CALIFORNIA HIGH-SPEED TRAIN
System Requirements Database Report

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CHSTP System Requirement Text sorted by Reference

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California High-Speed Train Project

SYSTEM REQUIREMENTS DATABASE REPORT

CHSTP System Requirement Text sorted by Reference

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Prepared by  for the California High-Speed Rail Authority

3-01 **Infrastructure General provisions** **(INF)**

This part prescribes minimum safety requirements and performance level for intercity railroads intended for the operation of passenger only trains at speed greater than 150 mph.
The infrastructure of the rail system under this part shall comply with the following characteristics:
•□Fully grade-separated trackway
•□Level boarding passenger platforms
•□Fully access-controlled trackway
•□Allow the passage of trains with a maximum length of 1320 feet and a maximum weight of 22 tons per axle.
The requirements prescribed in this part apply to specific track conditions existing in isolation. Therefore, a combination of track conditions, none of which individually amounts to a deviation from the requirements in this part, may require remedial action to provide for safe operations over that track. This part does not restrict a railroad from adopting and enforcing additional or more stringent requirements that are inconsistent with this part.

3-02 **Nominal track gauge** **(INF)**

(a) Track gauge is measured between the heads of the rails at right angles to the rail in a plane five-eighths of an inch below the top of the rail head.
(b) Nominal track gauge shall be 4'–8½"

3-03 **Minimum infrastructure gauge** **(INF)**

The infrastructure shall allow safe clearance for the passage of trains complying with the High-Speed Rolling Stock requirements, and shall meet the minimum clearance requirements of California PUC GO 26D.

3-04 **Distance between track centers** **(INF)**

The distance between track centers shall be based on that required for aerodynamic considerations, design speed, and ease of maintenance. The minimum distance between main track centers on lines where high-speed rolling stock will be operated exclusively (no Shared Use) shall be:

(See Attachment)

Where aerodynamic analysis demonstrates that larger values are required, the larger values shall become the minimum distances between track centers for the high-speed rolling stock and design speed under consideration.
Where conventional rolling stock is operated on the same tracks as the high-speed trains, the distance between track centers shall be increased to meet the requirements of respective operators.
The distance between track centers may be increased for passenger comfort or maintenance requirements.
The distance between main track centers shall remain constant to the extent practical.

3-05 **Maximum rising and falling gradients** **(INF)**

The alignment shall have the smoothest practical profile. Grades shall be as low as practical. Maximum grade shall not exceed 3.5%.
The following maximum grade requirements shall be observed:
- the slope of the moving average profile over 32,000 feet shall be less than or equal to 2.5%
- the maximum length of continuous 3.5% grade shall not exceed 20,000 feet
Grade of main tracks through passenger platforms shall not be greater than 0.25%

3-06 **Minimum radius of curvature** **(INF)**

The minimum radius of curvature shall be such that, at the maximum speed for which the curve is designed, the unbalanced superelevation does not exceed the values indicated in System Requirements Reference 3-08.

3-07 **Actual Superelevation (Ea)** **(INF)**

Actual Superelevation (Ea) is the maximum difference in height between outer and inner rails measured at the center of the rail head surface (in inches).
The maximum actual superelevation shall be limited to 7 inches.
In addition, approved HSR rolling stock equipment may be operated at curving speeds determined by the CHSTP System Requirement 3-06 provided:

(1) It is demonstrated when positioned on a track with uniform superelevation, Ea, reflecting the intended target cant deficiency, Eu, no wheel of the equipment unloads to a value of 60 percent or less of its static value on perfectly level track and, for passenger-carrying equipment, the roll angle between the floor of the vehicle and the

horizontal does not exceed 5.7 degrees.

(2) It is demonstrated when positioned on a track with a uniform 7-inch superelevation, no wheel unloads to a value less than 60% of its static value on perfectly level track and, for passenger-carrying equipment, the angle, measured about the roll axis, between the floor of the vehicle and the horizontal does not exceed 8.6 degrees.

3-08.1 **Unbalanced Superelevation on plan track and on the through route of switches and crossings** **(INF)**

Unbalanced superelevation on curves shall not exceed 3 inches.

3-08.2 **Abrupt change of unbalanced superelevation on diverging track of switches** **(INF)**

Abrupt change of unbalanced superelevation on curves through the diverging track of turnouts on CHSTP shall not exceed 4.5 inches per second.

3-09 **Equivalent conicity** **(INF)**

A consistent wheel-rail interface shall be provided.

3-09.1 **Definition** **(INF)**

None

3-09.2 **Design values** **(INF)**

None

3-09.3 **In service values** **(INF)**

In addition to the minimum and maximum values allowed for track gauge, the average track gauge through any given 500 feet of track on straight track and tracks with degree of curve of 0 degrees 10 minutes or less (radius of curve of 34,377.5 feet or more) shall be maintained to be no less than:
(See attachment)

3-10 **Track Geometrical Quality and limits on isolated defects** **(INF)**

Track meeting all the following requirements permits a maximum allowable operating speed of 250 mph.
Track gage.
(a) Gage is measured between the heads of the rails at right-angles to the rails in a plane five-eighths of an inch below the top of the rail head.
(b) Gage shall be within the limits prescribed in the following table: (See attachment)
Curves, elevation and speed limitations.
(a) The maximum crosslevel on the outside rail of a curve shall not be more than 7 inches. The outside rail of a curve shall not be more than ¼ inch lower than the inside rail.
(b) The maximum allowable operating speed for each curve is determined by the following formula: (See Attachment)
Where—
Vmax= Maximum allowable operating speed (miles per hour).
Ea= Actual elevation of the outside rail (inches)1 .
R = Radius of Curve (feet)2 .
3 = 3 inches of unbalance.
(c) For rolling stock meeting the requirements specified in paragraph (d) of this section, the maximum operating speed for each curve may be determined by the following formula: (See Attachment)
Where—
Vmax= Maximum allowable operating speed (miles per hour).
Ea= Actual elevation of the outside rail (inches)1 .
R = Radius of Curve (feet)2 .
Eu= Unbalanced elevation (inches).
Footnotes for (b) and (c):
1 Actual elevation for each 155 foot track segment in the body of the curve is determined by averaging the elevation for 10 points through the segment at 15.5 foot spacing. If the curve length is less than 155 feet, average the points through the full length of the body of the curve. If Eu exceeds 4 inches, the Vmax formula applies to the spirals on both ends of the curve.
2 Radius of curvature is determined by averaging the radius of curvature over the same track segment as the

elevation.
Track surface.
(a) For a single deviation in track surface, each owner of the track to which this subpart applies shall maintain the surface of its track within the limits prescribed in the following table:
(b) For three or more non-overlapping deviations in track surface occurring within a distance equal to five times the specified chord length, each of which exceeds the limits in the following table, each owner of the track to which this subpart applies shall maintain the surface of the track within the limits prescribed for each deviation:

Alignment.
(a) Uniformity at any point along the track is established by averaging the measured mid-chord offset values for nine consecutive points centered around that point and which are spaced according to the following table: (See Attachment)
(b) For a single deviation, alignment shall not deviate from uniformity more than the amount prescribed in the following table: (See Attachment)
(c) For three or more non-overlapping deviations from uniformity in track alignment occurring within a distance equal to five times the specified chord length, each of which exceeds the limits in the following table, each owner of the track to which this subpart applies shall maintain the alignment of the track within the limits prescribed for each deviation: (See Attachment)

3-11 **Rail inclination** **(INF)**

The rail seat shall provide for rail inclination within the range of 1:20 to 1:40 ±5 toward the center line of mainline tracks and mainline turnouts. The following exception is permitted in Switches and Crossings: The rail seat inclination may be provided by the shape of the active part of the rail head profile.

3-12 **Switches and crossings** **(INF)**

Turnouts and track crossings for High Speed Rail tracks - General.
a) In turnouts and track crossings, the fastenings shall be intact and maintained so as to keep the components securely in place. Also, each switch, frog, and guard rail shall be kept free of obstructions that may interfere with the passage of wheels.
(b) Track shall be equipped with rail anchoring through and on each side of track crossings and turnouts, to restrain rail movement affecting the position of switch points and frogs. Elastic fasteners designed to restrict longitudinal rail movement are considered rail anchoring.
(c) Each flangeway at turnouts and track crossings shall be at least 1½ inches wide.
(d) There shall be no fixed frogs in high speed rail tracks.
(e) There shall be no road crossings or rail to rail crossings in main tracks. Rail crossings may be used in main only in crossovers between main tracks.
1. Switches.
(a) Each stock rail shall be securely seated in switch plates, but care shall be used to avoid canting the rail by overtightening the rail braces.
(b) Each switch point shall fit its stock rail properly, with the switch stand in either of its closed positions to allow wheels to pass the switch point. Lateral and vertical movement of a stock rail in the switch plates or of a switch plate on a tie shall not adversely affect the fit of the switch point to the stock rail.
(c) Each switch shall be maintained so that the top of the switch rail shall be within one-eighth inch of the top of the stock rail.
(d) The heel of each switch rail shall be welded. If temporarily bolted, the heel shall be secure and the bolts in the heel shall be kept tight.
(e) Each switch stand and connecting rod shall be securely fastened and operable without excessive lost motion.
(f) Each throw lever shall be maintained so that it cannot be operated with the lock or keeper in place.
(g) Each switch position indicator shall be clearly visible at all times.
(h) Each hand operated switch shall be equipped with a redundant operating mechanism for maintaining the security of switch point position.
(i) Broken or cracked switch point rails shall be replaced.
(j) Chipped or worn switch points shall be repaired or replaced. Metal flow shall be removed to insure proper closure.
2. Frogs.
(a) The flangeway depth measured from a plane across the wheel-bearing area shall not be less than 1½ inches.
(b) Where frogs are designed as flange-bearing, flangeway depth shall not be less than seven-eighths inch.
(c) Self-guarded frogs shall not be used in tracks that will be used by high-speed equipment.
3. Spring rail frogs.
(a) The outer edge of a wheel tread shall not contact the gage side of a spring wing rail.
(b) The toe of each wing rail shall be solidly tamped and fully and tightly bolted.

(c) Each frog with a bolt hole defect or head-web separation shall be replaced.
(d) Each spring shall have compression sufficient to hold the wing rail against the point rail.
(e) The clearance between the hold-down housing and the horn shall not be more than one-fourth of an inch.

4. Frog guard rails and guard faces; gages:
(a) The guard check and guard face gages in frogs shall be within the following prescribed limits --
(1) Guard check gage: Distance between the gage line of a frog to the guard line1 of its guard rail or guarding face, measured across the track at right angles to the gage line2, shall not be less than:--. 4'-6 ½"
(2) Guard face gage: The distance between guard lines1, measured across the track at right angles to the gage line2, shall not be more than:-- 4'-5".
FOOTNOTES:
1 A line along that side of the flangeway which is nearer to the center of the track and at the same elevation as the gage line.
2 A line 5/8 inch below the top of the center line of the head of the running rail, or corresponding location of the tread portion of the track structure.
(See attachment)
5. Locking and Detection for switch points, movable point frogs, or split point derails.
(a) Switches, movable-point frogs, or split-point derails shall be equipped with a lock rod
(b) The lock rod shall be maintained so that it can not be locked when the point is open three-eighths inch or more.
(c) Point detector shall be maintained so that when switch mechanism is locked in normal or reverse position, contacts cannot be opened by manually applying force at the closed switch point..
(d) Point detector circuit controller shall be maintained so that the contacts will not assume the position corresponding to switch point closure if the switch point is prevented by an obstruction from closing to within one-fourth inch where latch-out device is not used, or to within three-eighths inch where latch-out device is used

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3-13 **Track resistance (category I and II)** **(INF)**

Track system strength.
(a) Track, including turnouts, shall have sufficient vertical strength to withstand the maximum vehicle loads, both static and dynamic, generated at maximum permissible train speeds, superelevation, unbalanced superelevation and surface defects. For purposes of this section, vertical track strength is defined as the track capacity to constrain vertical deformations so that following maximum loading the track returns to a configuration in compliance with the vehicle/ track interaction safety limits and geometry requirements.
(b) Track, including turnouts, shall have sufficient lateral strength to withstand the maximum thermal and vehicle loads, both static and dynamic, generated at maximum permissible train speeds, superelevation, unbalanced superelevation and lateral alignment defects. For purposes of this section lateral track strength is defined as the track capacity to constrain lateral deformations so that following maximum loading the track returns to a configuration in compliance with the vehicle/ track interaction safety limits and geometry requirements.
(c) Track, including turnouts, shall have sufficient longitudinal strength to withstand longitudinal forces so that following maximum loading the track returns to a configuration in compliance with the vehicle/ track interaction safety limits and geometry requirements. Effects of the following longitudinal forces shall be considered, both single and, as appropriate, in combinations in manners likely to occur.
(1) Forces due to traction and braking, which may be assumed as occurring at any location along the track.
(i) Traction forces shall include both steady state operation at the maximum allowed speed and maximum acceleration.
(ii) Braking forces shall include both normal braking and emergency braking.
(iii) Forces shall be based on the dynamic effects of equipment having the maximum design axle loading.
(2) Thermal forces due to the rail, including the effect of a rail break in one rail only.
(3) Structural movement and forces induced into the track due to:
(i) Expansion, contraction and other normal structural movement.
(ii) Seismic forces for high frequency minor earthquakes in areas where applicable.
Component Requirements.
(a) Rail: the rail sections shall meet the following:
(1) Section weight not less than 130 pounds per yard.
(2) Section shape that minimizes internal stress concentrations.
(3) Produced with a metallurgy and manufacturing process that result in a rail with a high level of toughness and ductility and no history of brittle fracture. Testing or records of the performance of the section in track shall be required as necessary to prove the satisfaction of this requirement.
(b) Rail shall be continuously welded with the minimum practical number of discontinuities such as insulated joints, turnouts, expansion joints and other features that interrupt the continuity of the rail
(c) Rail support and fastening system whether ballasted or non-ballasted track form: the rail support and fastening system shall meet the following:
(1) The rail clips or combination of rail clips and anchors shall prevent the rail from "running" in relation to the ties or fasteners.
(2) The point of failure in a non-ballasted track system shall be the rail clip or shoulder, not the supporting fastener.
Requirements Specific to CWR.

(a) Written procedures which address the installation, adjustment, maintenance and inspection of CWR, and a training program for the application of those procedures shall be submitted to the Federal Railroad Administration.
(b) The track owner shall have in effect a comprehensive training program for the application of these written CWR procedures, with provisions for periodic re-training, for those individuals qualified to supervise the installation, adjustment, and maintenance of CWR track and to perform inspections of CWR track.
(c) Procedures for the installation and adjustment of CWR which include—
(1) Designation of a desired rail installation temperature range for the geographic area in which the CWR is located; and
(2) De-stressing procedures/methods which address proper attainment of the desired rail installation temperature range when adjusting CWR.
(d) Rail anchoring or fastening requirements that will provide sufficient restraint to limit longitudinal rail and fastening system movement to the extent practical, and specifically addressing CWR rail anchoring or fastening patterns on bridges, bridge approaches, and at other locations where possible longitudinal rail and fastener movement associated with normally expected train-induced forces, is likely to differ from that in track that is not near to such features.
(e) Procedures which specifically address maintaining a desired rail installation temperature range when cutting CWR including rail repairs, in-track welding, and in conjunction with adjustments made in the area of tight track, a track buckle, or a pull-apart.
Rail repair practices shall take into consideration existing rail temperature so that—
(1) When rail is removed, the length installed shall be determined by taking into consideration the existing rail temperature and the desired rail installation temperature range; and
(2) Under no circumstances should rail be added when the rail temperature is below that designated by paragraph (c)(1) of this section, without either stretching the adjacent rail so that they will be at their design stress-free temperature length or by provisions for later adjustment.
(f) Procedures which address the monitoring of CWR in curved track for shifts of alinement either inward or outward relative to the center of the curve as a result of disturbed track.
(g) Procedures which control train speed on CWR track when-—
(1) Maintenance work, track rehabilitation, track construction, or any other event occurs which disturbs the rail support and fastening system and reduces the lateral and/or longitudinal resistance of the track; and
(2) In formulating the procedures under this paragraph (f), for ballasted track, the track owner shall—
(i) Determine the speed required, and the duration and subsequent removal of any speed restriction based on the restoration of the ballast, along with sufficient ballast re-consolidation by means of mechanical stabilization to stabilize the track to a level that can accommodate expected train-induced forces; and
(ii) Take into consideration the type of crossties used.
(h) Procedures which prescribe when physical track inspections are to be performed to detect buckling prone conditions in CWR track. At a minimum, these procedures shall address inspecting track to identify—
(1) Locations where tight or kinky rail conditions are likely to occur;
(2) Locations where track work of the nature described in paragraph (f)(1) of this section have recently been performed; and
(3) In formulating the procedures under this paragraph (g), the track owner shall—
(i) Specify the timing of the inspection; and
(ii) Specify the appropriate remedial actions to be taken when buckling prone conditions are found.
(i) The track owner shall prescribe record keeping requirements necessary to provide an adequate history of track constructed with CWR. At a minimum, these records shall include:
(1) Rail temperature, location and date of CWR installations. This record shall be retained for at least one year; and
(2) A record of any CWR installation or maintenance work that does not conform to the written procedures. Such record shall include the location of the rail and be maintained until the CWR is brought into conformance with such procedures.
(j) As used in this section—
(1) Adjusting/de-stressing means the procedure by which a rail's temperature is re-adjusted to the desired value. It typically consists of cutting the rail and removing rail anchoring devices, which provides for the necessary expansion and contraction, and then reassembling the track.
(2) Buckling incident means the formation of a lateral mis-alignment sufficient in magnitude to constitute a deviation of 5 inches measured with a 62- foot chord. These normally occur when rail temperatures are relatively high and are caused by high longitudinal compressive forces.
(3) Continuous welded rail (CWR) means rail that has been welded together into lengths exceeding 400 feet.
(4) Desired rail installation temperature range means the rail temperature range, within a specific geographical area, at which forces in CWR should not cause a buckling incident in extreme heat, or a pull-apart during extreme cold weather.
(5) Disturbed track means any disturbance of the track, as a result of maintenance or any other event, which reduces the lateral or longitudinal resistance of the track, or both.
(6) Mechanical stabilization means a type of procedure used to restore track resistance to disturbed ballasted track following certain maintenance operations. This procedure may incorporate dynamic track stabilizers or ballast consolidators, which are units of work equipment that are used as a substitute for the stabilization action provided by the passage of trains.
(7) Rail anchors means both those devices which are attached to the rail and bear against the side of the crosstie to control longitudinal rail movement and rail fasteners that also control longitudinal rail movement by exerting a

downward clamping force on the upper surface of the rail base.
(8) Rail temperature means the temperature of the rail, measured with a rail thermometer.
(9) Tight/kinky rail means CWR which exhibits minute alinement irregularities which indicate that the rail is in a considerable amount of compression.
(10) Train-induced forces means the vertical, longitudinal, and lateral dynamic forces which are generated during train movement and which can contribute to the buckling potential.
(11) Track lateral resistance means the resistance provided to the rail/rail support structure against lateral displacement.
(12) Track longitudinal resistance means the resistance provided by the rail anchors/rail fasteners and rail support system to the rail/crosstie structure against longitudinal displacement.

3-14.1 **Vertical loads** **(INF)**

Structures supporting dedicated high-speed train tracks shall be designed to support vertical loads in accordance with the high-speed rolling stock static loading plus a dynamic impact factor to model the associated design speed. The maximum vertical deflection of structures supporting high speed train tracks with spans up to 100 feet shall not exceed 1/3000 of the span length for live load plus dynamic impact acting together.
For longer spans a dynamic analysis must be performed to determine the required vertical stiffness.

3-14.2 **Dynamic analysis** **(INF)**

Dynamic analysis shall be performed as required to validate structure performance of designs for dynamic impact, resonance of structure components to high-speed trains, riding comfort of passengers and torsional response of girder systems to high-speed trains. A dynamic model considering the structural configuration, supports, foundation flexibility, and design speed shall be used to perform the dynamic analysis.

3-14.3 **Centrifugal forces** **(INF)**

Centrifugal forces
Where the track is curved over the whole or part of the length of a bridge, the centrifugal force shall be taken into account in the design of structures.

3-14.4 **Nosing forces** **(INF)**

Trains use the flange of the steel wheels to maintain guidance by coming into contact with the running rails. The contact is called the ‘nosing’ or ‘hunting’ force. The nosing force shall be taken into account in the design of structures carrying slab track with direct fixation. It shall be applied to both straight track and curved track as a concentrated force at the top of rail perpendicular to the track centerline at the most unfavorable position. The nosing force shall always be combined with a vertical traffic load.
Nosing forces are not applicable for the design of structures with ballasted track.

