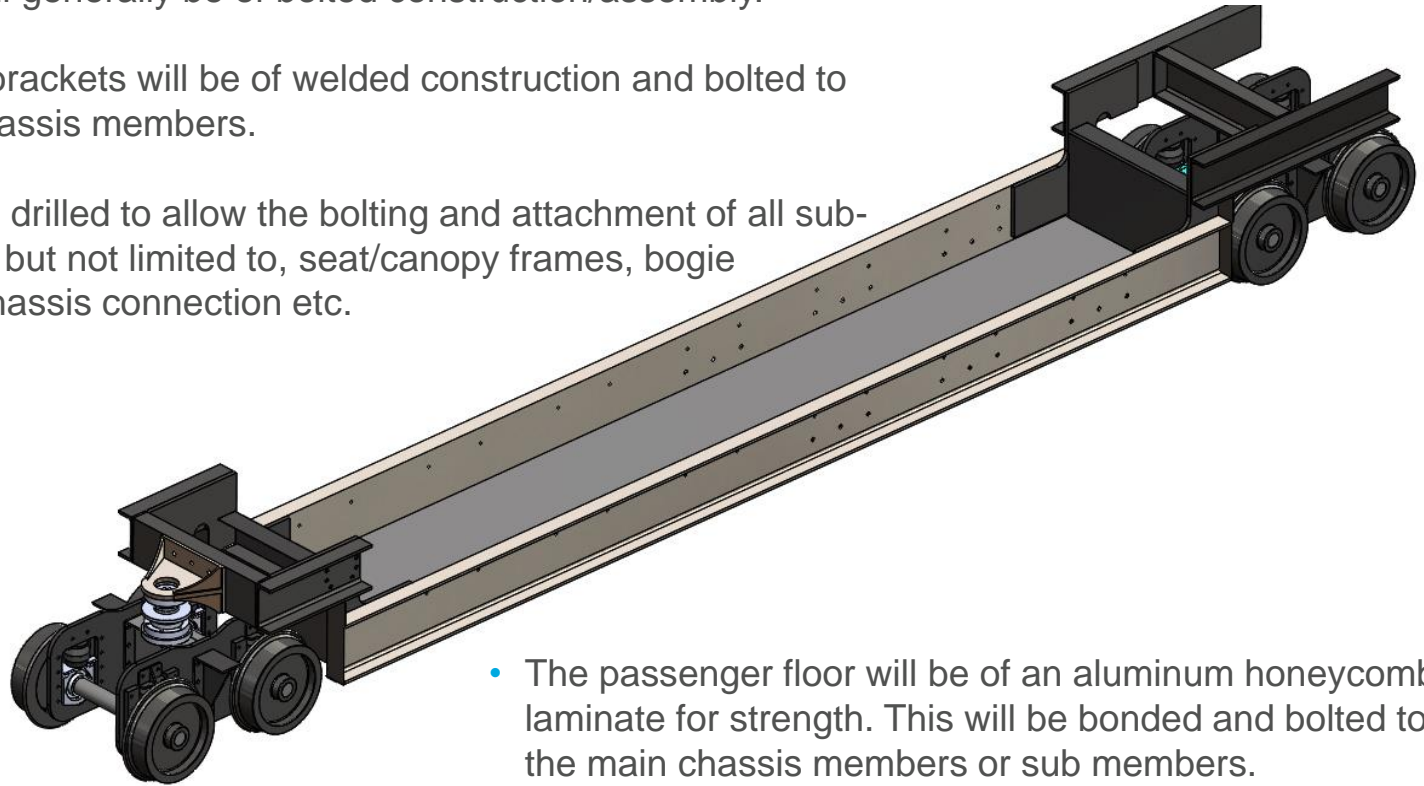
- 24" or 610mm Gauge
- Capacity of 32 adults/children with a seat width of 820mm
- Design to meet existing infrastructure
- Power train is battery electric
- Battery capacity (aka duty cycle) is
 - Max Speed: 6.5mph (10.5kph or 2.9m/s)
 - Gradient: 6.5% for 60m
 - Trips: 4 per hour (1 trip is based on 7 minutes of operational time based on an average speed of 4.5mph and 8 minutes of non operational time, total 15 minutes.)
 - Total hours: 7hrs (an option has been provided to increase the total duration to 10hrs)
- Battery charge time of 8-10hrs. One battery charger per train. Charger to be located in depot area for overnight charging.
- The train will operate in a shuttle mode
- Design to meet EN13814 Fairground and amusement park machinery and structures. Safety.

Technical Specification

- + Structural Chassis
- + Drive Bogies
- + Non Drive Bogie
- + Seats
- + Canopies
- + Doors
- + Passenger Cabin
- + Drive End
- + Drivers Cabin

Structural Chassis

- Both chassis' will be of steel construction throughout, BSEN 10025 S355 JR subject to stress calculations. Main members will be PF channels.
- Main chassis parts will generally be of bolted construction/assembly.
- Cross members and brackets will be of welded construction and bolted to the main structural chassis members.
- Main members will be drilled to allow the bolting and attachment of all sub-assemblies including, but not limited to, seat/canopy frames, bogie bolsters, chassis to chassis connection etc.

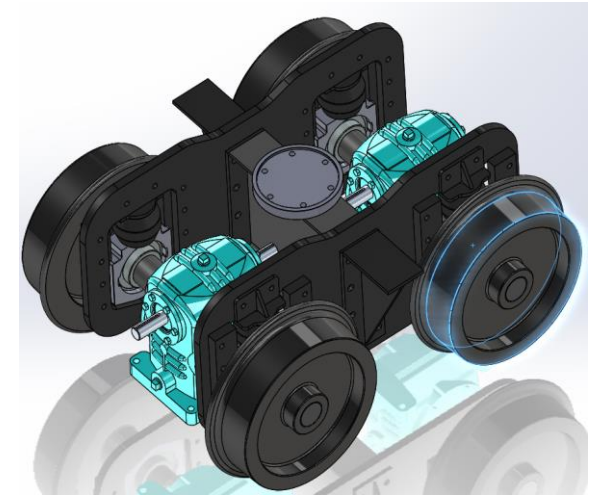


- The passenger floor will be of an aluminum honeycomb laminate for strength. This will be bonded and bolted to the main chassis members or sub members.