3-14.5 **Actions due to traction and braking (longitudinal loads)** **(INF)**

The design of structures supporting high-speed train traffic shall take into account traction and braking forces of high-speed trains, applied longitudinally at the top of the rails over the length of the train, in the permitted directions of travel of each track.

3-14.6 **Longitudinal forces due to interaction between structures and track** **(INF)**

Combined response of structure and track to variable actions shall be taken into account in the design of structures. Longitudinal actions due to temperature, vertical loadings, creep and shrinkage, and seismic response of the Lower Design Basis Earthquake produce longitudinal forces in the rails that are distributed to the aerial structures depending of the relative stiffness of the ties or fasteners, articulation of the structure system and stiffness of the substructure. Combined response of structure and track to variable actions shall be taken into account in the design of structures as is necessary to prevent rail damage.

3-14.7 **Aerodynamic actions from passing trains on line side structures** **(INF)**

Aerodynamic actions from passing trains shall be taken into account when designing structures adjacent to railway tracks. Structures adjacent to the high speed train tracks shall be designed to resist the aerodynamic pressures caused by trains passing at high speeds. The magnitude of the pressure depends on the distance from the train, the shape of the train, the square of the speed of the train, and the type and attitude of the surface acted upon. The maximum pressure on a vertical surface located 9.2 feet from center of track shall be 67 pounds per square foot. The maximum pressure on a horizontal surface located over the train 16.5 feet above top of rail shall be 93

pounds per square foot.

3-14.8 **Application of the requirements of EN1991-2:2003** **(INF)**

A comprehensive design standard that includes the unique issues of high-speed trains loads and the geographic issues specific to California, such as seismic risks, temperature variations and wind conditions, shall be used for the design of the structures carrying trains that operate at speeds of 125 mph or greater.

3-15 **Global track stiffness** **(INF)**

Track stiffness.
(a) Track shall have sufficient vertical strength to withstand the maximum vehicle loads generated at maximum permissible train speeds, superelevation, unbalanced superelevation and surface defects. Vertical track strength is defined as the track capacity to constrain vertical deformations so that following maximum loading the track returns to a configuration in compliance with the vehicle/ track interaction safety limits and geometry requirements.
(b) Track shall have sufficient lateral strength to withstand the maximum thermal and vehicle loads generated at maximum permissible train speeds, superelevation, unbalanced superelevation and lateral alignment defects. Lateral track strength is defined as the track capacity to constrain lateral deformations so that following maximum loading the track returns to a configuration in compliance with the vehicle/ track interaction safety limits and geometry requirements.

3-16.1 **General requirements** **(INF)**

The maximum allowable pressure variation in trains and in tunnels and underground structures at the maximum operating speed shall be restricted to acceptable limits to protect people from adverse medical effects which result from pressure variations. This may be achieved by infrastructure design, rolling stock design or a combination of both.
Rolling stock with sealing characteristics and the means to prevent sudden loss of sealing characteristics may be used during operations at the design speed.
The operator shall demonstrate by measurements that maximum pressure variations do not result in adverse medical effects and shall certify the results prior to revenue operation.
If the maximum allowable pressure variations exceed the acceptable limits at the proposed maximum design speed, the maximum design speed shall be reduced so that maximum allowable pressure variations are not exceeded.

3-16.2 **Piston effect in underground stations** **(INF)**

Pressure variations and resultant air speeds in enclosed spaces in which trains run and the other spaces of underground stations shall be limited to levels which can be safely resisted by passengers.
The operator shall demonstrate that this requirement has been achieved by monitoring pressure variations and resultant air speeds in accordance with the Rolling Stock System Requirements. The operator shall confirm that pressure variations and resultant air speeds can be safely resisted by passengers through full scale tests and trials in the underground station under proposed revenue operation conditions and train operating speeds.

3-17 **Effect of crosswinds** **(INF)**

High-speed rolling stock shall be designed to ensure crosswind stability. Cross wind safety shall be ensured for a train running along the line under the most critical normal operational conditions.
If high-intensity wind speed exceeds the characteristic wind curve of the trains, either due to the geographic situation or to other specific features of the line, measures shall be taken to maintain the level of cross wind safety.
Protective measures may include:
* installing protective equipment to shield the track section from cross winds
* locally reducing train speeds, possibly temporarily during periods at risk of storms
* temporarily interrupting service during periods of peak wind speed in excess of 90 mph or by other appropriate means.
The reaction due to cross wind pressure on the trains shall be considered as a load on bridges and aerial guideways applied through the center of resistance of the train. This load shall be added to the effects of cross wind pressure acting directly on the structures at the same intensity.
Structures supporting high-speed trains shall be designed to resist the maximum considered peak wind pressure at the site of the structure.

3-18 **Electrical characteristics** **(INF)**

The track installation shall provide the insulation required for the signaling circuits used by train detection systems. The minimum electrical resistance acceptable from rail to rail is 10 ohms per thousand feet.

When insulation is provided by rail fastening systems, the minimum electrical resistance from rail to rail shall be not less than 20,000 ohms for each set of rail supports (seats).
A higher resistance is permissible where it is required by control command and signaling systems.
The overhead contact system (OCS) shall be grounded in accordance with National Electrical Code requirements.
Footing resistance of individual structures shall be no greater than 25 ohms. If necessary, ground rods shall be installed to meet this requirement.
Ground connections to disconnect switches and ground leads for all surge arresters shall have a ground resistance not greater than 5 ohms. Ground rods may be utilized to obtain the required ground resistance. OCS support poles shall be bonded to concrete pier foundation reinforcing bars, when used.
OCS poles shall be electrically connected to the aerial ground (static) wire along the tracks.

3-19 Noise and vibration (INF)

An environmental study of noise and vibration caused by the construction and operation of the high-speed train system shall be performed in accordance with federal law, in particular the National Environmental Policy Act of 1969 (NEPA) (42 USC § 4321 et seq.).
Noise from operation of high-speed trains and ancillary sources shall not exceed limits defined in the Rolling Stock System Requirements and applicable noise laws and regulations.
Vibration from operation of high-speed trains and ancillary sources shall not exceed limits defined in applicable vibration laws and regulations.
If noise or vibration limits are exceeded, suitable mitigation shall be provided.

3-19.1 Noise mitigation (INF)

Noise prevention and mitigation measures shall be provided as required to ensure noise is within limits defined in the CHSTP system requirements, the program and project EIR/EIS documents, and other applicable laws and regulations.

3-19.2 Vibration mitigation (INF)

Vibration prevention and mitigation measures shall be provided as required to ensure vibration is within limits defined in the CHSTP system requirements, the program and project EIR/EIS documents, and other applicable laws and regulations.

3-20.1 Access to the platform (INF)

The speed of trains on tracks adjacent to station platforms shall not exceed 155 mph.
If trains on tracks alongside station platforms are intended to operate at more than 80 mph, one or more of the following measures shall be provided:
1. Passenger access to the platforms adjacent to the tracks shall only be permitted when a train is intended to stop.
2. Platform barriers shall be installed alongside of the platform adjacent to the passing train.

3-20.2 Usable length of the platform (INF)

The requirements are applicable to the station platforms where trains complying with high-speed rail rolling stock criteria are intended to stop for normal passenger operation.
The usable length of a station platform shall be a minimum length of 1312 feet.

3-20.3 Usable width of the platform (INF)

The requirements are applicable to the platforms where trains complying with high-speed train rolling stock criteria are intended to stop for normal passenger operation.
Platform design shall meet the requirements of NFPA 130 and ADA.
The platform width shall be sufficient to allow reception and movement for the maximum number of passengers based on projected ridership for the station.

3-20.4 Platform height (INF)

The requirements are applicable to the platforms where trains complying with high-speed rolling stock criteria are intended to stop for normal passenger operation.
The rail-to-platform height in new stations shall be compatible with the floor height of high-speed rolling stock vehicles so that the vertical difference, measured when the vehicle is at rest, is within plus or minus 5/8 inch under normal passenger load conditions.

3-20.5 **Distance from the centre of the track** **(INF)**

The requirements are applicable to the platforms where trains complying with the rolling stock criteria are intended to stop for normal passenger operation.
Track Centerline to Platform Dimension
The nominal distance between the center line of track and the passenger platform edge shall be set at a maximum of 3 inches wider than one-half of the width of the passenger vehicle operating on the line.

3-20.6 **Track layout along the platforms** **(INF)**

Tracks along the edge of passenger platforms shall be tangent. If it is not possible for a platform track to be tangent throughout its entire length, the largest practical radius of curve shall be used in conjunction with use of other means to meet ADA accessibility requirements.

3-20.7 **Prevention of electric shock on platforms** **(INF)**

Prevention of electric shock on station platforms shall be ensured by properly bonding and grounding all equipment and installations with metallic components on station platforms and by properly grounding of overhead contact system support structure per provisions of the High-Speed Energy System Requirements.

3-20.8 **Characteristics linked to the access of people with reduced mobility** **(INF)**

Stations shall be made readily accessible to and usable by individuals with disabilities in accordance with the requirements in Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities.

3-21 **Fire safety and safety in railway tunnels** **(INF)**

The general requirements for fire protection and fire safety are defined in the Safety in Railway Tunnels system requirements.

3-22 **Access to or intrusion into line installations** **(INF)**

There shall be no at-grade (level) highway crossings, public or private, or rail-to-rail crossings of the high-speed trackway.
The high-speed train right-of-way shall be protected from unauthorized access. Intrusion protection fencing, traffic barriers and other devices shall be provided between high-speed train tracks and adjacent roadways.
Barriers shall be provided on aerial structures over the high-speed train trackway to prevent intrusion of vehicles and the launching of objects onto the high-speed train tracks.
Fencing with intrusion detection devices shall be installed as appropriate to prevent access by unauthorized personnel and animals.

3-23.1 **Lateral space alongside tracks** **(INF)**

Lateral space with continuous walkway of 2.5 feet minimum width shall be provided alongside every track open to high-speed train service to allow passengers and onboard staff to detrain on the side of the tracks opposite from the adjacent tracks if the adjacent tracks are to be operated during evacuation of the train.
Walkways shall have a longitudinal slope not greater than one inch vertical to eight inches horizontal.
On aerial structures and retained fill sections, the side of the walkway away from the tracks shall have a safety barrier to protect passengers and onboard staff exiting the train from falling from the structure.

3-23.2 **Escape walkways in tunnels** **(INF)**

Walkways shall be provided in all tunnels.
In single track tunnels, walkways shall be provided on at least one side of the track. In double track tunnels, walkways shall be provided on both tracks. In wider tunnels with more than two tracks, access to a walkway shall be provided from each track.
Walkways shall be at least 2.5 feet wide and unobstructed up to a minimum height of 7.5 feet with handrails installed at a height of approximately 3.5 feet above the top of walkway. Handrails shall be placed outside the required 2.5 feet walkway width envelope.
Walkways in tunnels shall be located at a minimum distance of 6.5 feet from the closest track centerline. The walkway envelope shall be outside of the rolling stock dynamic envelope. Handrails shall be angled at 30 to 40 degrees to the longitudinal axis of the tunnel around obstacles.
Walkways shall provide a reasonably regular surface with gradual slope not to exceed approximately one inch to eight inches.

3-24 **Distance Markers** **(INF)**

Easily visible distance markers (signs) shall be provided at defined intervals along the railroad, normally one mile. The signs shall be large enough to be readily read from the moving train by the train crew. Milepost signs may be placed on only one side if both the following conditions are satisfied:
a. Track centers are less than 30 feet.
b. There is no intervening wall or other obstruction that would interfere with the sign being easily visible from the more distant track.
Otherwise, distance markers shall be placed adjacent to each main track and station track.

3-25 **Storage, yard, and connecting tracks and other locations with very low speed** **(INF)**

Storage tracks and other low speed tracks, excluding yard lead tracks, shall be maintained to no less than FRA Class 2.
Yard lead tracks and any track within 50 feet or less of a revenue track shall be maintained to no less than FRA Class 3.

3-26.1 **Toilet discharge** **(INF)**

The specifications for track used for toilet discharge shall be those of storage and yard tracks.
Tracks used for toilet discharges shall have at least 20 feet between track centers. If a toilet service vehicle is to be used, a service roadway shall be provided of sufficient width for service vehicle access.
Fixed discharge installation shall be compatible with the characteristics of the sealed toilet system specified for the high-speed rolling stock.

3-26.2 **Train external cleaning facilities** **(INF)**

The location of the washing facilities and their type is determined by the Rolling Stock maintenance plan and shall be designed in accordance with operational rules.
When washing machinery is used they shall be able to clean the outer sides of single or double-deck trains between a height of:
* to 11.5 feet for a single-deck train
* .5 to 14.5 feet for double-deck trains
Trains shall be able to pass through the washing plant at speeds of between 100 and 300 feet per minute.

3-26.3 **Water restocking equipment** **(INF)**

Fixed equipment for water supply on the high-speed train network shall be supplied with potable water meeting applicable regulatory requirements.
The specifications for track used for water supply shall be those of storage and yard tracks.
Tracks used for water restocking shall have at least 20 feet between track centers. If a service vehicle is to be used, a service roadway shall be provided of sufficient width for service vehicles.
Fixed water supply installation shall be compatible with the characteristics of the water system specified for the high-speed rolling stock.

3-26.4 **Sand restocking equipment** **(INF)**

Fixed sand restocking facilities shall be installed according to the rolling stock maintenance requirements.
Fixed sand restocking equipment shall be compatible with the characteristics of the sander system specified in the high-speed rolling stock requirements.
The equipment shall deliver sand specified in the high-speed control command and signaling requirements.
The specifications for track used for sand restocking equipment shall be those of storage and yard tracks.

3-26.5 **Refueling** **(INF)**

Refueling equipment shall be compatible with the characteristics of the fuel system specified in the high-speed rolling stock system requirements.
The equipment shall deliver fuel specified in the high-speed rolling stock system requirements.
The design and construction of fueling stations shall include provisions to prevent the pollution and contamination of public waters from spilled fuels through surface and subsurface waters, sewers and other conduits according to state and federal applicable regulations.

3-27 **Ballast pick-up** **(INF)**

No System Requirement.

3-33 **Infrastructure - Operating rules** **(OPS)**

The rules and procedures shall be identical throughout the CHSTP system where identical situations exist. In areas of joint operations, the CHSTP Code of Operating Rules shall apply.
Employees shall receive training in the theory and the practical application of operating rules, with emphasis on their particular craft or the employees they supervise.
The Code of Operating Rules and the Timetable and Timetable Special Instructions (Route Book) shall apply equally to all crafts and all supervisors engaged in train movements and the conduct of transportation.
With respect to those employees involved in the construction, maintenance, and inspection of infrastructure, the following categories of employees must be qualified on Code of Operating Rules and must re-qualify annually:
• Employees who request fouling time or take tracks out of service for maintenance
• Employees who operate track cars and MW heavy equipment
• Communications and Signal Maintainers
• Supervisors and managers who directly supervise any of the above employees.
Employees returning to duty after an absence from railroad service of 180 days or more must attend and pass an operating rules requalification before they perform service that requires operating rules qualification. If the absence from railroad service exceeds 365 days, then the employee must complete a program of requalification as determined by the Rules Department based on the particular employees needs and circumstances.
The requirement for operating rules qualification applies to those employees performing the functions described above, without reference to particular job title or responsibilities.
Any freight operation on CHSTP lines will be temporally separate from the high-speed passenger operation.

3-33.1 **Infrastructure - Execution of works** **(OPS)**

In addition to the technical engineering qualifications, employees who request fouling time or take tracks out of service for maintenance, or who operate track cars and their direct supervisors must qualify on the Code of Operating Rules and physical characteristics and re-qualify annually.

3-33.2 **Infrastructure - Notices given to railway undertakings** **(OPS)**

The engineering department (or any other manager responsible for the infrastructure) must give immediate notification to rhe Operating Department, through the Train Dispatcher, of any circumstance requiring a temporary speed restriction or any other alteration to the train operation.

3-33.3 **Infrastructure - Protection of workers against aerodynamic effects** **(OPS)**

The Operator shall develop, implement, and enforce a safe system of work to ensure protection of workers on the trackside. The Operator shall determine the safe distance from the track for the purposes of worker safety including but not limited to protecting workers against aerodynamic effects taking into account but not limited to the following factors:
• Airspeed
• Operating speed of trains
• Dynamic envelope of the rolling stock
• Prevailing weather conditions including windspeed and direction
• Compliance with medical health criteria
The operator shall establish at all locations on the railway where workers will be present, the airspeed during passage of trains by monitoring in accordance with the CHSTP Rolling Stock System requirements.

3-35 **Infrastructure - Professional competences** **(OPS)**

The minimum qualification requirements for operation of high-speed trains shall be as detailed in System Requirements for Operations.
The minimum qualification requirements for inspection and maintenace of high-speed tracks shall be as follows:
Designation of qualified individuals; general qualifications.
Each track owner to which this subpart applies shall designate qualified individuals responsible for the maintenance and inspection of track in compliance with the safety requirements prescribed in this subpart. Each individual, including a contractor or an employee of a contractor who is not a railroad employee, designated to:
(a) Supervise restorations and renewals of track shall meet the following minimum requirements:
(1) At least;
(i) Five years of responsible supervisory experience in railroad track maintenance in track Class 4 or higher and the successful completion of a course offered by the employer or by a college level engineering program, supplemented

by special on the job training emphasizing the techniques to be employed in the supervision, restoration, and renewal of high-speed track; or
(ii) A combination of at least one year of responsible supervisory experience in track maintenance in Class 4 or higher and the successful completion of a minimum of 80 hours of specialized training in the maintenance of high-speed track provided by the employer or by a college level engineering program, supplemented by special on the job training provided by the employer with emphasis on the maintenance of high-speed track; or
(iii) A combination of at least two years of experience in track maintenance in track Class 4 or higher and the successful completion of a minimum of 120 hours of specialized training in the maintenance of high-speed track provided by the employer or by a college level engineering program supplemented by special on the job training provided by the employer with emphasis on the maintenance of high-speed track.
(2) Demonstrate to the track owner that the individual:
(i) Knows and understands the requirements of high-speed track maintenance;
(ii) Can detect deviations from those requirements; and
(iii) Can prescribe appropriate remedial action to correct or safely compensate for those deviations; and
(3) Be authorized in writing by the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements of this subpart and successful completion of a recorded examination on this subpart as part of the qualification process.
(b) Inspect track for defects shall meet the following minimum qualifications:
(1) At least:
(i) Five years of responsible experience inspecting track in Class 4 or above and the successful completion of a course offered by the employer or by a college level engineering program, supplemented by special on the job training emphasizing the techniques to be employed in the inspection of high-speed track; or
(ii) A combination of at least one year of responsible experience in track inspection in Class 4 or above and the successful completion of a minimum of 80 hours of specialized training in the inspection of high-speed track provided by the employer or by a college level engineering program, supplemented by special on the job training provided by the employer with emphasis on the inspection of high-speed track; or
(iii) A combination of at least two years of experience in track maintenance in Class 4 or above and the successful completion of a minimum of 120 hours of specialized training in the inspection of high-speed track provided by the employer or from a college level engineering program, supplemented by special on the job training provided by the employer with emphasis on the inspection of high-speed track.
(2) Demonstrate to the track owner that the individual:
(i) Knows and understands the requirements of high-speed track inspection;
(ii) Can detect deviations from those requirements; and
(iii) Can prescribe appropriate remedial action to correct or safely compensate for those deviations; and
(3) Be authorized in writing by the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements in this subpart and successful completion of a recorded examination on this subpart as part of the qualification process.
(c) Individuals designated under paragraphs (a) or (b) of this section that inspect continuous welded rail (CWR) track or supervise the installation, adjustment, and maintenance of CWR in accordance with the written procedures established by the track owner shall have:
(1) Current qualifications under either paragraph (a) or (b) of this section;
(2) Successfully completed a training course of at least eight hours duration specifically developed for the application of written CWR procedures issued by the track owner; and
(3) Demonstrated to the track owner that the individual:
(i) Knows and understands the requirements of those written CWR procedures;
(ii) Can detect deviations from those requirements; and
(iii) Can prescribe appropriate remedial action to correct or safely compensate for those deviations; and
(4) Written authorization from the track owner to prescribe remedial actions to correct or safely compensate for deviations from the requirements in those procedures and successful completion of a recorded examination on those procedures as part of the qualification process. The recorded examination may be written, or it may be a computer file with the results of an interactive training course.
(d) Persons not fully qualified to supervise certain renewals and inspect track as outlined in paragraphs (a), (b) and (c) of this section, but with at least one year of maintenance of way or signal experience, may pass trains over broken rails and pull aparts provided that—
(1) The track owner determines the person to be qualified and, as part of doing so, trains, examines, and re-examines the person periodically within two years after each prior examination on the following topics as they relate to the safe passage of trains over broken rails or pull aparts: rail defect identification, crosstie condition, track surface and alignment, gage restraint, rail end mismatch, joint bars, and maximum distance between rail ends over which trains may be allowed to pass. The sole purpose of the examination is to ascertain the person's ability to effectively apply these requirements and the examination may not be used to disqualify the person from other duties. A minimum of four hours training is adequate for initial training;
(2) The person deems it safe, and train speeds are limited to a maximum of 10 m.p.h. over the broken rail or pull apart;
(3) The person shall watch all movements over the broken rail or pull apart and be prepared to stop the train if necessary; and
(4) Person(s) fully qualified under (a), (b) or (c) of this section are notified and dispatched to the location as soon as practicable for the purpose of authorizing movements and effectuating temporary or permanent repairs.

(e) With respect to designations under paragraphs (a), (b), (c) and (d) of this section, each track owner shall maintain written records of:
(1) Each designation in effect;
(2) The basis for each designation, including but not limited to:
(i) The exact nature of any training courses attended and the dates thereof;
(ii) The manner in which the track owner has determined a successful completion of that training course, including test scores or other qualifying results;
(3) Track inspections made by each individual as required by (a), (b) and (c) of this section. These records shall be made available for inspection and copying by the Federal Railroad Administration during regular business hours.

3-36 **Infrastructure - Health and safety conditions** **(OPS)**

Precautions must be taken to ensure health and a high level of safety for maintenance staff, particularly employees working on or near tracks., Persons working on or near the track shall wear appropriate high-visibility clothing. The System Safety Plan must specify what tools and additional personal protective equipment are appropriate for special circumstances.

3-37 **The rail** **(INF)**

See sub systems for 3-37.1, 3-37.2, 3-37.3 for requirements related to each component of the rail's properties.

3-37.1 **Railhead profile** **(INF)**

The shape of the rail head shall be compatible with the wheel tread shape so as to minimize noise, vibration, and ride quality deficiencies

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3-37.2 **Design linear mass** **(INF)**

The rail section to be used under high-speed train traffic shall be of sufficient mass and beam strength to adequately support and distribute the wheel loads, taking into account static and dynamic vertical and horizontal loads, including traction and braking forces of high-speed trains, applied longitudinally and vertically to the top of the rails for trains moving at the maximum allowable speed with the maximum allowable defects in both wheels and rails for trains moving in the permitted direction of travel for each track.

3-37.3 **Steel grade** **(INF)**

The design of the rail metallurgy, hardness, and strength for rail to be used under high-speed train traffic shall take into account static and dynamic vertical and horizontal loads, including traction and braking forces of high-speed trains, applied longitudinally and vertically to the top of the rails for trains moving at the maximum allowable speed with the maximum allowable defects in both wheels and rails for trains moving in the permitted direction of travel of each track.

3-38 **The rail fastening systems** **(INF)**

Fastenings shall provide sufficient electrical isolation to maintain the integrity of the operation of the signal system.
b. Fasteners showing deterioration, corrosion, missing components, or unable to perform the functions listed in c. shall be considered failed.
c. Each rail shall have not less than 18 rail seat locations per rail within any 39 feet of length that shall:
1. Have fasteners (spring clips) applied to both sides of the rail seat.
2. Provide a longitudinal restraint against rail movement of not less than 2,000 pounds
3. Hold gage within 3/8 inch.
4. Prevent rail lateral movement of over 3/8 inch.
5. Have rail seat abrasion, or deteriorated or missing rail seat pads such that fastener toe load is lost.

3-39 **Track sleepers and bearers** **(INF)**

Crossties and Switch Ties.
(a) Crossties, including switchties, shall be concrete. Wood ties may be used temporarily, but shall be replaced with concrete within 5 years. The maximum length of track in wood ties shall be 30 feet, and shall be separated from any other wood ties in track by not less than 150 feet.
(b) Requirements applying to concrete ties, non-concrete ties, and track constructed without crossties:
(1) The minimum number and type of crossties or rail supports per segment of track specified in paragraph (b), (c) or (d) of this section shall effectively distributed to support the entire segment; and
(2) Each 39 foot segment of track shall have a sufficient number of crossties or non-ballasted track fasteners which

in combination provide effective support that will—
(i) Hold gage within +½"-¼" with a maximum change in 31 feet of ¼"
(ii) Maintain surface within the limits prescribed in the following table; and
(iii) Maintain uniformity of alignment. Uniformity at any point along the track is established by averaging the measured mid-chord offset values for nine consecutive points centered around that point and spaced according to the following table:
(iv) Maintain alignment within the limits prescribed in the following table:
(3) Track shall have two non-defective ties or non-ballasted track fasteners within 36 inches on each side of a rail joint. (Four ties within the 6.00 feet length centered at the center of the rail joint.) Bonded joints are considered the same as non-bonded joints for the purpose of this paragraph.
(4) No metal object which causes a concentrated load by solely supporting a rail shall be allowed between the base of the rail and the bearing surface of the tie plate or pad under the rail.
(5) There shall be at least four non-defective ties or non-ballasted track fasteners each side of a defective tie or fastener.
(c) For track constructed without ballast, such as slab track and track connected directly to bridge structural components, the track structure shall meet the requirements of paragraphs (b) (2) (i), (ii), (iii), and (iv) of this section.
(1) Rail supporting system, of whatever nature, shall meet all relevant requirements of paragraph (d), including number of units per 39 feet of rail.
(2) Fasteners on opposite rails in this type track need not be set square with each other
(d) For concrete tie construction, each 39 foot segment track shall have 16 crossties which are not—
(1) So deteriorated that the prestress strands are ineffective or withdrawn into the tie at one end and the tie exhibits structural cracks in the rail seat or in the gage of track;
(2) Configured with less than 2 fasteners on the same rail;
(3) So deteriorated in the vicinity of the rail fastener such that the fastener assembly may pull out or move laterally more than ¼ inch relative to the crosstie;
(4) So deteriorated that the fastener base plate or base of rail can move laterally more than ¼ inch relative to the crossties;
(5) So deteriorated that rail seat abrasion is sufficiently deep so as to cause loss of rail fastener toeload;
(6) Completely broken through; or
(7) So unable, due to insufficient fastener toe load, to maintain longitudinal restraint and maintain rail hold down and gage.
(e) For non-concrete tie construction, each 39 foot segment shall have 18 crossties which are not—
(1) Broken through;
(2) Split or otherwise impaired to the extent the crossties will allow the ballast to work through, or will not hold spikes or rail fasteners;
(3) So deteriorated that the tie plate or base of rail can move laterally ¼ inch relative to the crossties;
(4) Cut by the tie plate through more than 25 percent of a crosstie's thickness;
(5) Configured with less than 2 rail holding spikes or fasteners per tie plate; or
(6) So unable, due to insufficient fastener toeload, to maintain longitudinal restraint and maintain rail hold down and gage.
(7) Where timber crossties are in use there shall be tie plates under the running rails on at least nine of 10 consecutive ties

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3-40 **Switches and crossings** **(INF)**

See System Requirement for 3-12

3-41 **Water filling connector** **(INF)**

Water service shall be provided at yards and/or service stations where train equipment may be watered. The water filling connectors shall be compatible with the water inlet connection described for the High-Speed Rolling Stock.

3-42 **ADA Accessibility Requirements for Infrastructure** **(INF)**

All infrastructure facilities shall comply with the requirements set forth in 28CFR Part 36, including Appendix A, the Americans with Disabilities Act Accessibility Guidelines (ADAAG).

3-43 **Vegetation Control** **(INF)**

Vegetation within the high-speed train right-of-way or adjacent to high-speed train facilities shall be controlled so that it does not:
(a) Become a fire hazard;
(b) Obstruct visibility of signs and signals along the right of way;
(c) Interfere with employees performing normal trackside duties;

(d) Prevent proper functioning of signal and communication lines;
(e) Prevent proper functioning of overhead contact systems;
(f) Prevent proper inspection and maintenance of bridges, buildings and other structures;
(g) Prevent employees from visually inspecting moving equipment from their normal duty stations;
(h) Encroach onto walkway surfaces;
(i) Encroach into the limits of operating infrastructure;
(j) Interfere with surface drainage or with the proper operation of drainage structures;
(k) Interfere with intrusion detection systems;
(l) Encroach on clearances of overhead wires;
(m) Interfere with electrical facilities or equipment; or
(n) Permit access to the trackway by people or animals.

3-44 **Drainage** **(INF)**

Each drainage or other water carrying facility under or immediately adjacent to the roadbed shall be maintained and kept free of obstruction, to accommodate expected water flow for the area concerned.

3-45 **Derailment Containment** **(INF)**

There shall be on on-track installed derailment containment devices. Derailment containment shall be achieved by rolling stock undercar equipment.

3-46 **Utility Encroachment** **(INF)**

The installation of new utilities and the relocation of existing utilities within the high-speed train right-of-way shall conform to the applicable requirements of Code of Federal Regulations (CFR), National Electric Code (NEC), and California Public Utility Commission (CPUC) General Orders.

3-47 **Welding of Rail** **(INF)**

CHSTP requirements for welding of rail shall be in accordance with 49CFR sections 213.339, 213.341 and 213.343

3-48 **Station Signage and Graphics** **(INF)**

Signs and graphics shall meet the requirements of: ADA, CPUC, NFPA 130, and Code of Federal Regulations Title 29, Part 1910.

3-49 **Geotechnical Monitoring – Instrumentation, Record Keeping, and Documentation** **(INF)**

Geotechnical monitoring of subsurface conditions is required to quantify uncertainties inherent within soil and rock masses which are often heterogeneous and non-uniform in nature. Geotechnical monitoring will be performed during the design and construction phases and the post-construction phase as deemed necessary. Geotechnical Monitoring includes basic and minimum standards for designing, furnishing, installing, maintaining and removing instrumentation systems for the detection of ground movements, settlements and lateral displacements of embankments, pore-water pressures, vibration and noise levels, movements of adjacent existing structures and utilities, performance of tunnel ground support, and measurement of loads in structural elements for the support of excavations in geotechnical designs and mitigation measures and permanent stabilization of geological hazards. Field instrumentation will be used (1) during design to aid in design process and to identify potential construction problems, and (2) during construction to monitor performance of the facility and/or changes in the fields, and (3) after construction, if needed, to safeguard the long term performance of high-speed train systems and facilities. Monitoring requirements depend on construction progress and types as well as subsurface ground behaviors. Instrumentation monitoring may be extended over several months or years, as warranted, to measure seasonal groundwater fluctuations and ground movements that vary with time. The objectives for instrumentation during construction will change depending on the size and type of construction, geotechnical conditions, and the schedule. Complete construction records of the geotechnical aspects shall be assembled, reduced, and kept in files, including written descriptions of problem soil and rock conditions, notes of any specialized construction procedures or design changes as well as photographs with annotations.

3-50.1 **Traffic Load on Structures - Seismic Risk and Performance** **(INF)**

Seismic Design for structures supporting high-speed trains shall use a hybrid probabilistic-deterministic approach to determining ground motions based on three performance criteria:
• No Collapse Performance Level (NCL): High-speed train structures are able to undergo the effects of the Maximum Considered Earthquake (MCE) with no collapse. Significant damage may occur that requires extensive

repair or complete replacement, and passengers and personnel are able to evacuate safely.
•□Safety Performance Level (SPL): High-speed train structures are able to undergo the effects of the Design Basis Earthquake (DBE) with repairable damage and temporary service suspension. However, normal service can resume within a reasonable time frame, and passengers and personnel can safely evacuate. Only short term repairs to structural and track components are expected.
•□Operability Performance Level (OPL): High-speed train structures are be able to operate at maximum authorized speed and safely brake to a stop during a Lower level Design Basis Earthquake (LDBE). Normal service will resume when track alignments have been inspected and necessary short term track repairs, such as minor realignment and grade-adjustment, are made. No structural damage is expected.
Building structures shall be designed to meet California Building Code (CBC) requirements if the buildings do not support the mainline tracks, platform tracks, or be designed such that damage to the structure will not cause service interruption due to debris falling onto the tracks. CBC is a force-based design method which does not offer the possibility of determining and designing for damage levels selected to corresponding risks. Portions of a structure that encroaches into the trackway or may provide debris that can fall into the trackway shall meet the guideway performance requirements. The performance requirements of ASCE 41 may be used for that purpose.

3-50.2 **Traffic Load on Structures - Derailment Effects** **(INF)**

Structures supporting tracks shall be designed to mitigate vehicle excursion so that, in the event of a derailment, the resulting damage to the bridge from overturning or collapse is limited to a minimum.
Intrusion protection structures may be used to limit the risk of damage from adjacent trains and highway vehicles.
Containment structures shall be used in mainline aerial trackways to contain the vehicle in the event of a derailment. Containment structures may be used on non main track aerial structures over river or highway or railroad crossings to minimize the damage should the train derail.
Containment structures shall be located at a maximum distance of seven (7) feet measured from the center of track.

3-50.3 **Traffic Load on Structures - Temperature Effects** **(INF)**

Stresses or movements due to temperature variations shall be considered in the design of structures supporting high-speed trains.

3-50.4 **Traffic Load on Structures - Gravity Loads on aerial structures and facilities** **(INF)**

Weights of materials used in the design of CHST including dead loads of materials, as well as densities, surcharges, track slab, precast trenches, and OCS loads shall be consistent for all situations.
Non vehicular live load sources such as platform and walkway live loads, equipment loads and railing loads shall be provided for all structures.

3-51 **Rail Joints** **(INF)**

Rail Joints installed in mainline shall meet the following requirements:
(a) Each rail joint, insulated joint, and compromise joint shall be of a structurally sound design and dimensions for the rail on which it is applied and shall be not less than 36 inches nominal length with six bolt holes.
(b) If a joint bar is cracked, broken, or because of wear allows excessive vertical movement of either rail when all bolts are tight, it shall be replaced.
(c) If a joint bar is cracked or broken between the middle two bolt holes it shall be replaced.
(d) Each rail shall be bolted with at least four bolts at each joint.
(e) Each joint bar shall be held in position by track bolts tightened to allow the joint bar to firmly support the abutting rail ends and to allow longitudinal movement of the rail in the joint to accommodate expansion and contraction due to temperature variations. When no-slip, joint-to-rail contact exists by design, the requirements of this section do not apply. Those locations, when over 400 feet long, are considered to be continuous welded rail track and shall meet all the requirements for continuous welded rail track prescribed in SR 3-47 Welding of Rail.
(f) No rail shall have a bolt hole which is torch cut or burned.
(g) No joint bar shall be reconfigured by torch cutting.

3-52 **Rail Mismatch** **(INF)**

Any mismatch of rails at joints, on the tread of the rail ends or on the gage side of the rail ends may be not exceed 1/8”.

3-53 **Torch Cut Rail** **(INF)**

Except as a temporary repair in emergency situations no rail having a torch cut end shall be used. When a rail end with a torch cut is used in emergency situations, train speed over that rail shall not exceed 30 mph. All torch cut rail

ends in tracks other than yard tracks shall be removed within 30 days of the temporary repair.

3-54 **Derails** **(INF)**

Derails shall conform to requirements of 49CFR section 213.357.

3-55 **Track qualification by vehicle** **(INF)**

(a) All rolling stock types which are intended to operate at speeds up to 250 mph shall be qualified for operation for the intended speed in order to demonstrate that the vehicle dynamic responses to track alignment and geometry variations are within acceptable limits to assure safe operation.
(b) The qualification testing shall ensure that, at any speed less than 10 mph above the proposed maximum operating speed, the equipment will not exceed the wheel/rail force safety limits and the truck lateral accelerations specified in 49CFR 213.333, and the testing shall demonstrate the following:
(1) The vertical acceleration, as measured by a vertical accelerometer mounted on the car floor, shall be limited to no greater than 0.55g single event, peak-to-peak.
(2) The lateral acceleration, as measured by a lateral accelerometer mounted on the car floor, shall be limited to no greater than 0.3g single event, peak-to-peak; and
(3) The combination of the lateral acceleration (L) and the vertical acceleration (V) within any period of two consecutive seconds as expressed by the square root of (V2 + L2) shall be limited to no greater than 0.604, where L may not exceed 0.3g and V may not exceed 0.55g.
(c) To obtain the test data necessary to support the analysis required in paragraphs (a) and (b) of this section, the track owner shall have a test plan which shall consider the operating practices and conditions, signal system and trains on adjacent tracks during testing. The track owner shall establish a target maximum testing speed (at least 10 m.p.h. above the maximum proposed operating speed) and target test and operating conditions and conduct a test program sufficient to evaluate the operating limits of the track and equipment. The test program shall demonstrate vehicle dynamic response as speeds are incrementally increased from acceptable Class 6 limits to the target maximum test speeds. The test shall be suspended at that speed where any of the safety limits specified in paragraph (b) are exceeded.
(d) At the end of the test, when maximum safe operating speed is known along with permissible levels of cant deficiency, an additional run shall be made with the subject equipment over the entire route proposed for revenue service at the speeds the railroad will request FRA to approve for such service and a second run again at 10 m.p.h. above this speed. A report of the test procedures and results shall be submitted to FRA upon the completions of the tests. The test report shall include the design flange angle of the equipment which shall be used for the determination of the lateral to vertical wheel load safety limit for the track/vehicle interaction safety measurements required per 49CFR 213.333(l).
(e) As part of the submittal required in paragraph (d) of the section, the operator shall include an analysis and description of the signal system and operating practices. This statement shall include a statement of sufficiency in these areas for the intended operating speed.
(f) Based on test results and submissions, FRA will approve a maximum train speed and value of cant deficiency for revenue service.

4-02 **Subsystem Infrastructure** **(TUN)**

The design and installation of fixed equipment in tunnels shall take into account the aerodynamic effect from passing trains.

4-02.1 **Installation of switches and crossings** **(TUN)**

The number of switches and crossovers located in tunnels shall be minimized to those necessary to comply with design, safety and operational requirements of the railway.

4-02.10 **Emergency communication** **(TUN)**

The tunnel emergency communication system shall have the ability to carry frequencies used by and ensure communication between emergency services, trains, and high-speed train control center.
Emergency telephones shall be provided at intervals along the high-speed rail guideway and other locations deemed necessary by the authority having jurisdiction. Emergency telephones shall permit adequate and reliable communication during emergency incidents.

4-02.11 **Access for rescue services** **(TUN)**

Access to tunnels through portals, emergency entrances and exits, shall be provided for evacuating passengers in the event of an incident and for access to the incident by first responders.

If road access is required in the emergency plan, it shall be located as close as possible to the planned rescue area. Alternative means of access shall be described in the emergency plan.

4-02.12 **Rescue areas outside tunnels** **(TUN)**

Rescue areas are sites designated as points of safety outside tunnels.
Rescue areas shall be provided near new tunnels. Where feasible, rescue areas shall be accessible via access roads connected to public roads. If road access is not practical, alternative solutions shall be provided in consultation with the State Fire Marshall.
If an access road is provided, it shall contain level parking and turn-around space for emergency vehicles. Access road and rescue areas shall be designed and constructed to minimize maintenance requirements.
Access roads that meet the requirements of rescue areas may be considered as rescue areas.

4-02.13 **Water supply** **(TUN)**

Water supply for firefighting shall be provided at access points to the tunnel. The water supply shall be capable of providing the system demand for at least 2 hours. The water source shall be a hydrant or a permitted water supply of 130 cubic yards, minimum.
Water supplies from the following sources shall be permitted:
(1) A public water works system where pressure and flow rate are adequate
(2) Automatic fire pumps connected to an approved water source
(3) Manually controlled fire pumps in combination with pressure tanks
(4) Pressure tanks
(5) Manually controlled fire pumps operated by remote control devices at each hose station
(6) Gravity tanks
Fire hydrants shall be attached to the distribution system at the locations and spacing designated by the agency responsible for their use for firefighting purposes or as otherwise indicated.
The water supply system shall be capable of providing a minimum of 500 gpm at a residual pressure of 100 psig to the most hydraulically remote standpipe outlet.

4-02.2 **Prevent unauthorized access to emergency exits and equipment rooms** **(TUN)**

Emergency exits, rooms containing fixed equipment, corridors, stairwells and other controlled areas in tunnels shall have doors and/or gates with a lock system capable of preventing unauthorized access from outside. A release mechanism shall be provided that makes it possible to open doors and/or gates from the inside for evacuation purposes.