MATERIAL: TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: +1.0mm ONE DEC. PLACE: ±0.5mm TWO DEC PLACES: ±0.1mm ANGULARS: ±30°		SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS BORDER A3 X 1:1 LOCATION CODE: . DRAWN: DATE: APPROVED: DATE: PROJECTION:		TITLE: Chassis WEIGHT (kg): DRAWING No: PART No: REV: SHEET:	
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Drive Bogie

- The drive bogie has been designed to be low maintenance and simple to assemble.
- The structural assembly consists of two main plate frames bolted to a simple fabricated 'I' beam bolster with flat bolting plates welded onto either end.
- All structural elements making up the drive bogie will be of BSEN 10025 S355 JR Steel.
- Wheels are of steel construction with hardened treads and flanges. The flange and tread profile are the same as the existing mail rail vehicles. These may be cast or machined from a solid billet. The wheels are currently 380mm in diameter.
- Wheels are outside of the bogie frames and attached to the axles using shrink disc clamps. This allows very easy removal and/or replacement of the wheels should this be required.
- Axle box bearings run on vertical 'horn guides'. The horn guides are bolted to the outer face of the bogie plate frames and doweled to ensure correct alignment allowing easy removal of the horn guides and the axle boxes.
- Each drive bogie has two drive axles with two wheels each. Each axle is driven.



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NEXT ASSEMBLY: FINAL ASSEMBLY: PROJECT TITLE:		DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: REMOVE ALL SHARP EDGES AND BURRS		DRAWN: DATE: APPROVED: DATE: PROJECTION:		WEIGHT (kg): DRAWING No: PART No: REV: SHEET:	
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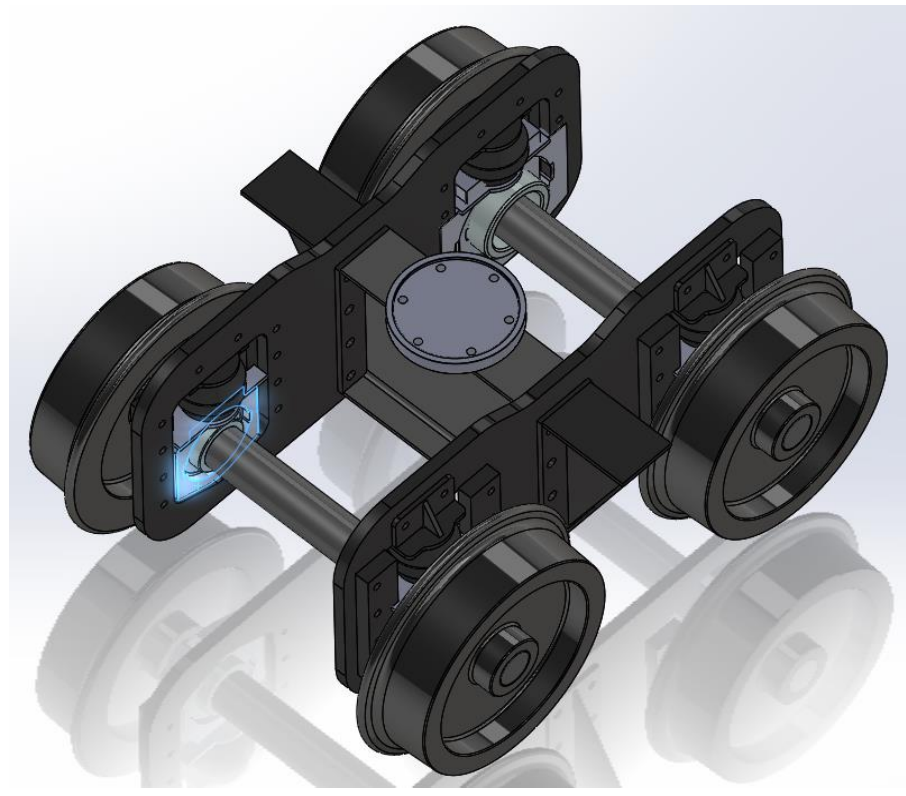
Drive Bogie

- Suspension is provided using conical rubber primary suspension springs. These springs also act as natural dampers.
- Each drive bogie has two gearboxes providing power to each of the axles. The two gearbox input shafts are coupled together by a short universal joint allowing one motor to power both axles. Gearboxes are attached to the axle using shrink disc clamps allowing quick and easy removal of the gearbox.
- Gearboxes are double enveloping worm boxes
- Service braking will be regenerative/plus braking via the electrical system. Service braking will hold the train on the incline. However if stopped on the incline for any length of time the application of the parking brake is recommended.
- Service braking is effected by proportionally reducing the speed by moving the joystick towards the neutral position, neutral braking which is when the joystick is in the neutral position which activates the electrical braking, and plug braking where the current through the motor is reversed slowing the motor down to a stop.
- Emergency & parking brake will be provided via a separate spring applied electrically released unit on the motor shaft. In the event of a recovery situation a brake release button is provided.
- In an emergency the brakes can stop a fully loaded train on the incline between 6.5m and 14m subject to track conditions.

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Non Drive Bogie

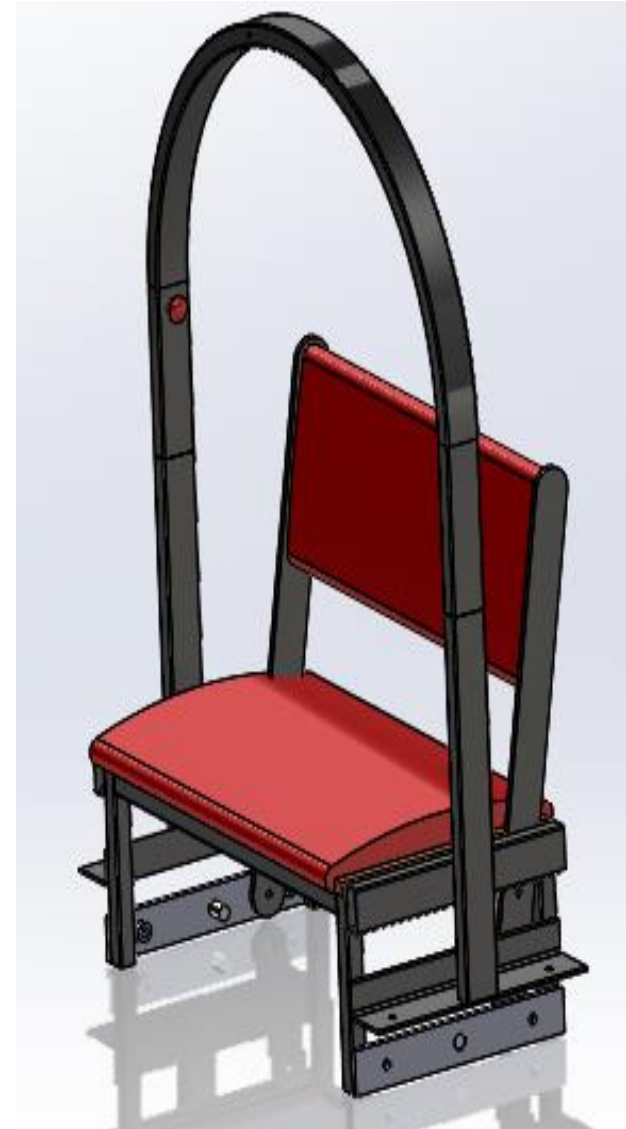
- Construction of the non-drive bogie is identical to the drive bogie without the 2 drive gearboxes and drive gearbox universal joint shaft.