4-02.3 **Fire protection requirements for structures** **(TUN)**

In the event of fire, the integrity of tunnel structures shall be maintained for a period of time sufficiently long to permit self-rescue and evacuation of passengers and staff and the intervention of rescue services without the risk of structural collapse.

4-02.4 **Fire safety requirements for building material** **(TUN)**

Materials and equipment shall have defined smoke emission and flammability characteristics. Only non-flammable materials shall be used in constructing the supporting structural members in tunnel structures. Non structural load bearing elements such as cable trays, insulation, conduits, cables, pipes, coatings and finishes, signs, crosswalks, rail ties, light fixtures, shall be demonstrated to not produce toxic fumes when exposed to flame or high temperature.

4-02.5 **Fire detection** **(TUN)**

Automatic fire detection systems consisting of heat and smoke detectors shall be installed in buildings, rooms, enclosed spaces, corridors, stairwells and escape routes with doors for access/ egress inside or outside the tunnel that contain safety, operating, maintenance, support equipment, and installations which are necessary for the following functions:
• Self rescue and evacuation
• Emergency communication
• Rescue and fire fighting
• Equipment and infrastructure associated with the fixed facility subsystems (for example lighting, power, tunnel ventilation)
• Equipment and infrastructure associated with the operating subsystems (for example train control, communications, traction power, signaling)
• Commercial communications

The status and alarms of the automatic fire detection system shall be annunciated locally at the facility's fire alarm control panel and remotely at the Operations Control Center. Each location / zone shall be uniquely identified at the fire alarm control panel and the Operations Control Center.
Heat and smoke detectors are not required where protection is provided by automatic fire extinguishing or suppression systems such as sprinkler systems.
Automatic fire detection systems are not required in tunnels, or underground spaces (for example cross-passages, niches) connected only to tunnels.

4-02.6 **Facilities for self-rescue, evacuation and rescue in the event of an incident** **(TUN)**

Facilities shall be provided for self rescue and evacuation from an incident in a tunnel to a point of safety.
A point of safety is defined as one of the following:
(1) an enclosed fire exit that leads to a public way or safe location outside the station, trainway, or vehicle;
(2) an at-grade point beyond the vehicle, enclosing station, or trainway;
(3) any other approved location.
where the following conditions exist:
• Conditions are survivable.
• Access for people is possible aided and unaided
• People may accomplish self-rescue if the opportunity is available or may wait to be rescued by the rescue services using procedures detailed in the emergency plan.
• Communication shall be possible by fixed connection to the control center and emergency services.
• Communications devices shall be located at cross passages and exits.
The point of safety may be reached by one of the following:
1) Lateral and/ or vertical emergency exits from the tunnel to the surface.
2) Cross passages from the tunnel to an adjacent parallel tunnel.
3) Cross passages from one trainway to another trainway where trainways are separated by a minimum two hour rated fire wall.
Lateral and/or vertical emergency exits to the surface shall be provided at 3000 feet (maximum) unless there is a parallel tunnel independent from the tunnel in which the incident occurred, connected by cross passages to provide access to a point of safety in the parallel tunnel.
The minimum dimensions of lateral and or vertical emergency exits to the surface shall be five (5) feet wide and seven and one half (7.5) feet high. The minimum dimensions of the exit doors openings shall be four (4) feet wide by six (6) feet eight inches high. All exits shall be equipped with lighting and signs.
Cross passages between adjacent independent tunnels enable the adjacent tunnel to be used as a safe area.
Cross-passages shall must be equipped with lights and signs. Minimum dimensions of the cross passage are seven and one half (7.5) feet in height by five (5) feet in width. The minimum dimensions of the doors are six feet eight inches in height and four feet in width. Cross passages in conformity with these requirements shall be provided at 1500 feet (maximum).
These facilities shall serve as access to the incident for emergency first responders.
Walkways, emergency lighting, emergency signage, and emergency communications are addressed in separate system requirements.

4-02.7 **Escape walkways** **(TUN)**

See System Requirement INF 3-23.2

4-02.8 **Emergency lighting on escape routes** **(TUN)**

The following requirements shall apply to continuous underground or enclosed high-speed trainways of more than 300 feet in length.
Emergency lighting shall be provided to guide passengers and staff to a safe area in the event of emergency.
Emergency lighting shall be located as follows:
• Single-track tunnels: on one side (same as walkway)
• Double-track tunnels: on both sides
• In exit and emergency access routes including but not limited to: stairways, passages, entryways
Where maintenance of illumination depends on changing from one energy source to another, a delay of not more than 15 seconds shall be permitted.
Lighting systems shall, during the period of evacuation, provide illumination levels, measured at the walking surface of:
• Trainway walkways: not less than 0.25 ft-candles (2.7 lux)
• Exit and emergency access routes, including stairs, not including trainway walkways: not less than 1.0 ft-candle (10.8 lux)
Uniformity Ratio of the emergency lighting system shall not exceed a ratio of 10:1 from the maximum to the minimum maintained horizontal luminance on walkway surfaces.
Emergency fixtures, exit lights and signs shall be wired separately from emergency distribution panels.

If the emergency light is switched off under normal operating conditions, it shall be possible to switch it on by both of the following means
- manually from inside the tunnel at intervals not exceeding 1000 feet
- by the train operator using remote control
Power supply for emergency lighting shall be guaranteed to ensure availability for at least 90 minutes from the time the emergency light is switched on.

4-02.9 **Escape signage** **(TUN)**

Underground or enclosed trainways more than 350 feet in length shall be provided with directional signs, indicating the emergency exits and the direction to a safe area, in accordance with the emergency evacuation procedures.
Signs indicating station or portal directions shall be installed at maximum 82 foot intervals on both sides of the underground or enclosed trainways.
Signs shall be made of reflective or illuminated material and shall be readily visible by passengers within the trainway.
Points of exit from underground or enclosed trainways shall be marked with internally or externally illuminated signs.
Emergency exit facilities shall be identified and maintained to allow for the intended use.

4-03.1 **Segmentation of overhead line or conductor rails** **(TUN)**

In tunnels of more than 3 miles (4.83 km) in length and where the signalling system permits the simultaneous presence of more than one train on each track in the tunnel, the overhead contact line shall be divided electrically into sections with insulated separation between those sections.

4-03.2 **Overhead line or conductor rail earthing** **(TUN)**

Facilities shall be provided so that emergency response personnel can isolate and ground each OCS electrical section in a tunnel in accordance with the emergency plan.

4-03.3 **Electricity supply** **(TUN)**

The facility power distribution system shall be adequately sized and include provisions to permit connection of first responders' standardized equipment at intervals throughout each tunnel in accordance with the requirements of the emergency plan and the local emergency services.

4-03.4 **Requirements for electrical cables in tunnels** **(TUN)**

Wires and cables installed in tunnel environments shall have low-smoke, zero halogen properties that shall not support combustion.

4-03.5 **Reliability of electrical installations** **(TUN)**

The Facility Power Distribution System shall include normal, backup and emergency power supply sources to ensure full operation in the event of the loss of any other major element.
The normal, backup and emergency power supply sources shall be physically segregated and routed in separate raceway systems.
Except for exposed overhead contact system (OCS) conductors and radio antennae, all other wires and cables shall be protected from mechanical impact, heat or fire.
The emergency power supply sources shall provide at least 90 minutes backup power to emergency light and communications equipment in the event of the loss of normal and back-up power sources.

4-04 **Subsystem control-command and signaling** **(TUN)**

The tunnel related requirements for Subsystem Train Control and Communications are covered under TUN 4-04.1

4-04.1 **Hot axle box detectors** **(TUN)**

Hot axle box detectors are required so that there is a high probability of detecting one or more hot axle box before a defective train enters a tunnel and that the train will be stopped by the ATC subsystem before entering.

4-05.1 **Material properties for rolling stock** **(TUN)**

Refer to CHSTP SR 5-07.2: Fire safety.

4-05.10 **Switching off of air conditioning in the train** **(TUN)**

Refer to CHSTP SR 5-07.11: Particular specification for tunnels

4-05.11 **Escape design of passenger rolling stock** **(TUN)**

Section heading.
Refer to CHSTP SR 5-07.1: Emergency exits
Refer to CHSTP SR 5-02.4: Access

4-05.12 **Rescue service's information and access** **(TUN)**

Rescue service's information and access
The CHSTP shall establish and maintain a working relationship with the on-line emergency responders by, as a minimum:
(i) Developing and making available a training program for all on-line emergency responders who could reasonably be expected to respond during an emergency situation. The training program shall include an emphasis on access to railroad equipment, location of railroad facilities, and communications interface, and provide information to emergency responders who may not have the opportunity to participate in an emergency simulation. Each affected railroad shall either offer the training directly or provide the program information and materials to state training institutes, firefighter organizations, or police academies;
(ii) Inviting emergency responders to participate in emergency simulations; and
(iii) Distributing applicable portions of its current emergency preparedness plan at least once every three years, or whenever the railroad materially changes its plan in a manner that could reasonably be expected to affect the railroad's interface with the on-line emergency responders, whichever occurs earlier, including documentation concerning the railroad's equipment and the physical characteristics of its line, necessary maps, and the position titles and telephone numbers of relevant railroad officers to contact.

4-05.2 **Fire extinguishers for passenger rolling stock** **(TUN)**

Refer to CHSTP SR 5-07.2: Fire safety

4-05.3 **Fire protection for freight trains** **(TUN)**

Section heading
N/A. The CHSTP will not be operating freight trains

4-05.4 **Fire barriers for passenger rolling stock** **(TUN)**

Refer to CHSTP SR 5-07.2: Fire safety

4-05.5 **Additional measures for running capability of passenger rolling stock with a fire on board:** **(TUN)**

Section heading.
Refer to CHSTP SR 5-07.2: Fire safety

4-05.6 **On board fire detectors** **(TUN)**

Refer to CHSTP SR 5-07.2: Fire safety

4-05.7 **Communication means on trains** **(TUN)**

Refer to CHSTP SR 5-05.1: Public address system.

4-05.8 **Emergency brake override** **(TUN)**

Refer to CHSTP SR 5-05.3: Passenger alarm.

4-05.9 **Emergency lighting system in the train** **(TUN)**

Refer to CHSTP SR 5-07.12: Emergency lighting system

4-12 **Tunnels - Operating rules** **(OPS)**

This CHSTP system requirement gives an overall view of operating rules and emergency procedures covering operations in tunnels. Some subsequent CHSTP Requirements will address some of the discreet components of the overall operation. Since railroad operations in tunnels pose unique risks beyond the normal risks associated with railroad operations. And to that extent may require additional safeguards enshrined in the Code of Operating Rules and the Timetable Special Instructions in order to facilitate prevention, mitigation of risks and, in emergency situations, evacuation and rescue.
CHSRP will provide initial training for Operations Control Center (OCC), on-train employees (both train and service crews), and appropriate roadway workers. Follow-up or refresher training will be provided annually.
Care needs be taken to provide training and other suitable materials for the benefit of first responders, as well as for the benefit of railroad employees.

4-12.1 **Tunnels - Checking the condition of trains and appropriate actions** **(OPS)**

A robust maintenance regimen and the positioning of defect detectors shall be employed to prevent or mitigate equipment failures in tunnels. A revenue train will not be dispatched from its origin terminal and put in service that has inoperative public address system, emergency lighting system, door unlocking system, passenger alarm system fire detection system, or train radio. Defect detectors such as hot box detectors (if used) and dragging equipment detectors shall be placed in the field that trains are alarmed in sufficient time for the engineer to bring the train to a safe stop before entering a tunnel of 1,000 feet or more in length. For an enroute failure of any of the subsystems noted above, the engineer will notify the train dispatcher. The effects must be repaired before the next daily inspection of the equipment must be held out of service.

Dragging equipment detectors shall be placed in the field in such a way that trains are alarmed in sufficient time for the engineer to bring the train to a safe stop before entering a tunnel of 1,000 feet or more in length. Special Instructions shall apply for handling hot journals and overheated bearings.

4-12.2 **Tunnels - Emergency rule** **(OPS)**

Unless it is unavoidable or safe operation dictates otherwise, passenger trains shall not stop in tunnels.

4-12.3 **Tunnels - Tunnel emergency plan and exercises** **(OPS)**

CHSTP will have a written Emergency Preparedness Plan approved by the FRA under the procedures of 49 CFR 239.201. CHSTP will exceed the minimum regulatory requirement conduct at least four full scale emergency simulations during each calendar year in different parts of the system.

4-12.4 **Tunnels - Earthing procedures** **(OPS)**

If rescue services request the catenary to be de-energized, the person in charge will make that request to the senior qualified CHST employee who will communicate with the train dispatcher, The plate order will be given to the qualified electric traction employee (or other qualified employee) who will show the order to the emergency services person in charge and explain the limits of the deenergized territory. If emergency services are still on the scene when the catenary is OK to be re-energized, the person receiving the plate order must explain to the emergency services commander the territory to be reenergized.

4-12.5 **Tunnels - Timetable Special Instructions (TTSI)** **(OPS)**

The Timetable Special Instructions (TTSI) shall indicate the relevant safety information for tunnels.

4-12.6 **Tunnels - Co-ordination between tunnel control centers** **(OPS)**

Coordination between the Operations Control Center (OCC), higher CHSTP management, the field, the media and outside agencies such as first responders and regulatory authorities shall be as prescribed in the Emergency Preparedness Plan.

4-13.2 **Tunnels - Maintenance of rolling stock** **(OPS)**

CHSTP trains will be designed, operated, and maintained for operations in tunnels and will meet or exceed federal requirements as pertains to equipment in emergency situations in tunnels.

4-14 **Tunnels - Professional qualifications** **(OPS)**

All employees, whose duties involve working in tunnels, operating or accompanying trains through tunnels must be

qualified on any special instructions or rules that have particular application to tunnels.
Employees must demonstrate their competence with respect to operation in normal and degraded conditions. This competence must be certified (and periodically re-certified) through oral and written examination and through periodic practical exercises or drills.
The Code of Operating Rules and the Timetable Special Instructions (TTSI) will contain procedures relating to operations in tunnels and issues such as equipment failure, fires, evacuation, transfer, and rescue.

4-14.1 **Tunnels - Tunnel specific competence of the train crew and other staff** **(OPS)**

Train Crew and other staff operating or accompanying trains through tunnels must be qualified on any special instructions or rules that have particular application to tunnels. Other staff shall include Assistant Chief Train Dispatchers and Train Dispatchers. Particular tunnel-specific instructions for train crew and other staff will be contained in the Code of Operating Rules and the Timetable Special Instructions
Employees must demonstrate their competence with respect to operation in normal and degraded conditions. This competence must be certified (and periodically re-certified) through oral and written examination and through periodic practical exercises or drills.
The Code of Operating Rules and the Timetable Special Instructions (TTSI) will incorporate procedures relating to operations in tunnels and issues such as equipment failure, fires, evacuation, transfer, and rescue.

4-15 **Tunnels - Health and safety conditions** **(OPS)**

The CHSTP System Safety Plan shall include any necessary instructions pertaining to life safety in tunnels.

5-01.1 **Introduction** **(RST)**

CHSTP rolling stock requirements shall be as the follows:

(a) Basic parameters:
The basic parameters for the rolling stock subsystem are:
—maximum track forces (track loading limit values)
—axle load
—maximum train length
—vehicle kinematic gauge
—minimum braking characteristics
—electrical boundary characteristics for rolling stock
—mechanical boundary characteristics for rolling stock
—exterior noise limits
—electromagnetic interference limits
—interior noise limits
—air conditioning limits
—requirements for the transport of people with reduced mobility
—maximum pressure variations in tunnels
—maximum gradients
—geometry of the pantograph collector head
—maintenance

(b) Performance criteria:
Performance criteria for the CHSTP high-speed network shall be met for the specific requirements for each of the following line categories:
—lines specifically built for high speed;
—lines specifically upgraded for high speed;
—lines specifically upgraded for high speed but with special features.
For the rolling stock subsystem these criteria include:
—Minimum performance requirements
—Maximum service speed of trains

(c) Minimum performance requirements:
In order to run on the CHSTP high-speed network and under conditions allowing trains to slot smoothly into the overall traffic pattern, all high-speed rolling stock shall be required to guarantee minimum traction and braking performance levels. The trains shall have sufficient standby and backup capacity to ensure that these performance levels are maintained or only slightly downgraded in case of breakdown in systems or modules contributing to these processes (traction equipment from pantograph to axles, mechanical/electrical braking equipment). These margins and redundancies are defined in detail in the characteristics contained in CHSTP System Requirements 5-04.2, 5-04.3, 5-04.7, 5-05.1, 5-07.2, 5-07.12, 5-08.1, and 5-08.2.

For safety reasons, in the probable event of significant failures of rolling stock equipment or functions, or passenger overload, the CHSTP shall have defined the operating rules associated with each reasonably foreseeable degraded mode in full knowledge of the consequences as defined by the manufacturer. The operating rules are part of the safety management system of the CHSTP. For this purpose, the manufacturer shall describe and list in a document the various reasonably foreseeable degraded modes and the related acceptable limits and operating conditions of the rolling stock subsystem that can be experienced. This document shall be part of a technical file and shall be taken into account in the operational rules.

(d) Maximum service speed of trains:
Trains shall have a maximum service speed of 350 km/h (218 mph)
The service speed is the nominal speed trains are expected to run in daily operation on appropriate sections.
In all cases, it shall be possible for rolling stock to be worked at their maximum speed, if allowed by the infrastructure, with sufficient acceleration margins.

5-01.2 **Design of trains** **(RST)**

CHSTP rolling stock requirements shall be as the follows:

(a) Design of trains:
This section is applicable to both trainsets and single vehicles, but always assessed within defined formations of powered and non-powered vehicles.
The following configurations for a CHSTP (Class 1) trainset are permissible:
— articulated and/or non-articulated trains;
— trains with and/or without tilt systems;
— single and/or double deck trains.

(b) CHSTP (Class 1) trains:
CHSTP (Class 1) trains shall be EMU self-propelled trainsets and shall provide a driver's cab at each end and be capable of bi-directional operation and to achieve the performances set forth in this section. It is permissible to couple trainsets to run in multiple to allow train capacity to meet changing traffic needs. Such a train formed from two or more trainsets shall also meet the relevant specifications and performances set forth in other sections. It is not a requirement that trainsets of different manufacturers' designs, or trains from other railway undertakings, need to be able to operate when coupled together.

(c) Assessment:
For CHSTP trains, whether assessing a trainset or a single vehicle within one or more formations, the formations for which such assessments are valid shall be clearly defined by the party asking for assessment. It is not permissible to assess a single vehicle without reference to a specific formation. The definition of each formation shall include the type designation, the number of vehicles and relevant characteristics of the vehicles as listed in the rolling stock register.

(d) Definitions:
A trainset is a fixed formation that can only be reconfigured within a workshop environment, if at all.
EMU (Electric Multiple Unit), are trainsets, where all vehicles are capable of carrying a payload. Traction and other equipment are usually, but not exclusively under-floor.
A coach is a non-traction vehicle in a fixed or variable formation capable of carrying a payload. It is permitted to equip such a coach with a driver's cab. Such a coach is named a driving coach.
A train is an operational formation consisting of one or more vehicles or trainsets.

5-02 **Structure and mechanical parts** **(RST)**

CHSTP rolling stock requirements shall be as follows:

Refer to subsections of the CHSTP System Requirements section 5-02 for relevant CHSTP system requirements.
CHSTP rolling stock requirements shall be as follows:

Refer to subsections of the CHSTP System Requirements section 5-02 for relevant CHSTP system requirements.

In addition, the following requirements shall be met::

(a) Safety appliance mechanical strength and fasteners.
(1) All handrails, handholds, and sill steps shall be made of 1-inch diameter steel pipe, 5/8-inch thickness steel, or a material of equal or greater mechanical strength; the steel shall have minimum yield strength of 25,000 psi. Safety appliances may be cast, rolled, forged, or made by any other process that provides the required strength. To allow for standard mill tolerances, actual sizes of components (i.e. material thickness, diameter, etc.) may be 5% below the nominal sizes. Clearance dimensions are minimum dimensions (-0%).

(2) All safety appliances shall be securely fastened to the car body structure with mechanical fasteners that have mechanical strength greater than or equal to that of a1/2-inch diameter steel bolt mechanical fastener. The bolts shall conform to the specifications of either SAE J429, Grade 5 for carbon/low alloy steel or ASTM F593, Groups 1-3, Condition CW1 for stainless steel. Nuts of corresponding strength and appropriate chemical composition shall be used.
(i) Safety appliance mechanical fasteners shall have mechanical strength and fatigue resistance equal to or greater than a1/2-inch diameter SAE steel bolt.
(ii) Mechanical fasteners shall be installed with a positive means to prevent unauthorized removal. With the exception of self-locking threaded fasteners, safety appliances shall be secured by methods defined in Section 3.1.19 of APTA SS-M-016-06 (ed. 7-1-07) – Standard for Safety Appliances for Rail Passenger Cars.
(iii) Mechanical fasteners shall be installed to facilitate inspection.
(3) Brackets or supports to which safety appliances are fastened are considered part of the carbody and are not required to be mechanically fastened to the piece of passenger equipment if all of the following are met:
(i) Except for any access required for attachment of the safety appliance, the weld is continuous around the perimeter of the surface of the bracket or support;
(ii) The area of the weld is sufficient to ensure a minimum weld strength, based on yield, of three times the strength of the number of SAE Grade 2, 1/2 inch diameter bolts that would be required for each attachment;
(iii) The attachment is made with fillet welds at least 3/16 inch in size;
(iv) The bracket or support is welded to a surface of the carbody that is at a minimum 3/16 inch sheet steel or is structurally reinforced to provide the equivalent strength and rigidity of 3/16 inch (5 mm) sheet steel;
(v) The weld takes into account the variable stress state of the carbody at the weld location;
(vi) The weld is designed for infinite fatigue life in the application in which it will be placed;
(vii) The weld is performed in accordance with the welding process and the quality control procedures contained in the current American Welding Society (AWS) Standard or an equivalent nationally or internationally recognized welding standard;
(viii) The weld is performed by an individual possessing the qualifications to be certified under the current AWS Standard or any equivalent nationally or internationally recognized welding qualification standard;
(ix) The weld is inspected by an individual qualified to determine that all welds are in conformance with the design drawings and the current AWS Standard or any equivalent nationally or internationally recognized welding qualification standard; and,
(x) A written or electronic record of the inspection shall be preserved and shall be provided to the FRA upon request. At a minimum, this record shall include date, time, location, identification of the person performing the inspection and the qualifications of the person performing the inspection.

(b) Handrails and handholds. Except as provided in paragraph (d) of this section:
(1) Handrails shall be provided for passengers on both sides of all steps used to board or depart the train.
(2) Exits from a cab shall be equipped with handrails and handholds so that crewmembers can get on and off the vehicle safely.
(3) Throughout their entire length, handrails and handholds shall be a color that contrasts with the color of the vehicle body to which they are fastened.
(4) The maximum distance above the top of the rail to the bottom of vertical handrails and handholds shall be 51 inches, and the minimum distance shall be 21 inches.
(5) Vertical handrails and handholds shall be installed to continue to a point at least equal to the height of the top edge of the control cab door. Per UIC651, Section 2.5, the distance from the top end of the hand rail to the driver's cab floor level must not be less than 47" (1200mm).
(6) The minimum hand clearance distance between a vertical handrail or handhold and the vehicle body shall be 21/2inches for the entire length 1.57" (40mm), increasing to 2.36" (60mm) at the bottom, vehicle gauge permitting (Ref. UIC651, Section 2.5).
(7) All vertical handrails and handholds shall be securely fastened to the vehicle body.
(8) If the length of the handrail exceeds 60 inches, it shall be securely fastened to the power vehicle body with two fasteners at each end.

(c) Sill steps. Each cab shall be equipped with a sill step below each exterior door as follows:
(1) The sill step shall have a minimum cross-sectional area of ½ by 3 inches;
(2) The sill step shall be made of steel or a material of equal or greater strength and fatigue resistance;
(3) The minimum tread length of the sill step shall be 10 inches;
(4) The minimum clear depth of the sill step shall be 8 inches 5.9" (150mm) (Ref. UIC651, Section 2.4);
(5) The outside edge of the tread of the sill step shall be flush with the side of the car body structure;
(6) Sill steps shall not have a vertical rise between treads exceeding 18 inches (17.7" (450mm) per UIC651, Section 2.4) ;
(7) The lowest sill step tread shall be not more than 24, preferably not more than 22, inches above the top of the track rail;
(8) Sill steps shall be a color that contrasts with the color of the vehicle body to which they are fastened;
(9) Sill steps shall be securely fastened;
(10) At least 50 percent of the tread surface area of each sill step shall be open space; and
(11) The portion of the tread surface area of each sill step which is not open space and is normally contacted by the foot shall be treated with an anti-skid material.

(d) Optional safety appliances. Safety appliances installed at the option of CHSTP shall be firmly attached with mechanical fasteners and shall meet the design and installation requirements provided in this section.

(e) Protection against personal injury. Fan openings, exposed gears and pinions, exposed moving parts of mechanisms, and pipes carrying hot gases shall be in non-hazardous locations or equipped with guards to prevent personal injury.

5-02.1 General (RST)

Refer to CHSTP System Requirements 5-02.2, 5-02.3, 5-02.4, 5-02.5, 5-02.6, 5-02.7, 5-02.8, and 5-02.9.

5-02.2 End couplers and coupling arrangements to rescue trains (RST)

(a) CHSTP (Class 1) trains shall be equipped at each end of the train with an automatic centre buffer coupler, geometrically and functionally compatible with a 'Type 10 latch system automatic centre buffer coupler' (also known as the 'Scharfenberg' system) as shown below in Figure K1.
(1) The leading and the trailing ends of a semi-permanently coupled trainset shall each be equipped with an automatic coupler that couples on impact and uncouples by either activation of an uncoupling mechanism that does not require a person to go between the equipment units.
(2) The automatic coupler and uncoupling device on the leading and trailing ends of a semi-permanently coupled trainset may be stored within a removable shrouded housing.

(b) All trains equipped with automatic centre buffer couplers shall be provided with a towing coupler that meets the requirements of Annex K clause K.2 of the TSI for Rolling Stock. The towing coupler shall be available on board. This is to enable such trains to be rescued or recovered in the event of a breakdown by motive power units or other trains.

(c) Requirements for the pneumatic brake equipment of high speed trains for towing in case of emergency rescue are specified in CHSTP System requirements section 5-04.8. and in clause K.2.2.2 of Annex K of the TSI for Rolling Stock.

ANNEX K
Coupler
K.1. Schematic of the coupler
The towing coupler shall comply with the dimensions in Figure K1 but its shape is permitted to be different.
(See attachment)
The centre of the end coupler shall be at 1 025 mm +15 mm/–5 mm above running surface, for an empty vehicle in running order condition and with new wheels.

K.2. Towing coupler used for recovery and rescue
K.2.1. Definition of terms
Recovery vehicles (locomotives, trains) are denoted by the term 'recovery vehicle'.

The rescue, emergency and recovery coupler on the recovery vehicle covered in this annex is denoted by the term 'towing coupler'.

The automatic coupler system shall be geometrically and functionally compatible with a 'Type 10 latch system automatic centre buffer coupler' (also known as the 'Scharfenberg' system) and referred to herein as an 'automatic coupler'.

The term 'draw hook' refers to a draw hook of shape and dimensions conforming to clause 4.2.2.1.2 of the Freight Wagon TSI 2005; the reference height above rail level (ARL) is defined as being 1 025 mm + 15 mm/– 5 mm for an empty vehicle in running order conditions and with new wheels.

The term 'half coupler' is adopted to describe the brake couplers to be connected to the air pipes between the vehicle and the rescue coupler (main brake pipe and main air pipe).

K.2.2. General conditions
K.2.2.1. Speeds
Permissible speeds when recovering trains are:
(See attachment)
K.2.2.2. Brakes
The train to be recovered shall be connected to the brake pipe of the recovery vehicle and braked from there.

K.2.2.3. General Pneumatic connection
All trains shall be able to be moved safely and braked when connecting the main brake pipe only. It is permissible to connect the main air reservoir pipe only when a specific procedure defined by the operator of the recovered vehicle allows it. Where the main air reservoir pipe cannot be connected operational rules shall be provided to continue to assure safety of passengers.

K.2.2.4. Coupling Process
The recovery vehicle shall come to a complete halt in front of the vehicle being recovered. The recovery vehicle shall then proceed at a maximum speed of 2 km/h to engage the two couplers.

K.2.2.5. Uncoupling conditions
It is permissible to uncouple manually or automatically.

K.2.3. Towing a train fitted with an automatic coupler by means of a towing coupler
K.2.3.1. General conditions
When a train fitted with an automatic coupler is hauled by a motive power unit fitted with buffing and draw gear components and a towing coupler, the towing coupler shall, as a minimum, be able to withstand the following static forces without permanent deformation:
a) tensile force at the coupler 300 kN
b) compressive force at the coupler 250 kN

K.2.3.2. Coupling conditions
Mechanical connection
The towing coupler shall be designed to be installed by two people in a maximum time of 15 minutes, its maximum weight shall not exceed 45kgs.

The mechanical connection between the train’s coupler and the towing coupler fitted to the recovery vehicle shall be established automatically.

It shall be ensured that the towing coupler fitted to a vehicle with buffing and draw gear components is able to be connected to the automatic coupler on the other vehicle, to allow train running on horizontal curves of R ≥ 150 m or on vertical curves of R ≥ 600 m on a crest or R ≥ 900 m on a hollow (see High Speed Infrastructure TSI 2006 clause 4.2.25.3)

Readiness for hauling shall be brought about by hooking the towing coupler onto the draw hook of the recovery vehicle and fastening it to the draw-hook itself.

The towing coupler shall be fastened in such a way that, whilst it cannot be worked loose by any relative motion occurring, it shall not impair the freedom of movement of the draw hook.

The towing coupler shall be provided with all necessary parts for installation and no additional tools shall be needed for installation.

Once the towing coupler has been installed on the draw hook of the vehicle,
a) the towing coupler shall be able to be centered on the draw hook by hand
b) the draw hook’s normal horizontal play shall not be impaired
c) the draw hook’s normal vertical play shall not be impaired
d) the vertical fastening on the towing coupler shall be easy to handle
e) any tilting mechanism shall be turned off.

In order not to exceed the towing couplers mechanical strength, the difference in the centre heights of the towing coupler and the coupler on the train being recovered shall not exceed 75 mm.

Pneumatic connection
The air pipes (main brake pipe and main air pipe) shall be connected as follows:

The air hoses on the recovery vehicle shall be joined to the corresponding air connectors on the coupler by means of the half couplers (see Figure K2).

It shall be ensured in the process that the air pipes are free to move about their longitudinal axes.
(See attachment)

It is permissible to equip CHSTP vehicles when fitted with automatic couplers, with additional air pipe connectors for a direct connection of the air pipes to the recovery vehicle.

K.2.4. Towing a train fitted with a draw hook by means of a towing coupler

K.2.4.1. General conditions
All requirements requested in previous section K.2.3 shall be applicable, taking into account the following modifications
resulting from the towing coupler installation.

K.2.4.2. Coupling conditions
Mechanical connection

The mechanical connection between the rescued train's towing coupler and the automatic coupler fitted to the recovery vehicle shall be established automatically.

Pneumatic connections

The air pipes (main brake pipe and main air pipe) shall be connected via the corresponding air ducts. It is not essential
to pneumatically connect the uncoupling lines.

5-02.4 **Access** **(RST)**

a) Door operation:
The door opening command shall be initiated by a crew member (e.g. Conductor); a mechanical latching device shall be incorporated into the design of the door to assure that the doors cannot be opened in the absence of such command or loss of power. The door system design shall permit only one active door control station per consist. For normal operations, the door opening signal shall be interlocked with a zero speed command.

If pushbuttons are provided for the powered operation of doors then each pushbutton shall be illuminated (or the surround shall be illuminated) when enabled and shall be operable by a force not greater than 15 Newton (3.4 lbf). If door open pushbuttons are to be provided, operating instructions shall be posted adjacent to the pushbutton.

(b) Door closing:
The door control device shall allow the train crew (driver or conductor) to close and lock the doors before the train departs. When the locking control is under staff control and activated from a door, it is permissible for this door to remain open when the other doors close. It shall be possible for staff to close and lock this door subsequently. This door shall be closed, prior to the train departing.

All exterior side doors and hatches shall be tied to a trainlined door closed signal (i.e. door summary circuit). This circuit would prevent the trainset from taking traction power in the event that an exterior door/hatch is not closed.

The doors shall be kept closed and locked until the train crew releases them. In the event of loss of power to the door controls, the doors shall be kept locked by the locking mechanism.

An audible warning sound shall be activated before the doors start to close.

The door system design shall incorporate a method to detect an obstruction in the path of a closing door. The impact force required to trigger the detection of said obstruction shall not exceed 20 lbf when the door is powered to close. Once this obstruction is detected, the system shall react in a manner that will allow the obstruction to be released. The doors shall not close and latch to permit a closed-door indication if an obstruction is detected. The sensitivity of the obstruction detection system shall conform to the requirements set forth in APTA SS-TBD – Standard for Power Door System Design for New Passenger Cars.

Provisions may be provided to allow a door panel to be manually pushed back to permit an obstruction to be removed; the force required to push back a door panel shall not exceed 45 lbf.

(c) Door control panel:
A door control panel may be provided in a car with powered doors to control the operation of the side entry doors, or other doors on that car, or other cars in the train via trainline control signals. A crew key, or other secure method, shall be utilized to enable the panel in order to prevent misuse or unauthorized use. The key shall be captive while the panel is activated; removal of the key shall prohibit input of open and close commands at the panel. Door status indicators may be incorporated into the panel to display the open or closed status of the doors at that door opening or on the car, or the status of the door closed summary circuit. If indicators are provided on the door control panel, a test feature shall be incorporated to provide a method of identifying failed indicators.

(d) Information available to the train crew:
An appropriate device shall indicate to the driver or the train crew that all the doors (except for the door under local control of the train crew) are closed and locked. Appropriate indication shall be provided to the driver or the train crew of any fault in the door closing operation.

A ‘door locked out of service’ shall not be taken into account.

(e) Locking a door out of service:
A manual device shall be provided to enable the train crew to lock a door out of service. This action shall be possible from both inside and outside the train. After the door is locked out of service, it shall no longer be taken into account by the door controls or the onboard monitoring systems.

(f) Door opening release:
The train crew shall be provided with controls that allow the doors to be released separately on each side when the train is stopped.

(g) Door opening control:
A normal opening control or opening device shall be accessible for passengers from both the outside and the inside of the vehicle.

Each door shall be provided with an individual internal emergency-opening device, accessible to passengers, that shall allow the door only to be opened at speeds below 10 km/h. (6.2mph). Such a device may be protected with a cover or a screen capable of removal without requiring the use of a tool or other implement.

This device, when activated, shall remove traction power, unlatch the door, remove the door isolation lock, remove power from the door operator or controls, and move the door to the open position a minimum 1.5 inches. In addition, door panel friction, including seals and hangers, shall allow the doors to be opened or closed manually with as low a force as practicable.

This device shall unlock ‘a door locked out of service’.

Each door shall be provided with an individual external emergency-opening device, accessible to rescue staff, to allow that door to be opened for emergency reasons. This device shall unlock ‘a door locked out of service’.

(h) Summary circuit by-pass:
Operating cabs may be equipped with a summary circuit bypass switch designed to override the door closed summary circuit. The switch shall have provisions for sealing in the “normal” position and shall provide an indication, visible to the operator, when the train is operating in by-pass. It shall be used to override the door summary circuit in the event a defective door fails to close and latch and the summary circuit cannot be completed when a defective door is secured using the door isolation lock mechanism. The by-pass switch shall only be active from the cab controlling the train.

(i) End of train detection:
Provisions shall be included to denote the end of the train so that all side passenger doors are protected by the door summary circuit. If end of train switches are used, then the switches shall be secured in a manner to prevent access by unauthorized personnel.

(j) Evacuation:
The number of the doors and their dimensions shall allow the complete evacuation within three minutes by passengers without their baggage in a situation where the train is stopped alongside a platform. Doors shall be fitted with transparent windows to allow passengers to identify the presence of a platform

It is permitted to consider that passengers with reduced mobility are to be assisted by other passengers or staff, and that wheelchair users are evacuated with their wheelchairs. Verification of this requirement shall be made by a physical test with a normal load as defined in CHSTP System Requirement 5-03.2, and under normal operating conditions.

(k) System safety:
No single point failure in the door system, internal to the car or train, shall cause:
— any door to unlatch or open;
— a door “open” command to be transmitted or responded to when the train is in motion;
— a door “closed” indication to be transmitted when any door is unlatched or open;
— a door “closed” indication to be transmitted when an unlatched or opening command is stored anywhere in the system.

The door shall be designed in a failsafe manner such that no single point failure shall cause an unsafe condition; in the event of such a failure, the door system shall default to a safe condition.

Unauthorized opening of doors on the vehicles shall be automatically communicated to the operations control center and/or the train operator.

In addition, the following requirements shall be met:

Each passenger car shall have a minimum of two exterior side doors, each door providing a minimum clear opening with dimensions of 32 inches horizontally by 74 inches vertically.

Design of CHSTP door systems shall adhere to the requirements of APTA SS-C&S-012-02 (ed. 3-22-04) – Standard for Door Systems for New and Rebuilt Passenger Cars.

5-02.5 Toilets (RST)

(a) Sanitation compartment:
CHSTP trains in use shall be equipped with a sanitation compartment. Each sanitation compartment shall be:
—adequately ventilated;
—equipped with a door that closes and possesses a modesty lock;
—equipped with a sealed retention toilet system;
—equipped with a washing system including dryer or towel dispenser;
—equipped with toilet paper in sufficient quantity to meet crew and passenger needs;
—equipped with a trash receptacle;
—equipped with mirrors.

The railroad shall utilize potable water where the washing system includes the use of water. Flushing shall be permissible with either clean water or by re-circulation techniques. If the flushing medium is not clean water, the characteristics of the flushing medium shall be recorded in the rolling stock register.

(b) Sanitation servicing requirement:
The sanitation compartment of each passenger car in use shall be sanitary.

All components for the sanitation compartment shall operate as intended such that:
—all mechanical systems shall function;
—water shall be present in sufficient quantity to permit flushing;
—for those systems that utilize chemicals for treatment, the chemical (chlorine or other comparable oxidizing agent) used to treat waste must be present;
—no blockage is present that prevents waste from evacuating the bowl.

(c) Maintenance:
Maintenance of sanitation facilities shall be addressed in the CHSTP System Requirements for Operations and Maintenance.

5-02.6 Driver's cab (RST)

(a) Access and egress:
The cab shall be accessible from both sides of the train from the platforms as defined in the CHSTP Infrastructure System Requirement 3-20.4 and from a level 200 mm below the top of the rail on a stabling track. It is permissible for this access to be either directly from the exterior or through an adjoining compartment at the rear of the cab.

The train crew shall be able to prevent the cab being accessed by non-authorized persons.

(b) External visibility:
Forward Vision: The driver's cab shall be designed such that a driver has a clear, unobstructed line of sight to be able to see fixed signals set to both the left and right of the track from the normal seated driving position as defined in Figures B.1 through B.5 inserted below, when the train is on a level and straight track, with the signals following locations defined in Figure B.2, measured from either the coupling face or the buffer plane (whichever is applicable). Consideration of a standing driving position is not required.
Side vision: The driver shall be provided with an opening window or opening panel, sufficiently large for the driver to put his head through the aperture, at each side of the cab. Additional equipment for side and rearwards vision is not mandatory.

(See attachment)
(See attachment)
(See attachment)
(See attachment)
(See attachment)

(c) Seats:
The main seat available to the driver shall conform with the requirements set forth in APTA SS-C&S-011-00 (Ed. 3-22-04) – Standard for Cab Crew Seating Design and Performance and shall be designed in such a way that it

allows him or her to undertake all normal driving functions in a seated position; the dimensions in section (b) shall be used in lieu of APTA SS-C&S-011-00 Sections 5.2 and 5.4. The dynamic seat attachment test set forth in APTA SS-C&S-011-00 shall also be modified to reflect the longitudinal acceleration identified below.

In addition, a second forward facing seat shall be provided for possible accompanying crew. The requirements for external visibility given in section (b) do not apply to this position; however, this seat shall still meet the acceleration requirements identified below.

(d) Interior layout:
Freedom of movement of personnel in the cab interior shall not be inhibited by obstructions. Steps are not permitted on the cab floor; they are permitted between the cab and adjacent compartments or outside doors. The interior layout shall take into account the anthropometric dimensions of the driver as set out in Figure B.1.