MATERIAL: TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: ± 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC PLACES: ± 0.1mm ANGULARS: ± 30°		SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS BORDER A3 X 1:1 LOCATION CODE: . DRAWN: DATE: APPROVED: DATE: PROJECTION:		TITLE: Non Drive Bogie	
NEXT ASSEMBLY: FINAL ASSEMBLY: PROJECT TITLE:		DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURS		THIS IS THE PROPERTY OF SEVERN-LAMB AND MAY NOT BE COPIED OR USED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF SEVERN-LAMB		WEIGHT (kg): DRAWING No: PART No: REV: SHEET: 1 OF 1	

Seats

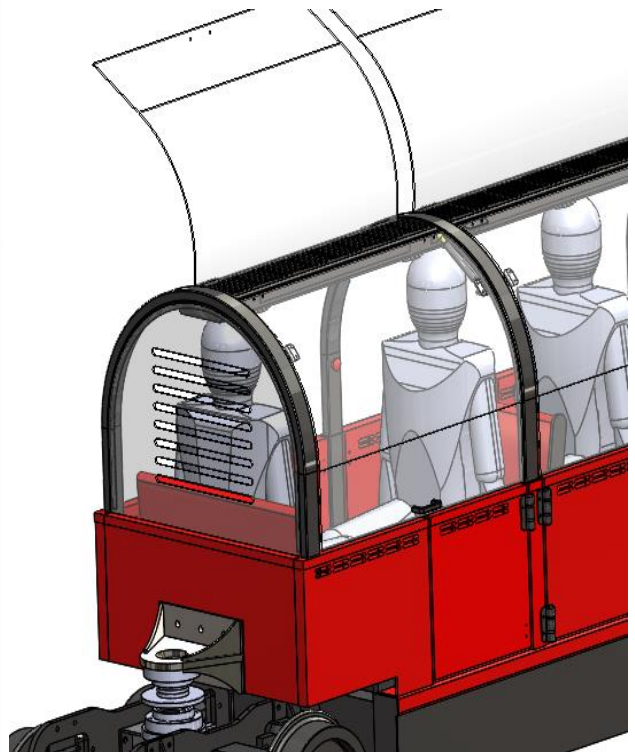
- Seat frames will be individual units and will incorporate the vehicle canopy hoop.
- Seat frames will be manufactured from steel sections with a combination of welding and bolting as appropriate. The steel will be BSEN 10025 S235 or S275.
- The seat backs will pivot/swing in the fixed seat frame allowing the operators/passengers to alter the direction the seat will face. This allows passengers to travel facing forwards.
- The seats at each end of the carriage are fixed and cannot be altered to allow for the direction of travel of the vehicle. However one pair of seats will be facing forwards at any one time.
- Padded seats will be upholstered with a mass transit grade moquette cloth.



NEXT ASSEMBLY: FINAL ASSEMBLY:		MATERIAL:	TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: ± 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC. PLACES: ± 0.1mm ANGULAR: ± 30'	SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS BORDER A3 X 1:1 LOCATION CODE:	TITLE: Seats
PROJECT TITLE:		TREATMENT:	DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS			DRAWN: DATE: APPROVED: DATE: PROJECTION:	WEIGHT (kg): DRAWING No: PART No: REV: SHEET:
		FINISH:	THIS IS THE PROPERTY OF SEVERN LAMB AND MAY NOT BE COPIED OR USED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF SEVERN LAMB				1 OF 1

DO NOT SCALE - IF IN DOUBT - ASK!

Canopies

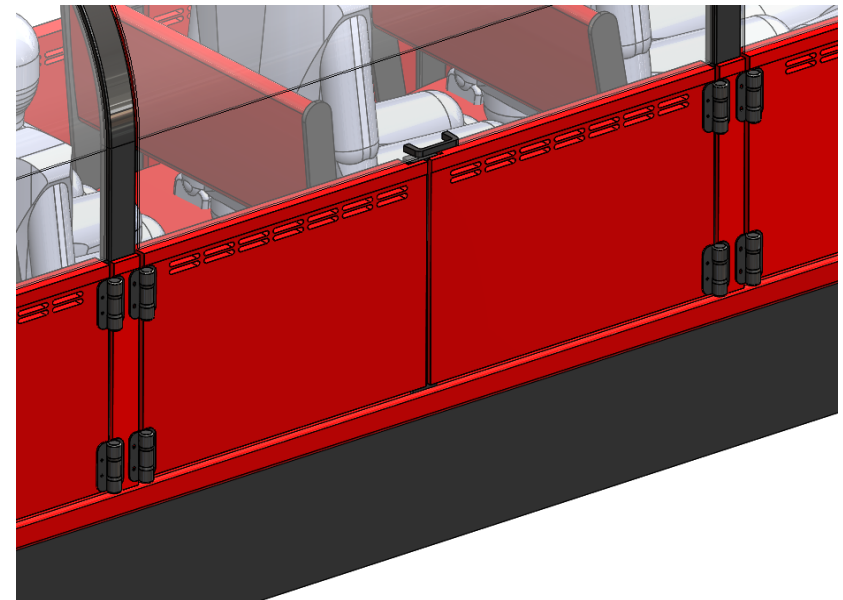


- Canopies will be hinged from the vehicle centre top rail.
- The most likely material for the canopies is glass, a combination of toughened and laminated.
- Support for the canopies to aid opening and closing will be provided by gas struts.
- Canopies will be secured shut to prevent unauthorized opening during the ride.
- Canopies will be fitted with an interior and exterior handle to aid opening & closing.
- Both sides of the vehicle will be fitted with canopies.
- Canopy closing edge will be fitted with a rubber protective edging to protect both fingers and the glass edge.
- Canopy will operate in accordance with the HAZOP.

MATERIAL: TREATMENT: FINISH:		TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: + 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC. PLACES: ± 0.1mm ANGULAR: ± 30'		SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS BORDER A3 X 1:1 LOCATION CODE:		TITLE: Canopies	
NEXT ASSEMBLY: FINAL ASSEMBLY:		DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS		THIS IS THE PROPERTY OF SEVERN LAMB AND MAY NOT BE COPIED OR USED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF SEVERN LAMB		DRAWN: DATE: APPROVED: DATE: PROJECTION:		WEIGHT (kg): DRAWING No: PART No: REV: SHEET:	

Doors

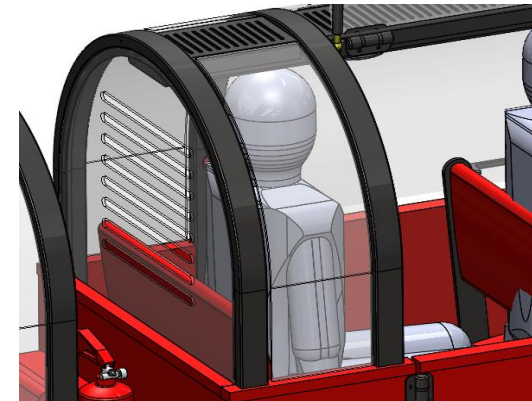
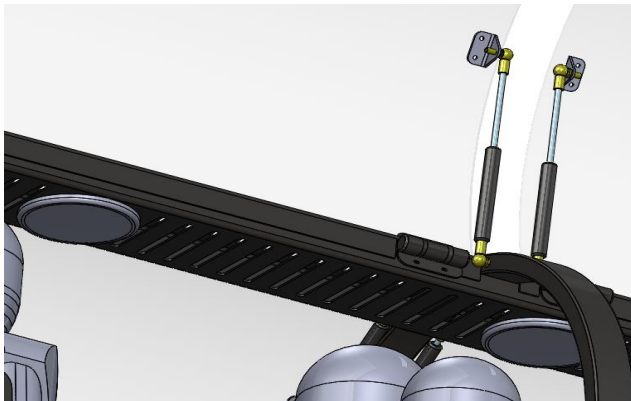
- Conventional hinged doors are provided on both sides of the vehicle.
- The doors are fitted as 3 opposing pairs (saloon door style).
- An additional single door is fitted at one end of the vehicle to access one of the single seats.
- Door hinges are sprung meaning the door naturally returns to its closed position.
- Doors will be fitted with an electromagnetic fail safe interlock to prevent any unauthorised opening during vehicle movement.
- Doors will be unlocked/locked by a button operated by the driver.
- This also ensures the train cannot move until all doors are closed and secure.
- Doors will operate in accordance with the HAZOP.
- Optionally the doors may include vented louvres as shown



PROJECT TITLE:		MATERIAL:	TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: ± 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC. PLACES: ± 0.1mm ANGULAR: ± 30'	SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS	TITLE:		
NEXT ASSEMBLY:	FINAL ASSEMBLY:	TREATMENT:	DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS			BORDER A3 X 1:1	Doors		WEIGHT (kg):
FINISH:				THIS IS THE PROPERTY OF SEVERN LAMB AND MAY NOT BE COPIED OR USED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF SEVERN LAMB		LOCATION CODE: _____ DRAWN: _____ DATE: _____ APPROVED: _____ DATE: _____ PROJECTION: 	PART No:	REV:	SHEET:
									1 OF 1

Passenger Cabin

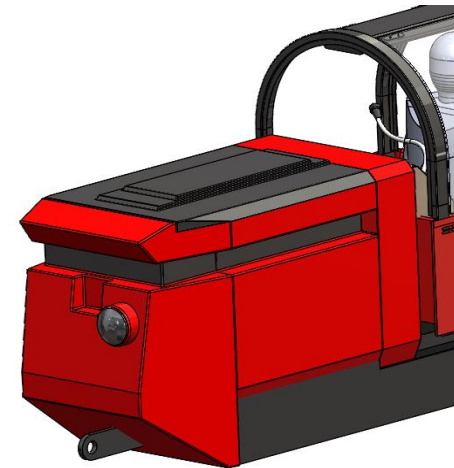
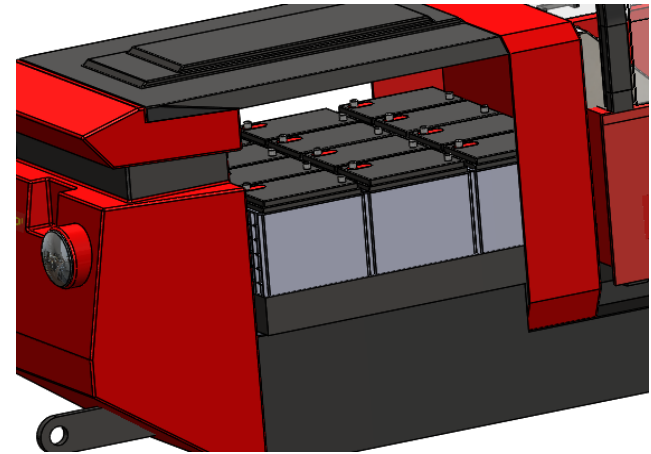
- The passenger cabins are fitted with roof mounted speakers, 8 per carriage, 16 in total.
- The passenger cabins are vented through slots in the roof spine and bulkhead windows.
- The passenger cabin will include driver alert buttons flush mounted in the roof spine.
- The floor of the passenger cabins have been designed as low as possible to allow passengers to adopt a normal seating position.
- The floor will be finished with rail grade no slip vinyl flooring, compliant to BS6853 Category 1b flammability layed using Altrofix 19+ adhesive to maintain BS6853 compliance, fitted and edged with same-colour sealant.



MATERIAL: TREATMENT: FINISH:		TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: ± 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC PLACES: ± 0.1mm ANGULARS: ± 30° DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS		SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS BORDER A3 X 1:1 LOCATION CODE: . DRAWN: DATE: APPROVED: DATE: PROJECTION: X		TITLE: Passenger Cabin WEIGHT (kg): DRAWING No: PART No: REV: SHEET:	
NEXT ASSEMBLY: FINAL ASSEMBLY:								1 OF 1	

Drive End

- The drive end aesthetics are based on existing Royal Mail rolling stock.
- The drive end houses the traction motor, batteries and drives for the traction system. (the location of the batteries has been made in consultation with and agreed with CH2M fire advisor)
- The traction motors are 12kw each with a rated speed of 2200 rpm. Two off motors are installed in the vehicle, one per drive end.
- The traction system is 72 volts D.C.
- Batteries are GEL type – maintenance free.
- The drive end has been designed to allow a winch attachment point..