In addition, the following requirements shall be met:

— floors of cabs, passageways, and compartments shall be kept free of any obstruction that creates a slipping, tripping or fire hazard. Floors shall be properly treated to provide secure footing;
— containers shall be provided for carrying fusees and torpedoes. A single container may be used if it has a partitior to separate fusees from torpedoes. Torpedoes shall be kept in a closed metal container;
— the driver's cab shall have cab lights which will provide sufficient illumination for the control instruments, meters, and gauges to enable the driver to make accurate readings from his or her normal position in the cab. These lights shall be located, constructed, and maintained so that light shines only on those parts requiring illumination and does not interfere with the driver's vision of the track and signals. Each cab shall also have a conveniently located light that can be readily turned on and off by the driver and that provides sufficient illumination for him or her to read train orders and timetables;
— cab passageways and compartments shall have adequate illumination;
— driver controls in the driver's cab shall be arranged so as to minimize the chance of human error, and be comfortably within view and within easy reach when the driver is seated in the normal train control position;
— the driver's control panel buttons, switches, levers, knobs, and the like shall be distinguishable by sight and by touch;
— the driver's cab information displays shall be designed with the following characteristics:
— simplicity and standardization shall be the driving criteria for design of formats for the display of information in the cab;
— essential, safety-critical information shall be displayed as a default condition;
— driver selection shall be required to display other than default information;
— cab or train control signals shall be displayed for the driver; and
— displays shall be readable from the driver's normal position under all lighting conditions;
— each seat provided for an employee regularly assigned to occupy a power car cab and any floor-mounted seat in the cab shall be:
— secured to the car body with an attachment having a minimum ultimate strength capable of withstanding the loads due to the following individually applied accelerations acting on the combined mass of the seat and the mass of a seat occupant who is a 95th-percentile adult male:
— longitudinal: 12g;
— lateral: 4g; and
— vertical: 4g;
— designed so that all adjustments have the range necessary to accommodate a person ranging from a 5th-percentile adult female to a 95th-percentile adult male, as persons possessing such characteristics are specified, correcting for clothing as appropriate, in any recognized survey after 1958 of weight, height, and other body dimensions of U.S. adults;
— equipped with lumbar support that is adjustable from the seated position;
— equipped with force-assisted, vertical-height adjustment, operated from the seated position;
— equipped with a manually reclining seat back, adjustable from the seated position;
— equipped with an adjustable headrest; and
— equipped with folding, padded armrests;
— sharp edges and corners shall be eliminated from the interior of the driver's cab, and interior surfaces of the cab likely to be impacted by an employee during a collision or derailment shall be padded with shock-absorbent material.

5-02.8 Storage facilities for use by staff (RST)

CHSTP rolling stock requirements shall be as the follows:

(a) Storage facilities:
There shall be adequate storage facilities for staff's clothing and equipment in or near the driver's cab and where a train is equipped with a separate service compartment.

5-02.9 **External steps for use by shunting staff** **(RST)**

The requirement for external steps for use by shunting staff is not applicable to CHSTP trainsets, as the trainsets will be coupled automatically, without requiring a person to go between the trainsets.

5-03 **Track interaction and gauging** **(RST)**

(a) Clearance above top of rail:
No part or appliance of a locomotive except the wheels, flexible nonmetallic sand pipe extension tips, and trip cock arms may be less than 2 ½ inches above the top of rail.

5-03.1 **Kinematic gauge** **(RST)**

Kinematic gauge:

Rolling stock shall comply with the static gage and corresponding dynamic envelopes identified in Figures 1, 2, 3, and 4, provided below.
The pantograph gauge shall comply with Clause 5.2 of prEN 50367:2006

(See attachment)
(See attachment)
(See attachment)
(See attachment)

(See attachment)

5-03.10 **Sanding** **(RST)**

(a) General requirements:
Sanding devices shall be provided for improving the braking and traction performance of the trainset.

Prior to departure from an initial terminal, each CHSTP trainset shall be equipped with operative sanders that deposit sand on each rail in front of the first power operated wheel set in the direction of movement.

(b) Amount of sand:
For improving braking and traction performances, it is permissible to apply sand on the tracks. The allowed amount of sand per sanding device within 30s is:
— for speeds of V < 140 km/h: 400 g + 100 g;
— for speeds of V ≥ 140 km/h: 650 g + 150 g.

The number of active sanding devices shall not exceed the following:
— for multiple units with distributed sanding devices: first and last car and intermediate cars with a minimum of 7 intermediate axles, between two sanding devices that are not sanded. It is permissible to couple such multiple units and to operate all sanding devices at the coupled ends;
— for emergency and full service braking: all available sanding devices;
— in all other cases: a maximum of 4 sanding devices per rail.

In addition, there shall be provisions on rolling stock to permit interruption of sanding:
—□within switching zones;
—□when at standstill except during starting and testing of the sanding devices;
—□during braking at speeds below 20 km/h.

5-03.11 **Ballast pick up** **(RST)**

(a)□Ballast pick up:

The aerodynamic performance of the exterior of the carbody shall be optimized to mitigate ballast pick-up when operating at the maximum operating speed.

Refer to CHSTP System Requirement 5-02.7 for windscreen glazing requirements.

Refer to CHSTP System Requirement 5-06.1 for pollution considerations.

5-03.2 **Static axle load** **(RST)**

(a) Static axle load:
The nominal static axle load (Po) on the track shall be as set out in Table 1 below and shall meet the following requirements in order to limit the forces exerted on the track by the train. Measurements shall be made under the following normal load conditions:

—with normal payload (as defined in (b) below);

—train crew;

—all materials needed for operation (e.g. lubricants, coolants, catering equipment, flushing medium for toilets etc.);

—2/3 of consumables (e.g. sand, food, etc).

(See attachment)

The maximum total static axle load of the train (the total mass of the train) shall not be greater than: (the sum of all nominal static axle loads of the train) x 1,02.

The total mass of the train shall not exceed 1 000 t.

The maximum individual static axle load of any axle shall not be greater than: (the nominal individual static axle load) x 1,04.

The difference in static wheel load between any wheel on the same bogie or running gear shall not exceed 6 % of the average wheel load of that bogie or running gear. It is permitted to center the car body to the center lines of the bogies before the weighing process.

Individual static axle loads shall not be less than 5 t.

(b) Normal payload:
The following definition of the normal payload will apply, dependent upon the type of vehicle or area:

—passenger seating areas including seats in dining cars:
—number of passenger seats multiplied by 80 kg (176 lb) (stools (low and high), resting bars or standing aids are not classified as seats);

—areas of temporary occupation (e.g. vestibules, gangways, toilets):
—no passenger payload to be taken into account;

—other compartments not accessible to passengers containing luggage, freight:
—maximum payload in revenue service.

5-03.3 **Rolling stock parameters which influence ground based train monitoring systems** **(RST)**

(a) Electrical resistance:
To ensure the operation of track circuits, the electrical resistance of each wheelset, measured from tire to tire shall meet the requirements of the CHSTP Train Control and Communications SR 8-11.

In the case of independent wheels (left and right parallel wheels that rotate independently), it is necessary to electrically connect the pair of wheels to achieve the above value.

(b) Axle bearing health monitoring:
The health of wheelset bearings on CHSTP (Class 1) trains shall be monitored by on board detection equipment.

This equipment shall be able to detect a deterioration of the wheelset bearing health, either by monitoring its temperature, or its dynamic frequencies or some other suitable wheelset bearing health condition characteristic. A maintenance requirement shall be generated by this equipment and indicate a need for operational restrictions when necessary depending on the extent of the wheelset bearing deterioration.

The detection system shall be located entirely on board and diagnosis messages shall be communicated to the driver.

To prevent CHSTP (Class 1) trains triggering an incorrect alarm of trackside hot axle box detection (HABD) equipment, CHSTP (Class 1) trains shall have no component (other than axle boxes), or vehicle part, or commodity, that generates sufficient heat in the target area, defined in (c) below, that triggers an alarm. Where such a possibility

exists then that component, vehicle part or commodity that has the possibility of generating an alarm shall be permanently shielded from the trackside HABD equipment.

It is permissible for CHSTP (Class 1) train axle boxes, by mutual agreement between all the infrastructure managers to whose lines the trains are intended to run and the railway undertaking, to interface with trackside HABD, in addition to the on board detection equipment, if all the requirements of (c) are fulfilled. As an alternative it is permissible by mutual agreement between infrastructure manager and railway undertaking to identify these trains by train identification systems and use the HABD information as agreed.

When, for vehicles with independent rotating wheels, inhibition of false alarms by using the train identification number is not possible, priority shall be given to the on-board detection system provided that all bearings of the wheels are monitored. The rolling stock register shall indicate if the axle boxes that have the possibility of generating an alarm are or are not shielded permanently from the trackside HABD equipment.

(c) Hot axle box detection:
The minimum area on a vehicle that shall remain clear for the observation and measurement of axle box temperatures by trackside HABD equipment, known as the target area (TA), shall comply with the requirements set forth.

The vehicle's axle box shall be designed such that the maximum temperature difference between the loaded zone of the bearing and the target area shall not exceed 20 °C when assessed by the methods defined in Clause 6 of EN 12082:1998, rig performance test.

A minimum of three alarm trigger levels shall apply to CHSTP (Class 1) trains on the axle box target area temperatures (Taxle box) as measured by the trackside HABD equipment:

— warm alarm: Taxle box °C, as defined by the equipment manufacturer;

— hot alarm: Taxle box °C, as defined by the equipment manufacturer;

— difference alarm (difference between the temperature of the right and the left bearing of a wheelset = ΔTdiff): ΔTdiff °C, as defined by the equipment manufacturer.

Specific alarm trigger levels shall be listed in the rolling stock register.

The target area on the underside of an axle box, that shall remain unobstructed to permit observation by a trackside HABD, shall occupy a minimum uninterrupted length of 50 mm within a minimum transverse distance from the wheelset center of 1,040 mm and a maximum transverse distance from the wheelset center of 1,120 mm at a height above the top of the rail between 260 mm and 500 mm;

The longitudinal dimension on the underside of the axle box that shall remain unobstructed to permit observation by a trackside HABD (Figure 1) shall be centered on the wheelset's centerline and shall have a minimum length Lmin (mm) = 130mm for CHSTP (Class 1) trains where used.

(See attachment)

To prevent unwanted activation of the trackside HABD, in the vertical plane and over a minimum longitudinal length of LE (mm) = 500 mm centered on the wheelset centerline:

— no component, or vehicle part, or commodity that has a temperature greater than that of the axle box (e.g. hot load, equipment exhaust) shall be located within the longitudinal limit of LE mm and at a distance of less than 10 mm from either outer edge of the target area's transverse limits unless it is shielded from observation by the trackside HABD;

— no component, vehicle part or commodity that has the potential to increase the temperature of a component or part that lies within the longitudinal limit of LE mm and the target area transverse limits to a temperature above that of the wheelset-box (e.g. equipment exhaust), shall be located at a distance of less than 100 mm from either outer edge of the target area's transverse limits unless it is shielded and prevented from causing an increase in temperature of any part within that area.

In order to maximize the emissivity of the observed target area surface and to limit stray radiation from the axle box, the underside surfaces of the axle box and its immediate environment shall be designed to have a matt finish and be painted with dark paint of a matt finish. The paint used shall be to a specification of a maximum 5 % specular reflection in its new state (as defined in clause 3.1 of EN ISO 2813:1999) and be appropriate for the axle box surfaces to which it is applied.

5-03.4 Rolling stock dynamic behavior (RST)

(a) General:
The dynamic behavior of a vehicle has a strong influence on safety against derailment, running safety and track loading. The vehicle dynamic behavior is mainly determined by:

—□the maximum speed;
—□the maximum designed cant deficiency for the rolling stock;
—□wheel/rail contact parameters (wheel and rail profile, track gauge);
—□mass and inertia of the car body, bogies and wheelsets;
—□suspension characteristic of the vehicles;
—□track irregularities.

In order to ensure safety against derailment and running safety, as well as to avoid overloading of the track, an acceptance procedure test shall be carried out for vehicles which:

—□are newly developed;
—□have had relevant design modifications that could affect safety against derailment, running safety or track loading or
—□have had changes in their operating regimes that could affect safety against derailment, running safety or track loading.

The acceptance procedure tests for safety against derailment, running safety and track loading shall be carried out in accordance with the relevant requirements in EN 14363:2005. The parameters described in (b) and (c) below shall be assessed using the normal or simplified method as permitted in EN 14363:2005 Clause 5.2.2.

The tests shall be carried out under a range of conditions of speed, cant deficiency, track quality and curve radius appropriate for the application of the vehicle.

The track geometric quality for the tests shall be representative of the service routes and shall be included in the test report. The methodology of EN 14363 Annex C shall be used with the specified quality levels QN1 and QN2 values taken as guidance.

(b) Limit values for running safety:
EN 14363:2005 (Clauses 4.1.3, 5.5.1, 5.5.2 and appropriate sections of clauses 5.3.2, 5.5.3, 5.5.4, 5.5.5 and 5.6) contains definitions of the frequency content, measuring methods and conditions for the parameters specified below:

—□transverse track forces:
Rolling stock shall comply with the PRUD'HOMME criteria for the maximum transverse force ΣY defined as follows:
(See attachment)
where:

ΣY – sum of the guiding forces of a wheelset;
P0 – static load on the axle (kN).

The result of this formula defines the limit of wheel/rail adhesion between the sleeper and the ballast under the influence of transverse dynamic forces.

—□quotient of the transverse and vertical forces of a wheel in normal operating conditions (for a curve radius R ≥ 250 m):
The ratio of transverse to vertical force (Y / Q) of a wheel shall not exceed the limit
(See attachment)
where:

Y – lateral guiding force of a wheel exerted on the rail measured in a wheelset based reference frame;
Q – vertical force of the wheel on the rail measured in the same reference frame.

—□quotient of the transverse and vertical forces of a wheel on twisted track (for a curve radius R < 250 m):
The ratio of transverse to vertical force (Y / Q) of a wheel shall not exceed the limit:
(See attachment)
where:

Y – lateral guiding force of a wheel exerted on the rail measured in a wheelset based reference frame;
Q – vertical force of the wheel on the rail measured in the same reference frame;
γ – flange angle;
μ – coefficient of friction (0.36).

If the flange angle γ is 70o, the limit value (Y / Q)lim = 1.2.

This limit characterizes the ability of the rolling stock to run on twisted track.

— instability criterion:
On straight track or large radius curves a wheelset is running in an unstable manner if the periodic lateral movement of the wheelset exhausts the clearance between the wheel flanges and the gauge corner of the rails. In unstable motion this lateral movement is exerted over several cycles and is strongly dependent on speed and equivalent conicity (defined in (f) below), where relevant (see (k) below), and causes excessive lateral vibrations.

The root mean square (RMS) value of the sum of the guiding forces used in the acceptance testing shall not exceed the limit:
(See attachment)
where:

ΣYmax,lim – maximum transverse force.

This limit characterizes the ability of the rolling stock to run in a stable manner.

The criteria for the activation of an on board instability alarm shall follow either:

— the requirements of clause 5.3.2.2 and clause 5.5.2 of EN 14363:2005 for simplified acceleration measurement method; or
— indicate instability characterized by a maintained lateral oscillation (more than 10 cycles) generating accelerations of the bogie frame above the centerline of the wheelset greater than 0.8 g peak value, with a frequency between 3 and 9 Hz.

In addition, the following criteria for lateral motion shall be met:

The total uncontrolled lateral motion between the hubs of the wheels and boxes, between boxes and pedestals or both, on any pair of wheels shall be as specified by the vehicle supplier, but may not exceed 1” on non-powered axles and friction bearing powered axles, or 3/4" on all other powered axles.

(c) Track loading limit values:
The frequency content, measuring methods and conditions for the parameters specified below are defined in EN 14363:2005 (Clauses 5.5.1, 5.5.2 and appropriate sections of clauses 5.3.2, 5.5.3, 5.5.4, 5.5.5 and 5.6).

— vertical dynamic wheel load:
The maximum vertical force exerted by the wheels on the rails (dynamic wheel load, Q) shall not be more than the value given in Table 1 for the speed range of the vehicle.
(See attachment)
— longitudinal load:
In order to limit the longitudinal forces exerted on the track by the rolling stock the maximum acceleration or deceleration shall be less than 2.5 m/s2.

Braking systems which dissipate kinetic energy through heating the rail shall not create braking forces of more than:

— case 1: 360 kN per train in the case of emergency braking;
— case 2: for other braking cases, such as a normal service braking for speed reduction or non repetitive braking to a halt, or repetitive braking for speed control, the use of the brake and the maximum braking force allowed shall be determined by the infrastructure manager for each line concerned. Any limitations on the braking force defined in CHSTP System Requirement 5-04.5 shall be justified and published in the infrastructure register and taken into account in the operating rules.
— quasi static guiding force Yqst:
Limitation of the quasi static guiding force Yqst is to avoid excessive wear of rails in curves.
— quasi static wheel force Qqst:
In order to limit the vertical forces in curves at cant deficiency and cant excess the quasi static vertical wheel force shall be less than
(See attachment)
where:

Qqst,lim – maximum quasi static vertical wheel force.

(d) Wheel/rail interface:
The wheel-rail interface is fundamental for safety against derailment and for explaining the dynamic running behavior of a railway vehicle. The wheel profile shall meet the following requirements:

—□the flange angle (see Figure 1 in section (n) below) is at least 67 degrees;
—□the taper angle (see Figure 1) is between 3.7 and 8.5 degrees (6.5 % to 15 %);
—□the equivalent conicity is in the limits set out in (f) and (h) below.

(e) Design for vehicle stability:
Vehicles shall be designed to be stable on track, meeting the requirements of CHSTP System Requirements for High-Speed Infrastructure, at the maximum vehicle design speed plus 10 %. Unstable running is defined in section (b) above.

Rolling stock designed for higher speeds shall still be stable when running on lines designed for lower speeds. For example, rolling stock designed for speeds > 250 km/h shall still be stable when running on lines designed for speeds of the order of 200 km/h or less.

The range of values of speed and conicity for which the vehicle is designed to be stable shall be specified, certified and indicated in the rolling stock register.

An on board instability alarm shall be fitted on the trainsets. The detection of instability shall be based on acceleration measurements taken on the bogie frame. This alarm shall advise the driver to reduce speed in the event of instability. The criteria for activation of this alarm shall be as defined in section (b) above.

In addition, the following criteria shall be met:

All CHSTP passenger equipment shall exhibit freedom from hunting oscillations at all operating speeds. If hunting oscillations do occur, the railroad shall immediately take appropriate action to prevent derailment. For purposes of this paragraph, hunting oscillations shall be considered lateral oscillations of trucks that could lead to a dangerous instability.

All CHSTP passenger equipment shall demonstrate stable operation during pre-revenue service qualification tests at all operating speeds up to 10% 5 mph in excess of the maximum intended operating speed under worst-case conditions—including component wear—as determined by the operating railroad.

Nothing in this section shall affect the requirements of 49CFR213 Track Safety Standards as they apply to passenger equipment as provided in that part.

Each truck shall be equipped with a permanently installed lateral accelerometer mounted on the truck frame. The accelerometer output signals shall be processed through a filter having a band pass of 0.5 to 10 Hz to determine if hunting oscillations of the truck are occurring. If hunting oscillations are detected, the train monitoring system shall provide an alarm to the operator, and the train shall be slowed to a speed at least 5 mph less than the speed at which the hunting oscillations stopped. For purposes of this paragraph, hunting oscillations are considered a sustained cyclic oscillation of the truck which is evidenced by lateral accelerations in excess of 0.4g root mean square (mean-removed) for 2 seconds.

(f) Definition of equivalent conicity:
Equivalent conicity is the tangent of the cone angle of a wheelset with coned wheels whose lateral movement has the same kinematic wavelength as the given wheelset on straight track and large-radius curves.

The limiting values for equivalent conicity quoted in the tables below shall be calculated for the amplitude (y) of the wheelset's lateral displacement:
(See attachment)
where:

TG – track gauge;
SR – the distance between the active faces of the wheelset.

(g) Design values for wheel profiles:
Wheel profiles and the distance between active faces of the wheels (Dimension SR in Figure 1) shall be selected to ensure that the equivalent conicity limits set out in Table 2 are not exceeded when the designed wheelset is modeled passing over the representative sample of track test conditions (simulated by calculation) specified in Table 3.
(See attachment)
The requirements of this clause are deemed to have been met by wheelsets having unworn S1002 or GV 1/40 profiles, as defined in prEN 13715:2006 with spacing of active faces between 1,420 mm and 1,426 mm.