MATERIAL: TREATMENT: FINISH:		TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: + 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC PLACES: ± 0.1mm ANGULAR: ± 30'		SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS BORDER A3 X 1:1 LOCATION CODE: . DRAWN: DATE: APPROVED: DATE: PROJECTION: <input checked="" type="checkbox"/>		TITLE: Drive End		WEIGHT (kg): DRAWING No: PART No: REV: SHEET:	
PROJECT TITLE: NEXT ASSEMBLY: FINAL ASSEMBLY:		DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS		THIS IS THE PROPERTY OF SEVERN LAMB AND MAY NOT BE COPIED OR USED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF SEVERN LAMB				1 OF 1			

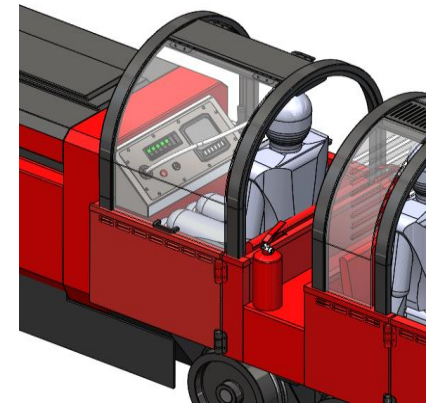
Charger

- Battery charger rated suitably to recharge the above batteries from 80% discharged to fully charged within a 8-10hour period.
- The battery charger will be a High Frequency charger with a rated output of 72V 60A. The input will be 415Vac 3 Phase, which we would suggest is connected to a 3 phase D type circuit breaker rated at 10A per phase.
- The charger is approximately 330 x 355 x 170mm and weighs approximately 15kg. Final dimensions and weight subject is subject to change and final specification.
- The charger will be remote to the train and will have one common plug to both battery banks
- The train can operate on a minimum charge level however in order to ensure a full days use the battery will require to be 100% charged.
- The train can be charged pro rata therefore based on a full 8hr charge taking the battery from 20% to 100%, 2hrs would take it from 20% to just below 40%.
- The train will operate as normal down to a minimum charge level.
- The train can be maintained while the battery is charging although the battery itself cannot be. By connecting the charger this disconnects the batteries, motors and controllers.

PROJECT TITLE:		MATERIAL:	TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: ± 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC PLACES: ± 0.1mm ANGULARS: ± 30'	SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS BORDER A3 X 1:1 LOCATION CODE:	TITLE: Charger				
NEXT ASSEMBLY:	FINAL ASSEMBLY:	TREATMENT:	DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS	THIS IS THE PROPERTY OF SEVERN-LAMB AND MAY NOT BE COPIED OR USED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF SEVERN-LAMB		DRAWN: DATE: APPROVED: DATE: PROJECTION:	WEIGHT (kg):	DRAWING No:	PART No:	REV:	SHEET:
		FINISH:				 					1 OF 1

Drivers Cabin

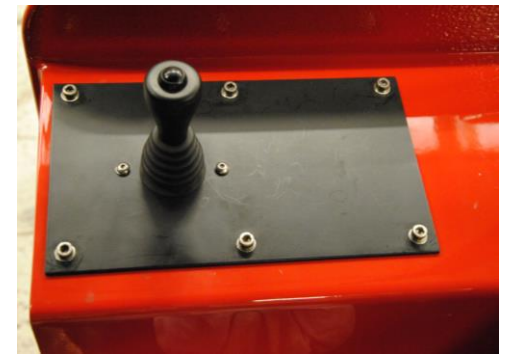
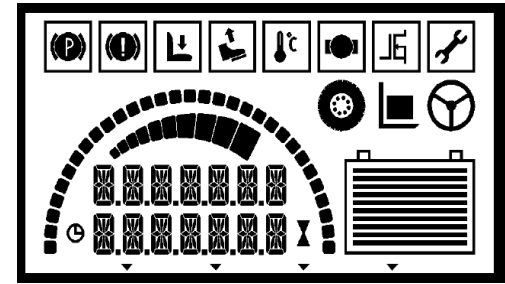
- The drivers cab is fitted with a clear front screen. There is no rear screen and no canopy.
- The cab is fitted with a dash panel consisting of all controls, switches and indicator lights required to operate the vehicle in a controlled and safe manner.
- Forward facing driver position including back lit cockpit controls.
- Drivers seat to be a bench seat similar to the passenger seats.
- Fully featured operator controls will be provided including a joystick drive control with deadmans thumb switch and a fully featured dash including drive system monitoring system, passenger audio controls, handbrake, 2 way radio, passenger announcement gooseneck microphone and other required pushbutton controls.
- Controls will be illuminated
- Two fire extinguishers are mounted behind the drivers cabin. Type of extinguisher to be defined by CH2M



MATERIAL: TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: ± 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC PLACES: ± 0.1mm ANGULARS: ± 30°		SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS BORDER A3 X 1:1 LOCATION CODE:		TITLE: Drive End	
NEXT ASSEMBLY: PROJECT TITLE:	FINAL ASSEMBLY: TREATMENT: FINISH:	DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS		DRAWN: DATE: APPROVED: DATE: PROJECTION:		WEIGHT (kg): DRAWING No: PART No: REV: SHEET:	
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Drivers Dash

- Ignition key switch
- Joystick for proportional speed control with deadmans function
- Sevcon Display
 - Speed
 - Battery Charge State
 - Fault Codes
- Parking brake
- Lock doors & canopy switch & over-ride switch
- Doors locked left (optional extra)
- Doors locked right (optional extra)
- Canopies locked left (optional extra)
- Canopies locked right (optional extra)
- Driver alert light with buzzer
- Over heating indicators
 - Motor (optional extra)
 - Controller
 - Batteries (optional extra)
- E-Stop
- Creep speed switch (provisional subject to mode of operation)
- Over speed Switch (provisional subject to normal speed of operation)
- Goose-neck microphone for passenger announcements
- Audio System



MATERIAL: TREATMENT: FINISH:		TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: ± 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC PLACES: ± 0.1mm ANGULARS: ± 30° DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS	SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TITING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS BORDER A3 X 1:1 LOCATION CODE: . DRAWN: DATE: APPROVED: DATE: PROJECTION: X	TITLE: Drivers Dash WEIGHT (kg): DRAWING No: PART No: REV: SHEET: 1 OF 1
NEXT ASSEMBLY: PROJECT TITLE:	FINAL ASSEMBLY:					

Redundancy

The electrical and drive system includes a number of redundancy systems as follows.

- Each drivers cabin are a replication of each other. The train can be operated from either end.
- Should a motor fail at one end, the driver will be notified by way of a light on the dash, and the train can still operate using only one motor. During this time the maximum operating speed will be halved.
- Should a controller, or joystick fail the train can be operated from the other end drive end.
- Should a battery fail the train can still be operated however total capacity will be circa halved.
- The braking is fail safe therefore if there is a total loss of power the brakes will automatically be applied. There is an override button and manual override to unlock the brakes for the purposes of winching the train.
- Included are two proximity sensors allowing for redundancy should one proximity fail.