Design conicity values for rail profiles are given in the CHSTP System Requirements for High-Speed Infrastructure. Those values are different from the values given here for wheel profiles. This difference is intentional and results

from the selection of reference wheel and rail profiles for the assessment.

(h) In service values of equivalent conicity:
The maintenance plan shall set out the railway undertaking's procedures for maintaining wheelsets and wheel profiles. The procedures shall take account of the conicity ranges for which the vehicle is certified (see (e) above).

Wheelsets shall be maintained to ensure (directly or indirectly) that the equivalent conicity remains within the approved limits for the vehicle when the wheelset is modeled passing over the representative sample of track test conditions (simulated by calculation) specified in Tables 3 and 4.
(See attachment)
For a novel bogie/vehicle design, or for the operation of a known vehicle on a route with relevant different characteristics, the development of the wear of a wheel profile, and therefore the change in equivalent conicity, is usually not known. For this situation, a provisional maintenance plan shall be proposed. The validity of the plan shall be confirmed following monitoring of the wheel profile and equivalent conicity in service. The monitoring shall consider a representative number of wheelsets and shall take into account the variation between wheelsets in different positions in the vehicle and between different vehicle types in the trainset.

If ride instability is reported, the railway undertaking shall model the measured wheel profiles and distances between active faces of the wheels (Dimension SR in Figure 1) over the representative sample of track test conditions specified in Table 3 and Table 4 to check for compliance with the maximum equivalent conicity at which the vehicle is designed and certified to be stable.

If the wheelsets comply with the maximum equivalent conicity at which the vehicle is designed and certified to be stable, the infrastructure manager shall check the track for compliance with the requirements set out in the CHSTP System Requirements for High-Speed Infrastructure.

If both vehicle and track comply with the requirements, a joint investigation by the railway undertaking and the infrastructure manager shall be undertaken to determine the reason for the instability.

(i) Trucks (Bogies):
If applicable based on the truck design, the male center plate shall extend into the female center plate at least 3/4". On trucks constructed to transmit tractive effort through the center plate or center pin, the male center plate shall extend into the female center plate at least 1 1/2". The maximum lost motion in a center plate assemblage may not exceed 1/2".

Each CHSTP vehicle shall have a device or securing arrangement to prevent the truck and body from separating in case of derailment.

If applicable based on the truck design, a truck may not have a loose tie bar or a cracked or broken center casting, motor suspension lug, equalizer, hanger, gib or pin. A truck frame may not be broken or have a crack in a stress area that may affect its structural integrity.

(j) Wheelsets:
The manufacture of wheelsets for the CHSTP shall conform to APTA SS-M-012-99, Rev. 1 (ed. 2-13-04) – Standard for the Manufacture of Wrought Steel Wheels for Passenger Cars and Locomotives.

The maximum and minimum dimensions for wheelsets for standard track gauge (1,435 mm) are given in Table 5 below.

The variation in the circumference of wheels on the same axle shall be as specified by the vehicle supplier, but in no case shall this variation exceed 1/4" (two tape sizes) when applied or turned.

The requirements related to electrical resistance of wheelsets linked to control-command and signaling subsystem are specified in CHSTP System Requirement 5-03.3.

(k) Interoperability constituent wheel:
The maximum and minimum dimensions for wheels for standard track gauge (1,435 mm) are given in Table 5 below.

To achieve a proper match between the choice of materials for the rail (as defined in the CHSTP System Requirements for High-Speed Infrastructure) and the wheels, the wheels shall use materials defined as follows:

— for the entire wheel rim wearing depth, the values of Brinell hardness (HB) of the material shall be greater than or equal to 245;
— if the thickness of the zone of wear is greater than 35 mm, the value of 245 HB shall be obtained to a depth of 35 mm below the bearing surface;
— the value of hardness at the interface between the wheel center and the wheel rim shall be at least 10 points less than when measured at the maximum depth of wear.

The requirements related to geometry and material for wheels linked to control-command and signaling subsystem are specified in CHSTP System Requirement 5-07.9.

(l) Specific requirements for vehicles with independently rotating wheels:
A vehicle equipped with independently rotating wheels shall have the following characteristics:

—suspension/bogie design to ensure stable behavior of the axle/bogie in curves;
—a method to center the axle in the track when running on straight track;
—wheel dimensions complying with the requirements given in section (n) below.

Equivalent conicity requirements (sections (f) to (h)) do not apply to vehicles equipped with wheels rotating independently and therefore wheel profiles not complying with these conicity requirements may be used for vehicles with independent wheels.

The other dynamic behavior requirements (sections (a) to (d)) for vehicles with wheelsets do apply to vehicles equipped with independent wheels.

(m) Detection of derailments:
Derailment detection systems shall be installed on CHSTP trainsets.

(n) In service limits of the geometric dimensions of wheels and wheelsets:
(See attacment)
The dimension AR is measured at the top surface of the rail. The dimensions AR and SR shall be complied with in laden and tare conditions and for loose wheelsets. For specific vehicles smaller tolerances within the above limits may be specified by the vehicle supplier.
(See attachment)
(o) Wheels and tire defects:
Wheels and tires shall be maintained in accordance with the vehicle suppliers recommendations, but in no case shall they have any of the following conditions:

—a single flat spot that is 2 1/2” or more in length, or two adjoining spots that are each two or more inches in length
—a gouge or chip in the flange that is more than 1 1/2” in length and 1/2” in width;
—a broken rim, if the tread, measured from the flange at a point 5/8” above the tread, is less than 3 3/4" in width;
—a shelled-out spot 2 1/2" or more in length, or two adjoining spots that are each 2” or more in length;
—a seam running lengthwise that is within 3 3/4" of the flange;
—a flange worn to a 7/8” thickness or less, gauged at a point 3/8” above the tread;
—a tread worn hollow 5/16” or more;
—a flange height of 1 1/2" or more measured from tread to the top of the flange;
—tires less than 1 1/2" thick;
—rims less than 1” thick;
—a crack or break in the flange, tread, rim, plate, or hub;
—a loose wheel or tire;
—fusion welding may not be used on tires or steel wheels. A wheel that has been welded is a welded wheel for the life of the wheel.

(p) Spring rigging:
If applicable based on truck design:
- protective construction or safety hangers shall be provided to prevent spring planks, spring seats or bolsters from dropping to track structure in event of a hanger or spring failure.

- an elliptical spring may not have its top (long) leaf broken or any other three leaves broken, except when that spring is part of a nest of three or more springs and none of the other springs in the nest has its top leaf or any other three leaves broken. An outer coil spring or saddle may not be broken. An equalizer, hanger, bolt, gib, or pin may not be cracked or broken. A coil spring may not be fully compressed when the train is at rest.

- a shock absorber may not be broken or leaking clearly formed droplets of oil or other fluid.

(q) Bearings:
If applicable based on truck design:

- a plain bearing box shall contain visible free oil and may not be cracked to the extent that it will leak oil.

- friction side bearings with springs designed to carry weight may not have more than 25 percent of the springs in any one nest broken.

- friction side bearings may not be run in contact unless designed to carry weight. Maximum clearance of side

bearings may not exceed 1/4" on each side or a total of 1/2" on both sides, except where more than two side bearings are used under the same rigid superstructure. The clearance on one pair of side bearings under the same rigid superstructure shall not exceed 1/4" on each side or a total of 1/2" on both sides; the other side bearings under the same rigid superstructure may have 1/2" clearance on each side or a total of 1 inch on both sides. These clearances apply where the spread of the side bearings is 50” or less; where the spread is greater, the side bearing clearance may only be increased proportionately.

(r) Suspension system:

The suspension systems shall be designed to reasonably prevent wheel climb, wheel unloading, rail rollover, rail shift, and a vehicle from overturning to ensure safe, stable performance and ride quality. The following requirements shall be met:

—in all operating environments, and under all track conditions and loading conditions as determined by the operating railroad; and
—at all track speeds and over all track qualities consistent with the Track Safety Standards in 49CFR213, up to the maximum operating speed and maximum cant deficiency of the equipment.

A passenger car shall not operate under conditions that result in a steady-state lateral acceleration greater than the maximum value specified by the vehicle supplier, but in no case greater than 0.12 g as measured parallel to the car floor inside the passenger compartment. During pre-revenue service acceptance testing of the equipment, a passenger car shall demonstrate that steady-state lateral acceleration does not exceed the maximum value specified by the vehicle supplier, but in no case greater than 0.1 g at the maximum intended cant deficiency.

While traveling at the maximum operating speed over the intended route, the train suspension system shall be designed to:

—limit the vertical acceleration, as measured by a vertical accelerometer mounted on the car floor, to no greater than the maximum value specified by the vehicle supplier, but in no case greater than 0.55 g single event, peak-to-peak over a one second period;
—limit lateral acceleration, as measured by a lateral accelerometer mounted on the car floor, to no greater than the maximum value specified by the vehicle supplier, but in no case greater than 0.3 g single event, peak-to-peak over a one second period; and
—limit the combination of lateral acceleration (aL) and vertical acceleration (aV) occurring over a one second perioc as expressed by the square root of (aL2 +aV2) to no greater than the maximum value specified by the vehicle supplier, but in no case greater than 0.6 g, where aL may not exceed 0.3 g and aV may not exceed 0.55g.

Compliance with the limits above shall be demonstrated during the pre-revenue service acceptance testing of the equipment.

Car body acceleration measurements shall be processed through a filter having a cut-off frequency of 10 Hz.

Wheel/rail force measurements shall be processed through a low pass filter having a cut-off frequency of 25 Hz.

Steady-state lateral acceleration shall be computed as the mathematical average of the accelerations in the body of a curve, between the spiral/curve points. In a compound curve, steady-state lateral acceleration shall be measured separately for each curve segment.

Passenger equipment suspension systems shall be designed to limit the lateral and vertical forces and lateral to vertical (Y / Q) ratios, for the time duration required to travel five feet at any operating speed or over any class of track, under all operating conditions as determined by the railroad, as follows:

—the net axle lateral force shall not exceed 0.5 times the static vertical axle load;
—the vertical wheel/rail force shall not be less than or equal to 10 percent of the static vertical wheel load;
—the sum of the vertical wheel loads on one side of any truck shall not be less than or equal to 20 percent of the static vertical axle load. This shall include the effect of a crosswind allowance as specified by the railroad for the intended service;
—when stopped on track with a uniform 6-inch superelevation, vertical wheel loads, at all wheels, shall not be less than or equal to 60 percent of the nominal vertical wheel load on level track.
—Should these requirements conflict with the requirements contained in sections a), b), c), d), e), and f) above, the requirements contained in sections a), b), c), d), e), and f) above shall govern.

5-03.5 **Maximum train length** **(RST)**

(a) Maximum train length:
The length of trains shall not exceed 400 m. A tolerance of 1 % is permissible in order to improve aerodynamic

penetration of the front and rear of the train.

In addition, the maximum length of trains shall be compatible with the usable length of platform specified in the CHSTP System Requirement 3-20.2.

5-03.6 Maximum gradients (RST)

(a) Maximum gradients:
Trains shall be able to start, operate and stop on the maximum gradients on all the lines for which they are designed and over which they are likely to operate.

The gradient requirements are set out in CHSTP System Requirement 3-05; the maximum gradients of each line shall be defined in the infrastructure

5-03.7 Minimum curve radius (RST)

((a) Minimum curve radius:
This parameter is an interface with the high-speed infrastructure subsystem in that the minimum curvatures to be taken into account are defined for the high-speed tracks (based on the cant deficiency) and for the stabling tracks. Refer to CHSTP System Requirements 3-05, 3-06, 3-08 and 3-25.

5-03.8 Flange lubrication (RST)

(a) Flange lubrication:
To protect the rails and wheels against excessive wear, particularly in curves, trains shall be equipped with flange lubrication. This shall be installed as a minimum on one axle close to the leading end of a train.

After such a lubrication the wheel tread/rail contact area shall not be contaminated.

5-03.9 Suspension coefficient (RST)

(a) Suspension coefficient:
Whenever a stationary vehicle is placed on a canted track whose running surface lies at an angle δ to the horizontal, its body leans on its suspension and forms an angle η with the perpendicular to the rail level. The vehicle suspension coefficient s is defined by the ratio:
(See attachment)
This parameter influences the swept envelope of a vehicle. The suspension coefficient s of vehicles equipped with pantographs shall be less than 0.25. It is permissible for tilting trains to not meet this requirement provided that they are equipped with pantograph compensation devices.

5-04 Braking (RST)

Refer to TSI, sub sections 5-04.1 through 5-04.8 for relevant CHSTP system requirements.

5-04.1 Minimum braking performance (RST)

Minimum braking performance

(a) Trains shall incorporate a brake control system with one or more deceleration levels. The prescribed performance levels defining the minimum braking power are given in Tables 6 and 7. Meeting these performance levels and the safe operation of the braking system shall be fully demonstrated.
(b) It is important to note that the values in Table 6 below are those appropriate for rolling stock and they shall not be interpreted as being the absolute values for defining the braking curves required by the control-command and signalling subsystem.
(c) Performance: trains shall be able to achieve, over the range of speeds shown, the minimum mean decelerations within each the speed range shown in Table 6.

(See attachment)

Case A
— Level track and normal train load as defined in CHSTP Section 5-03.2, on dry rails and the worst degraded operation mode defined below (In cases where loading is not possible, alternative methods are permissible, such as simulation by isolating further brake units provided they do not introduce significant errors in the procedure):
— One dynamic brake unit, which is able to function independently of the other dynamic brake units, is deactivated

if it is independent of the contact wire, or all units on the dynamic brake are deactivated if they are dependent on the voltage in the contact wire.
— Or one independent module of the braking system, which dissipates kinetic energy through heating the rails, is inoperable, if this system is independent of the dynamic brake.

Case B
As per case A and
— One distributor valve or equivalent self-supporting control device acting on the friction brake from one or two carrying bogies is deactivated.
and
— Reduced wheel/rail adhesion
and
— Brake pad/brake disc friction coefficient reduced as a result of dampness.

The complete process of assessment is described in annex P of the TSI for Rolling Stock.

Normal service braking conditions are defined in CHSTP Section 5-04.4.

(d) Stopping distances: The stopping distance ‘S’ calculated as a function of the minimum decelerations defined above is defined by the formula:

(See attachment)

For example, using the data in Table 6, the following stopping distances to be met from specific initial speeds are given in Table 7.

(See attachment)

(e) Additional conditions:
For the Cases A & B, when emergency braking is considered:
The contribution of electric dynamic brakes shall only be included in the calculation of the performance defined above if their operation is independent of the presence of voltage in the catenary.

It is permissible to include the contribution of braking systems that dissipate kinetic energy through heating the rails in the emergency braking performance under the conditions defined in CHSTP Section 5-04.5.

Electromagnetic brakes with magnets that are in contact with the rail shall not be employed at speeds higher than 280 km/h. It is permissible to include the contribution made by electromagnetic brakes independent of wheel rail adhesion for emergency braking on all lines as a means of maintaining the envisaged braking performance.

In addition, the following requirements shall be met:
(a) A passenger train's brake system shall be capable of stopping the train from its maximum operating speed within the signal spacing existing on the track over which the train is operating under worst-case adhesion conditions.
(b) The brake system shall be designed to prevent thermal damage to wheels and brake discs. The supplier of the trainsets shall demonstrate through analysis and testing that no thermal damage results to the wheels or brake discs under conditions resulting in maximum braking effort being exerted on the wheels or discs.
(c) The brake system design shall allow a disabled train's pneumatic brakes to be controlled by a rescue unit, during a rescue operation, through brake pipe control alone.

5-04.2 **Brake wheel/rail adhesion demand limits** **(RST)**

Brake wheel/rail adhesion demand limits

The design of the train and the calculation of its braking performance shall not assume wheel/rail adhesion values in excess of the following values. For speeds below 200 km/h, the maximum wheel/rail adhesion coefficient demand during braking shall be assumed to be no more than 0.15. For speeds above 200 km/h, the wheel/rail adhesion coefficient maximum demand shall be assumed to decline linearly to 0.1 at 350 km/h.
A train in full service condition and with a normal load (as defined in CHSTP Section 5-03.2) shall be used in calculations to verify the braking performance.

5-04.3 **Brake system requirements** **(RST)**

a) Brake system requirements:
A passenger train's brake system shall be capable of stopping the train from its maximum operating speed within the signal spacing existing on the track over which the train is operating under worst-case adhesion conditions.

In addition to the needs listed in CHSTP System Requirements 5-04.1 and 5-04.2, the brake system, for the complete train, shall meet the following requirements:
—use of the emergency brake, for whatever reason, shall automatically cut all traction power, without the facility of reapplying traction power while the emergency brake is being applied;
—the emergency brake shall be capable of being applied at all times with the driver in his normal driving position;
—vehicles shall be fitted with wheel-slide devices (see (c) below) to control the sliding of wheels in the event of reduced adhesion between wheel and rail;
—CHSTP trains shall be equipped with a wheel rotation monitoring system to advise the driver that an axle has seized. The wheel slide protection device and the rotation monitoring system shall function independently;
—emergency brake applications actuated via the driver's brake valve or additional emergency brake control as well as via the monitoring and speed control equipment shall have the following immediate and simultaneous effects:
—a rapid pressure drop in the main brake pipe to ≤ 2 bar (29 psi). The cab shall be equipped with both a drivers brake valve and an additional emergency brake control to provide redundancy;
—an interruption in re-filling of main brake pipe;
In the case of short trains less than 250 m in length and if the equivalent time of application (te) of 3s or less is met when the emergency brake is applied, it is not mandatory to interrupt re-filling of the main brake pipe.
—an application of the electro-pneumatic brake (ep brake), if fitted;
In the case of short trains less than 250 m in length and if the equivalent time of application (te) of 3s or less is met when the emergency brake is applied, it is not mandatory to control the electro-pneumatic brake.
—an application of full brake force corresponding to performance set out in CHSTP System Requirement 5-04.1;
—a traction cut-off;
—application of full service braking shall result in a traction cut-off without an automatic restoration of traction power
—full service braking is defined as the braking resulting from the maximum braking force within the range of service braking before emergency braking;
—blended braking systems shall have the following requirements:
—loss of power or failure of the dynamic brake does not result in exceeding the allowable stopping distance;
—the friction brake alone is adequate to safely stop the train under all operating conditions;
—the operational status of the electric portion of the brake system shall be displayed for the train operator in the control cab; and
—the operating railroad shall demonstrate through analysis and testing the maximum operating speed for safe operation of the train using only the friction brake portion of the blended brake with no thermal damage to wheels or discs;
—system shall be designed to allow an inspector to determine that the brake system is functioning properly without having to place himself or herself in a dangerous position on, under, or between the equipment.

All vehicles shall be provided with a means of brake isolation, indicators of brake status, and a system of (brake) fault diagnostics.

(b) Electric braking:
The contribution of electric brakes shall be in accordance with the requirements set forth in section (e) of CHSTP System Requirement 5-04.1.

Where the electrical installations (the substations) permit, the return of electrical energy generated in braking is permissible, but this shall not cause the voltage to exceed the limits defined in Table 1 (Reference EN 50163:2004):

(See attachments)

The following requirements shall also be fulfilled:
—the duration of voltages between Umin1 and Umin2 shall not exceed 2 min;
—the duration of voltages between Umax1 and Umax2 shall not exceed 5 min;
—the voltage of the busbar at the substation at no load condition shall be less than or equal to Umax1. For d.c. substations it is acceptable to have this voltage at no load condition less than or equal to Umax2, knowing that when a train is present, the voltage at this train's pantograph shall be in accordance with Table 1 and its requirements;
—under normal operating conditions, voltages shall lie within the range Umin1 ≤ U ≤ Umax2;
—under abnormal operating conditions the voltages in the range Umin2 ≤ U ≤ Umin1 in Table 1 shall not cause any damages or failures.
The use of train power limitation devices on board may limit the presence of low voltage on the overhead line (see EN 50388).
—If voltages between Umax1 and Umax2 are reached, it shall be followed by a level below or equal to Umax1, for an unspecified period.
Voltages between Umax1 and Umax2 shall only be reached for non permanent conditions such as
—regenerative braking;
—move of voltage regulation systems such as mechanical tap changer.
—lowest operational voltage: under abnormal operating conditions Umin2 is the lowest limit of the contact line voltage for which the rolling stock is intended to operate.
Recommended values for undervoltage tripping: The settling of undervoltage relays in fixed installations or on board

rolling stock should be set from 85% to 95% of Umin2.

(c) Wheel-slide protection devices:
The Wheel Slide Protection device (WSP) fitted to a vehicle has the role of reducing excessive wheel slide resulting from brake applications in situations where wheel/rail adhesion is temporarily impaired (inclement weather conditions, fouling of the rail), and of preventing wheels from locking.