Expected Component Life

The following durations are estimated durations of component life cycles based on manufacturers advice, regular maintenance and use within manufacturers guidelines. These do not constitute any form of guarantee or warranty.

Batteries	7-10 years
Wheels	3-5 years
Motors/Controllers	15 years
Communications Systems Network	15 years
Design Life	20 years

Optional Extras - Mechanical

Second Train & associated additional commissioning (based on original specification excluding any selected optional extras)	One off cost	£224,300
Loco Cabin & Passenger Cabin Ergonomic Rig - wood seat, box door frame wood clad, hinges, wire frame canopy with polythene cover	One off cost	£4,920
Wayside Winch Recovery includes rail trolley and rail clamping assembly	Per Winch	£16,400
Wayside Flange Lubricator – hydraulic grease rail lubricator , includes 5 x 12.5kg drums of grease (recommended quantity 2 off)	Per Lubricator	£5,530
On board Flange Lubricator	Per Train	£4,750
Door grill/louvre vents top of each door with mesh	Per Train	£5,415
End of line hard stop/buffers	One off cost	TBC

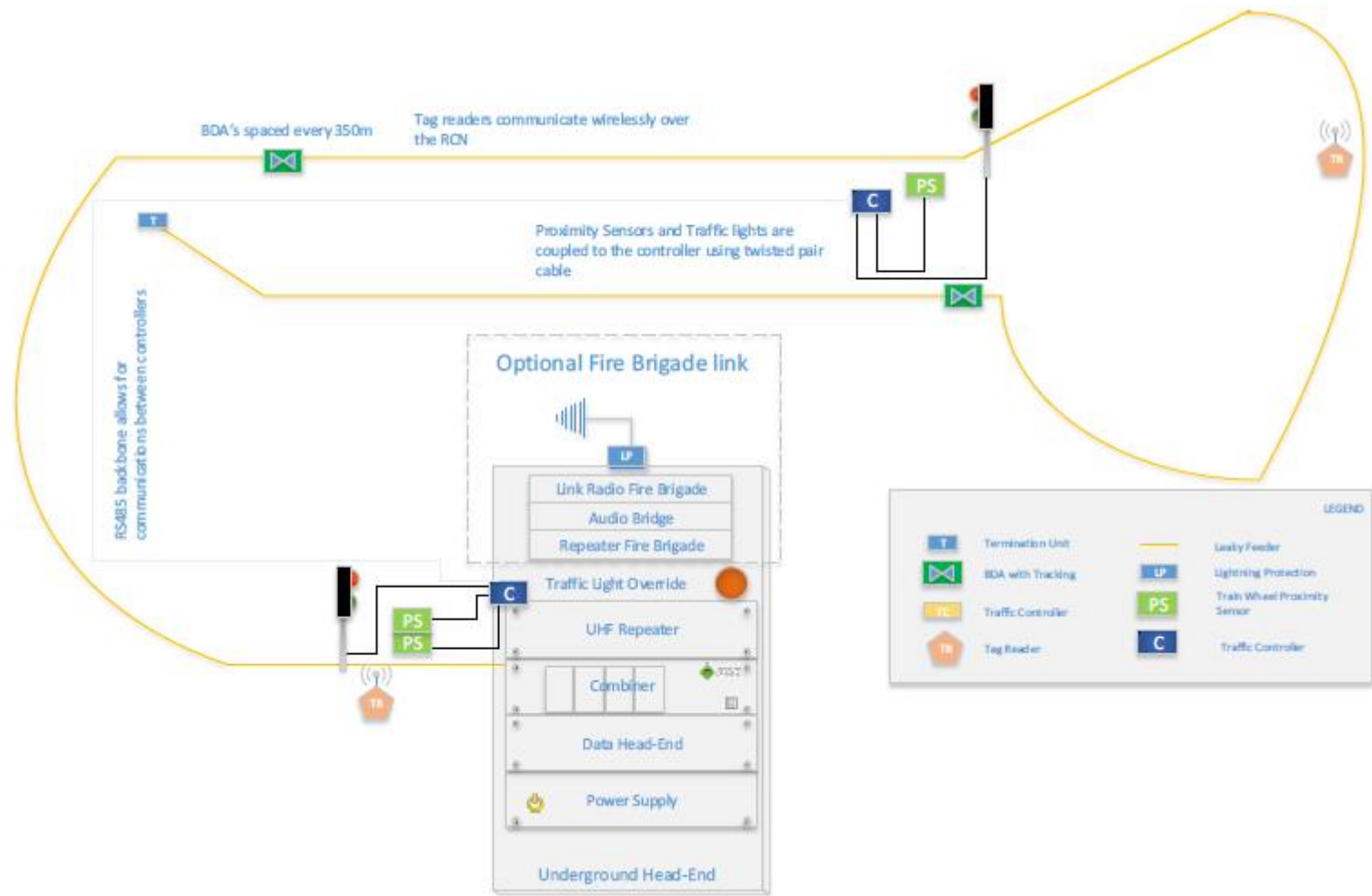
Optional Extras – Electrical

Increase of duty cycle from 7hrs to 10hrs	Per Train	£2,750
Battery management system allowing for overheat indicator on dash	Per Train	£650
Motor overheating indicator on dash	Per Train	£410
Half speed onboard proximity sensors. This could then be used for limiting the speed entering the station area as well initiating creep speed at various points around the route.	Per Train	£1,500
Dead stop onboard proximity sensors. This would be located at the station end to kill power to the train should it pass a designated point at the end of the station	One off cost	£1,750
Zoning Targets – required to designate the start and end of a half speed zone. One pair will be required per zone.	Per Pair	£250
Door closed indicator lights on doors	Per Train	£3,000
Door/canopy interlocked status lights on dash	Per Train	£2,500
Passenger cabin courtesy lighting, based on 14 LED lights per carriage, total of 28 LED lights	Per Train	£4,250
Opposing drive end dash fault indicators	Per Train	£825

Communications & Operator Console

- + Head end - Basic 2 Channel UHF Head End
- + Software - Mineboss Platform
- + Radiating Cable and Amplifiers (aka Leaky feeder)
- + Portable Radio's (10 off)
- + Entry and Exit tagging System - Assumed 4 locations
- + Electronic Tags - Assumed 10no Tags
- + Installation works will be completed as part of a single mobilisation and planned works.
- + Please note that we have not been provided with any actual locations for the equipment locations so we have made some sensible assumptions. If there is a significant change in design we would require that that element be re-validated against the revised scope.

Communication Network



MATERIAL:		TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: + 1.0mm ONE DEC. PLACE: - 0.5mm TWO DEC. PLACES: - 0.1mm ANGULAR: - 30'	
NEXT ASSEMBLY:		DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS	
FINAL ASSEMBLY:			
TREATMENT:			
FINISH:			

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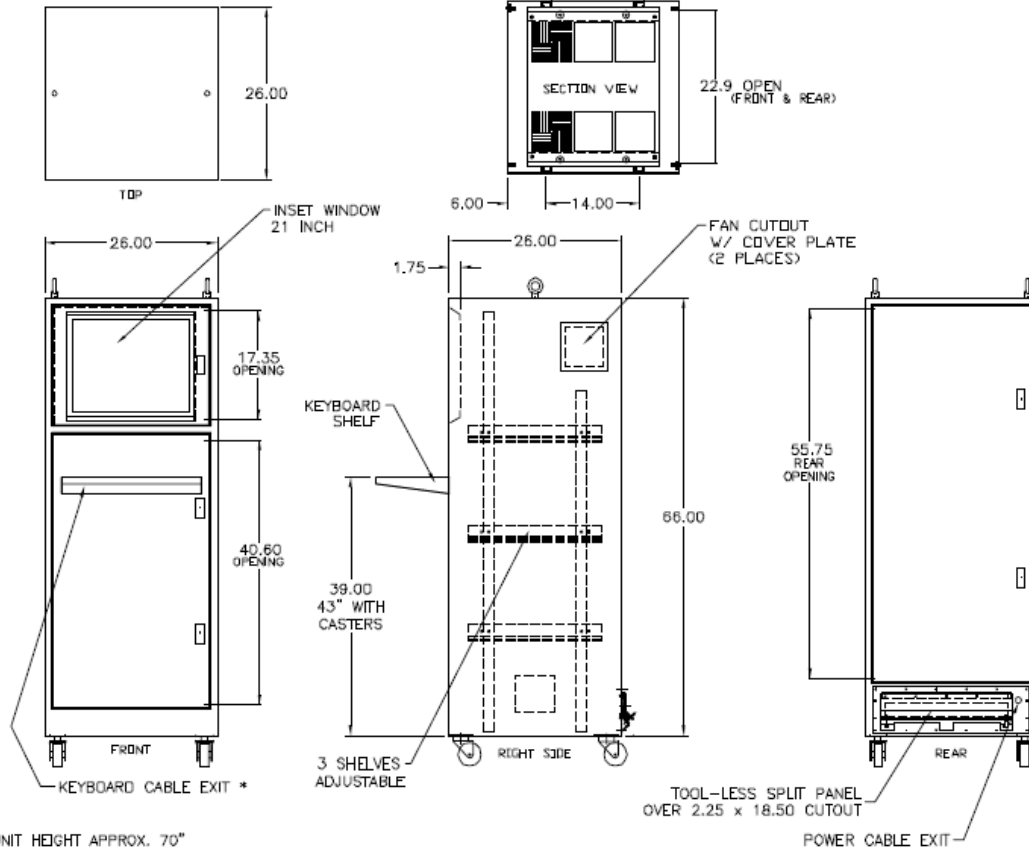
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DRAWING SCALE: NTS	TITLE:
BORDER A3 X 1:1	Communication Network Example
LOCATION CODE:	
DRAWN: DATE:	
APPROVED: DATE:	
PROJECTION:	

WEIGHT (kg):	DRAWING No:	PART No:	REV:	SHEET:
				1 OF 1

Ride Controller Console



TOTAL UNIT HEIGHT APPROX. 70"
 WHEN MOUNTED ON LOCKABLE CASTERS OR FIXED LEGS
 21" VIEWING AREA 13.88 x 17.48
 ENCLOSURE INCLUDES TWO INSTALLED
 PS2 8-PIN KEYBOARD CABLES.

MATERIAL:		TOLERANCES: UNLESS OTHERWISE STATED OPEN DIMS: ± 1.0mm ONE DEC. PLACE: ± 0.5mm TWO DEC PLACES: ± 0.1mm ANGULAR: ± 30°		SEVERN LAMB PHONE: 01789 400140 - FAX: 01789 400240 TYTHING ROAD, ALCESTER, WARWICKSHIRE, B49 6ET, ENGLAND (E-MAIL: technical@severn-lamb.com)		DRAWING SCALE: NTS BORDER A3 X 1:1 LOCATION CODE:		TITLE: Ride Controller Console	
NEXT ASSEMBLY:		DIMENSIONS IN MILLIMETRES (mm) SURFACE TEXTURE VALUES IN (µm) MACHINE WHERE MARKED: ✓ REMOVE ALL SHARP EDGES AND BURRS		THIS IS THE PROPERTY OF SEVERN LAMB AND MAY NOT BE COPIED OR USED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF SEVERN LAMB		DRAWN: DATE: APPROVED: DATE: PROJECTOR:		WEIGHT (kg): DRAWING No: PART No: REV: SHEET:	
PROJECT TITLE:		FINISH:		THIS IS THE PROPERTY OF SEVERN LAMB AND MAY NOT BE COPIED OR USED IN WHOLE OR PART WITHOUT THE WRITTEN CONSENT OF SEVERN LAMB		PROJECTOR:		1 OF 1	

Optional Extras – Communications

Signalling (manual)	One off cost	£19,700
Increase tracking zones – an extra tag reader is required for each additional zone, includes power supply	Per reader	£3,795
Fire brigade interface	One off cost	£3,500
Installation of the surface coverage cables and antennas required for the fire brigade option	One off cost	TBC
Multi gas monitoring – per station	Per station	£5,985
Installation of signalling (subject to final location)	One off cost	Included
Upgrade signalling from manual to automatic with override	One off cost	£5,200
<p>UPS</p> <ul style="list-style-type: none"> • Head End Cabinet:- Additional labour time required for build-up and testing in the factory, Additional cabling would be included, Battery backup hardware would be included. • Signal Controller Remote:- Enclosure price would require updating to allow for larger enclosure to house the battery backup, Additional labour time required for build-up and testing in the factory, Additional cabling would be included, Battery backup hardware would be included • Sensors traffic lights and cabling:- The traffic lights would be changed to a DC variant with controller, Additional 60m of cabling would be provided to supply DC to the traffic lights rather than being powered from source. • Override unit:- Battery backup would be included. Additional cabling and install costs have been included. 	One off cost	£8,575

Track work

- + Removal of Third Rail
- + Correct one Position Tight of Gauge
- + Replace 14 split sleepers/timbers and 44 rotten sleepers/timbers (Labour Only)
- + All turnouts to be locked off with a proprietary lock (excluding padlocks)
- + Addition of 1x Turnout

Optional Extras – Track Work

Supply only of additional turnout (based on free issue of necessary track)	Per turnout	£9,875

Queue Line

- + 8 x Portable Lightweight Aluminium barriers
- + 1 x Portable Lightweight Aluminium barrier - Door
- + 2 x Portable (On Casters) Barrier Cart/Container
- + 44 x Portable posts and retractable belt line, post 3.6m, powder coated finish

Variations to Contract

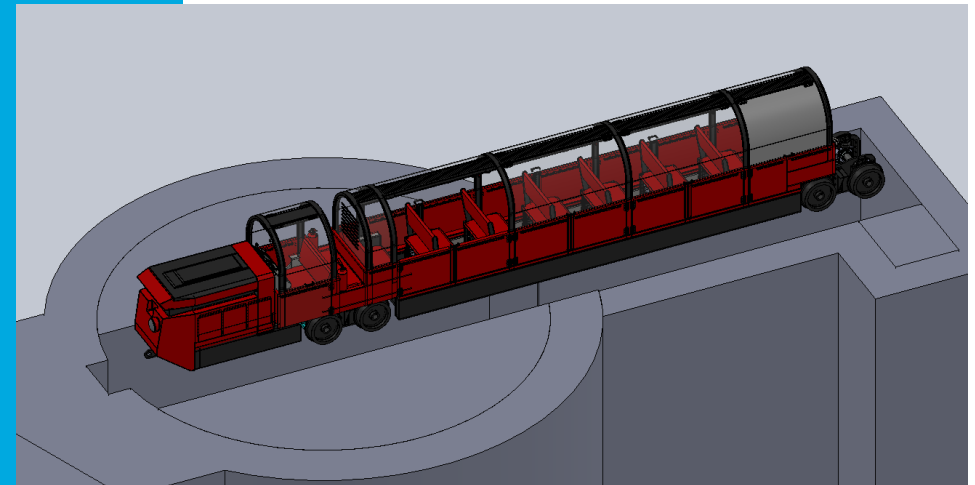
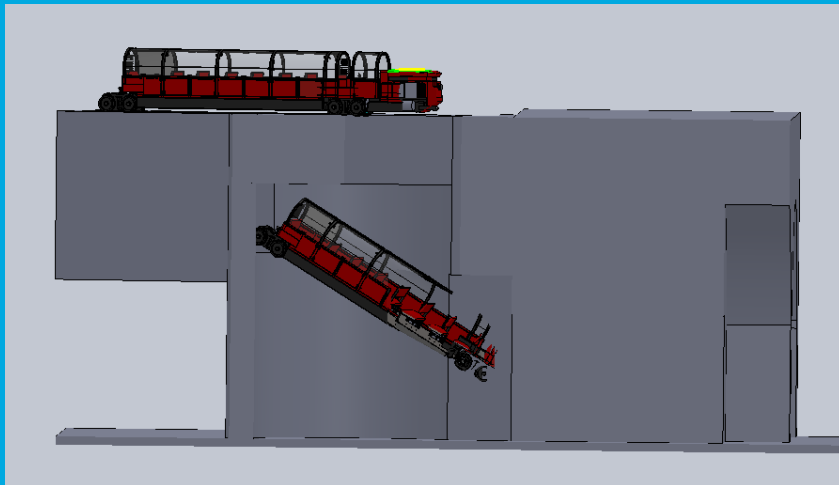
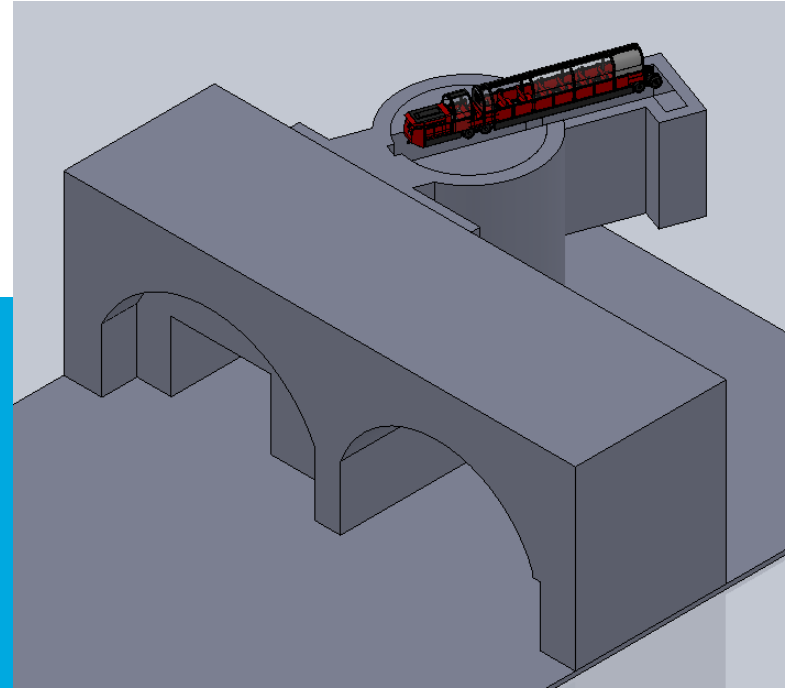
VO #	Brief Description of the reasons for the change:	Change Description:	List of deliverables	Timetable for implication of the change:	Contract Implications:	Costs implications:
1	We have been able to incorporate an optional extra, the provision of gearboxes, within the existing design and supply budget which ultimately provides the train with a more robust, smaller packaged and maintenance friendly way of providing drive to the wheels.	To replace the chain and sprockets with a gearbox	Design to incorporate a drive system using a gearbox rather than chain and sprockets	With immediate effect	None	None
2	The light "brightness" of the Sevcon display is not variable/dimmable.	Exclude the button to dim the dash lights.	n/a	With immediate effect	None	None

Installation

From the models provided we can demonstrate that the carriage will clear the existing access shaft aperture.

For the purposes of installation we would likely remove the batteries and non drive bogie. We would also suggest covering the carriage body work with a protective foam. Each carriage would enter at approximately 30degrees.

Installation is by others. Lifting points are provided.



ENGINEERED CONCEPT

Design Approval

You are confirming that the trains design and its character matches your visual intent and technical specification. The ride will be designed, fabricated and assembled to these outline details unless otherwise stipulated. Changes from what is agreed within this document and from this point forwards will be managed via formal change management and may incur cost and/or schedule delays.

Date	
Signed on behalf of The British Postal Museum & Archive	

Proud to be made in Britain **since 1947**

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