A WSP is activated by a temporary reduction in braking force. The WSP exploits available wheel/rail adhesion to a maximum and improves it by providing controlled wheel slide so that any increase in braking or stopping distance is kept to a minimum.

The WSP shall not alter the functional characteristics of the brakes. The vehicle's air supply equipment shall be dimensioned such that the air consumption of the WSP does not impair the performance of the pneumatic brake.

The WSP shall not have a detrimental effect on the constituent parts of the vehicle (braking gear, wheel tread, axle boxes etc).

CHSTP trains shall be provided with monitoring equipment in addition to the WSP (a rotation monitor), which detects locked axles and indicates this, through an audible or visual alarm, in the driver's cab. In addition, an independent failure-detection system shall compare brake commands with brake system output to determine if a failure has occurred. The failure detection system shall report brake system failures to the automated train monitoring system. In the event that two or more trainsets are coupled in multiple or remote control, the alarm shall be shown in the cab of the controlling cab.

Functional characteristics and testing of WSPs shall conform to those set forth in UIC 541-05.

(d) Main reservoirs:
Main reservoirs used on CHSTP trains shall:
— be made of a cylindrical part of circular cross-section with two outwardly dished torispherical ends (two dished ends with the same axis of rotation) and fabricated by welding;
— be constructed to withstand at least five times its maximum working pressure;
— be used at a maximum working pressure (Ps) of 10 bar (145 psi); a momentary overpressure of 1 bar (15 psi) of the maximum working pressure is permitted (10 % of Ps) during normal service. The product of the maximum working pressure (in bar) and the volume (in liter) shall be 500 bar liters < PV ≤ 10 000 bar liters;
— be equipped with at least one safety valve that shall prevent an accumulation of pressure of more than 1 bar (15 psi) above the maximum working air pressure;
— be fastened to the vehicle with straps, or by welded brackets;
— have at least two sightholes to permit complete circumferential visual inspection and cleaning of the interior surface. The openings shall be sized according to the following table (Reference EN 13445-5:2002):

(See attachment)

Each CHSTP trainset that has a pneumatically actuated system of power controls shall be equipped with a separate reservoir of air under pressure to be used for operating those power controls. The reservoir shall be provided with means to automatically prevent the loss of pressure in the event of a failure of main air pressure, have storage capacity for not less than three complete operating cycles of control equipment and be located where it is not exposed to damage.

A governor shall be provided that stops and starts or unloads and loads the air compressor within 5 psi above or below the maximum working air pressure.

Each compressor governor used in connection with the automatic air brake system shall be adjusted so that the compressor will start when the main reservoir pressure is not less than 15 psi above the maximum brake pipe pressure and will not stop the compressor until the reservoir pressure has increased at least 10 psi.

(e) Aluminum reservoirs:
CHSTP trains utilizing aluminum reservoirs shall:
— be made from a single shell, of an aluminum alloy (EN AW-5083 or equivalent), and designed according to EN 13445-5:2002 and EN 286-4;
— be designed for a working temperature of between – 50 oC (-58oF) and + 65 oC (+149oF);
— be calculated with a design pressure P ≥ 1.15Ps;
— meet the verification, surveillance, manufacturing, mounting, and service surveillance requirements of Annexes A through G of EN 286-4.

(f) Testing and inspection requirements for aluminum reservoirs:
Each vessel with all its fittings (bosses, brackets, etc.) shall be subjected to a hydrostatic test, prior to the application of the protective coating, equivalent to a pressure of 1.5 times the design pressure in the presence of a

person of recognized competence.

This pressure shall be maintained for a sufficient length of time to permit a visual examination of all the surfaces and all the welded joints. The vessel shall show no sign of plastic deformation or leakage.

Subject to agreement, a pneumatic test may be carried out on each vessel, at the pressure defined above. However, the pneumatic test is potentially a much more dangerous operation than the hydraulic test in that, irrespective of the size of the vessel, any failure during testing may result in an explosion. It should therefore only be carried out after consultation with the inspection body and having ensured that the safety measures taken comply with all regulations.

All vessels which fail the pressure test shall be rejected. Repairs may be permitted, with the agreement of the client network, but in this case the pressure test shall be repeated.

Each welded reservoir may also be drilled over its entire surface with telltale holes that are 3/16 in in diameter. The holes shall be spaced not more than 12 in apart, measured both longitudinally and circumferentially, and drilled from the outer surface to an extreme depth determined by the formula:

(See attachment)

where:
D = extreme depth of telltale holes in inches but in no case less than 1/16 in;
Ps = certified working pressure, in psi;
S = one-fifth of the minimum specified tensile strength of the material, in psi; and
R = inside radius of the reservoir, in in.

One row of holes shall be drilled lengthwise of the reservoir on a line intersecting the drain opening. A reservoir so drilled must meet the requirements for a hydrostatic or pneumatic test before it is placed in use. Whenever any such telltale hole shall have penetrated the interior of any reservoir, the reservoir shall be permanently withdrawn from service.

All inspections and tests shall be carried out before being placed in use and at intervals that do not exceed 736 calendar days.

(g) Steel reservoir:
CHSTP trains utilizing steel reservoirs shall:
—□be made from a single shell, of non-alloy steel (steel sheet grade SPH 235 or SPH 265, as specified in EN 10207), and designed according to EN 13445-5:2002 and EN 286-3;
—□be designed for a working temperature of between – 40 oC (-40oF) and + 100 oC (+212oF);
—□be calculated with a design pressure P ≥ Ps;
—□meet the verification, surveillance, manufacturing, mounting, and service surveillance requirements of Annexes A through G of EN 286-3.

(h) Testing and inspection requirements for steel reservoirs:
Each vessel with all its fittings (bosses, brackets, etc.) shall be subjected to a hydrostatic test, prior to the application of the protective coating, equivalent to a pressure of 1.5 times the design pressure in the presence of a person of recognized competence.

This pressure shall be maintained for a sufficient length of time to permit a visual examination of all the surfaces and all the welded joints. The vessel shall show no sign of plastic deformation or leakage.

Subject to agreement, a pneumatic test may be carried out on each vessel, at the pressure defined above. However, the pneumatic test is potentially a much more dangerous operation than the hydraulic test in that, irrespective of the size of the vessel, any failure during testing may result in an explosion. It should therefore only be carried out after consultation with the inspection body and having ensured that the safety measures taken comply with current legislation of the country in which the test is carried out.

All vessels which fail the pressure test shall be rejected. Repairs may be permitted, with the agreement of the client network, but in this case the pressure test shall be repeated.

Each main reservoir other than an aluminum reservoir shall be hammer tested over its entire surface while the reservoir is empty at intervals that do not exceed 736 calendar days.

Each welded reservoir may be drilled over its entire surface with telltale holes that are 3/16 in in diameter. The holes shall be spaced not more than 12 in apart, measured both longitudinally and circumferentially, and drilled from the outer surface to an extreme depth determined by the formula

(See attachment)

where:
D = extreme depth of telltale holes in inches but in no case less than 1/16 in;
Ps = certified working pressure, in psi;
S = one-fifth of the minimum specified tensile strength of the material, in psi; and
R = inside radius of the reservoir, in in.

One row of holes shall be drilled lengthwise of the reservoir on a line intersecting the drain opening. A reservoir so drilled must meet the requirements for a hydrostatic or pneumatic test before it is placed in use. Whenever any such telltale hole shall have penetrated the interior of any reservoir, the reservoir shall be permanently withdrawn from service.

All inspections and tests shall be carried out before being placed in use and at intervals that do not exceed 736 calendar days.

(i) Brake gauges:
All mechanical gauges and all devices providing indication of air pressure electronically that are used by the engineer to aid in the control or braking of the train shall be located so that they may be conveniently read from the engineer's usual position during operation. A gauge or device shall not be more than five percent or three psi in error, whichever is less.

(j) Piston travel:
Brake cylinder piston travel shall be sufficient to provide clearance when the brakes are released.

If applicable based on the design of the brake system, when the brakes are applied, the brake cylinder piston travel may not exceed 1 1/2 in less than the total possible piston travel.

The minimum brake cylinder pressure shall be 30 psi.

(k) Foundation brake gear:
A lever, rod, brake beam, hanger, or pin may not be worn through more than 30 percent of its cross-sectional area, cracked, broken, or missing. All pins shall be secured in place with cotters, split keys, or nuts. Brake shoes shall be fastened with a brake shoe key and aligned in relation to the wheel to prevent localized thermal stress in the edge of the rim or the flange.

(l) Leakage:
Leakage from the main air reservoir and related piping may not exceed an average of 3 psi per minute for 3 minutes after the pressure has been reduced to 60 percent of the maximum pressure.

Brake pipe leakage may not exceed 5 psi per minute.

With a full service application at maximum brake pipe pressure and with communication to the brake cylinders closed, the brakes shall remain applied for at least 5 minutes.

Leakage from control air reservoir, related piping, and pneumatically operated controls may not exceed an average of 3 psi per minute for 3 minutes.

(m) Passenger equipment:
Passenger equipment shall be provided with an emergency brake application feature that produces an irretrievable stop, using a brake rate consistent with prevailing adhesion, passenger safety, and brake system thermal capacity. An emergency brake application shall be available at any time, and shall be initiated by an unintentional parting of the train. A means to initiate an emergency brake application shall be provided at two locations in each unit of the train; however, where a unit of the train is 45 feet or less in length a means to initiate an emergency brake application need only be provided at one location in the unit. The words “Emergency Brake Valve” shall be legibly stenciled or marked near each valve or shall be shown on an adjacent badge plate.

5-04.4 **Service braking performance** **(RST)**

In addition to the specifications required in clause CHSTP Section 5-04.1, ‘minimum braking characteristics’, the trains shall comply with the average decelerations in service defined in Table 8.
[See attachment]
These decelerations shall be achieved by a train on level track, in the configurations defined in clause 4.2.4.1 of the TSI for Rolling Stock, Case A.

5-04.5 **Eddy current brakes** **(RST)**

This paragraph deals with the infrastructure subsystem interfaces relating to eddy current track brakes.

The use of this type of brake, independent of wheel/rail adhesion is permissible as follows:
— For emergency braking on all lines except specific connecting lines listed in the infrastructure register.
— For full or normal service braking on the sections of line where the infrastructure manager permits it. In this case the conditions of use shall be published in the infrastructure register.

Trains equipped with this type of brake shall meet the following specifications:
— Brakes independent of wheel rail adhesion are permitted to be used from the maximum operating speed down to 50 km/h: (Vmax ≥ V ≥ 50 km/h)
— The maximum average deceleration shall be less than 2.5 m/s2 (this value, which is an interface with the longitudinal resistance of the track, shall be met with all brakes in use).
— In the worst case, that is to say with the trainsets working in multiple to their maximum permitted train length, the maximum longitudinal braking force applied to the track by the eddy current train brake shall be:
— 105 kN for brake applications with a force lower than 2/3 of full service braking
— Linear between 105 kN and 180 kN for brake applications between 2/3 and full service braking,
— 180 kN for full service braking
— 360 kN in emergency braking

It is permissible to include the contribution of brakes independent of wheel/rail adhesion in the braking performance defined in CHSTP System Requirement 5-04.1. This is with the understanding that the safe operation of this type of brake can be assured and is not affected by any single point failure.

5-04.6 **Protection of an immobilized train** **(RST)**

Protection of an immobilised train

In the event of the compressed air supply being disrupted or the power supply failing, it shall be possible to stop and hold a train with a normal load (as defined in CHSTP Section 5-03.2) on a 35‰ (3.5%) gradient by using the friction brake alone, even if one distributor valve is switched off, for at least two hours.

It shall be possible to keep a train with a normal load stationary for an unlimited period on a 35‰ (3.5%) gradient.

5-04.7 **Brake performance on steep gradients** **(RST)**

Brake performance on steep gradients

The brake thermal performance shall allow a train to run on a maximum gradient set out in clause 4.2.5 of the High Speed Infrastructure TSI 2006 at a speed of at least equivalent to 90 % of the maximum train operating speed. This thermal performance shall be used for calculating the limiting gradient where maximum train speed can be operated.

The same conditions for train loading, means of braking and rail condition apply as for emergency braking case A as defined in CHSTP Section 5-04.1. Compliance to this requirement shall be proven by calculation.

5-04.8 **Brake requirements for rescue purposes** **(RST)**

Brake requirements for rescue purposes

Requirements for the pneumatic brake equipment of high speed trains for towing in case of emergency rescue are as follows:
1. Filling time of the brake cylinder to 95 % maximum pressure: 3-5 seconds, 3-6 seconds with load braking system.
2. Release time of the brake cylinder to 0.4 bar (5.8 psi) pressure: a minimum of 5 seconds.
3. Reduction in brake pipe pressure required to obtain maximum brake cylinder pressure: 1,5 ± 0,1 bar (21.8 ± 1.5 psi) (coming from a nominal value in the brake pipe of 5,0 ± 0,05 bar (72.5 ± .73 psi)).
4. The sensitivity of the brake to slow decreases in brake pipe pressure shall be such, that the brake is not activated if the normal working pressure drops by 0,3 bars (4.35 psi) in one minute.
5. The sensitivity of the brake to decreases in brake pipe pressure shall be such, that the brake is activated within 1,2 seconds, if the normal working pressure drops by 0,6 bar (8.7 psi) in 6 seconds.
6. Each brake, including the parking brake, shall have an on/off device.
7. A minimum of five steps of brake force shall be available by variation of the brake pipe pressure.
8. The status (applied/released) of brakes, including the parking brake, shall be indicated.

Where the on-board train braking system is initiated by other than pneumatic means the pneumatic information given at the coupling interface shall result in a performance equivalent to the above.

5-05.1 **Public address system** **(RST)**

(a) PA (public address) system:
All CHSTP (Class 1) passenger cars shall be equipped with a PA system that provides a means for a train crewmember to communicate by voice to passengers, and/or ground control of his or her train in an emergency situation. The PA system shall also provide a means for a train crewmember to communicate by voice in an emergency situation to persons in the immediate vicinity of his or her train (e.g. persons on the station platform). Emergency communication procedures and protocols set forth in APTA SS-PS-001-98 – Standard for Passenger Railroad Emergency Communications shall be adhered to. The PA system may also be part of the same system as the intercom system.

(b) Intercom system:
All CHSTP (Class 1) passenger cars shall be equipped with an intercom system that provides a means for passengers and crewmembers to communicate by voice with each other in an emergency situation. Except as further specified, at least one intercom that is accessible to passengers without using a tool or other implement shall be located in each end (half) of each car. If any passenger car does not exceed 45 feet in length, only one such intercom is required. The intercom system may be part of the same system as the PA system.

The following requirements apply all CHSTP (Class 1) passenger cars:

— the location of each intercom intended for passenger use shall be conspicuously marked with luminescent material;
— legible and understandable operating instructions shall be posted at or near each such intercom.

(c) Back-up power:
PA and intercom systems shall have a back-up power system capable of:

— Operating in all equipment orientations within 45 degrees of vertical;
— Operating after the initial shock of a collision or derailment resulting in the following individually applied accelerations:

— longitudinal: 5g;
— lateral: 3g; and
— vertical: 3g.

— Powering each system, independent from the main energy source, to allow intermittent emergency communication for a minimum period of 3 hours. Intermittent communication shall be considered equivalent to continuous communication during the last 15 minutes of the 3 hours minimum period.

The communication system shall be designed in such a manner that it continues to operate at least half (distributed throughout the train) of its loudspeakers in the event of a failure in one of its transmission elements, or another mean shall be available to inform the passengers.

CHSTP System Requirement section 9-22.8 shall also apply.

5-05.2 **Passenger information signs** **(RST)**

(All CHSTP cars shall be conspicuously and legibly posted with emergency signs and instructions in their interiors (e.g. on car bulkhead signs, seatback decals) that shall be visible at all lighting levels.

Emergency exits shall be clearly identified to passengers and rescue teams by means of suitable signs. The design and placement of such signs shall conform to the requirements of APTA SS-PS-002-98, Rev. 3 – Standard for Emergency Signage for Egress/Access of Passenger Rail Equipment.

Emergency exits shall also be clearly identified to passengers by means of low-location exit path markings, which shall be used in addition to the emergency lighting system (reference CHSTP System Requirement 5-07.12). The design and placement of such markings shall conform to the requirements of APTA SS-PS-004-99, Rev. 2 – Standard for Low-Location Exit Path Marking.

All other passenger signs closely connected with safety shall use the unified sign formats given in standards ISO 3864-1:2002.

(a) Emergency window exit signs:
Each emergency window exit shall be conspicuously and legibly marked with photo-luminescent material on the inside of each car to facilitate passenger egress. Legible and understandable operating instructions, printed on photo-luminescent material, including instructions for removing the window, shall be posted at or near each such

window exit. If window removal may be hindered by the presence of a seatback, headrest, luggage rack, or other fixture, the instructions shall state the method for allowing rapid and easy removal of the window, taking into account the fixture(s); this portion of the instructions may be in written or pictorial format.

(b) Rescue access window and roof access signs:
Each rescue access window shall be marked with retroreflective material. A unique and easily recognizable symbol, sign, or other conspicuous marking shall also be used to identify each such window. Legible and understandable window-access instructions, including instructions for removing the window, shall be posted at or near each rescue access window.

Each emergency roof access location shall be conspicuously marked with retroreflective material of contrasting color. In addition, legible and understandable instructions shall be posted at or near each such location. The retroreflective material shall conspicuously mark the line along which the roof skin shall be cut; a sign plate with a retroreflective border shall also state as follows:
CAUTION—DO NOT USE FLAME CUTTING DEVICES
CAUTION—WARN PASSENGERS BEFORE CUTTING
CUT ALONG DASHED LINE TO GAIN ACCESS
ROOF CONSTRUCTION—[STATE RELEVANT DETAILS]

(c) Emergency door exit signs:
All door exits intended for emergency egress shall be either lighted or conspicuously and legibly marked with photo-luminescent material on the inside of the car. Clear and understandable instructions printed on photo-luminescent material shall be posted at or near such exits.

All door exits intended for emergency access by emergency responders for extrication of passengers shall be marked with retroreflective material. Clear and understandable instructions shall be posted at each such door.

(d) Emergency communication signs:
The location of each intercom intended for passenger use shall be conspicuously marked with photo-luminescent material. Legible and understandable operating instructions printed on photo-luminescent material shall be posted at or near each such intercom.

Requirements set forth in CHSTP System Requirement 5-15 shall also apply.

5-05.3 **Passenger alarm** **(RST)**

Passenger occupied areas on trains (excluding vestibules, gangways and toilets) shall be fitted with emergency signal devices. These devices shall be installed where they can be easily seen and reached, without having to pass through an interior door, by the passengers.

The emergency handle shall have a clearly visible seal.

The alarm, once activated, shall not be capable of being disengaged by passengers. A device shall be provided to indicate that the alarm has been activated.

Operating instructions of the emergency signal shall be posted adjacent to the device.

Activating the alarm shall:

— initiate braking;
— cause a visual (flashing or continuous light) and acoustic (buzzer/klaxon or spoken message) alarm to be triggered in the driver’s cab;
— transmit a message (acoustic or visual signal or radio message by mobile phone) by the driver or an automatic system to the train crew working among the passengers;
— transmit an acknowledgement, recognizable by the person who triggered the signal (acoustic signal in the vehicle, braking application, etc.).

The arrangements installed in the rolling stock (automatic brake application, in particular) shall allow the driver to intervene in the braking process so as to be able to choose the stopping point of the train.

When the train has stopped the driver shall be able to start again as soon as possible if the driver considers it safe to start again. Activation of one or more than one alarm shall have no additional effect unless the first alarm is rearmed.

A communication link between the cab and the train screw shall enable the driver, at his or her initiative, to investigate the reasons why the emergency signal was triggered. If there is no train staff present during normal

service, a device shall be available for passengers to communicate directly with the driver in case of an emergency.

In addition, the following requirements shall be met:

Transmission locations shall be provided at each end of each passenger car, adjacent to the car's end doors, and accessible to both passengers and crewmembers without requiring the use of a tool or other implement. If the passenger car does not exceed 45 feet in length, only one transmission location is required.

Emergency signal and transmission locations shall be clearly marked with luminescent material.

Back-up power for a minimum period of 90 minutes shall be available in case of an emergency.

5-06 Environmental conditions (RST)

Refer to CHSTP System Requirement References 5-06.1, 5-06.2, 5-06.3, 5-06.4, 5-06.5, 5-06.6, 5-06.7, 5-06.8, and 5-06.9.

5-06.1 Environmental conditions (RST)

(a) Environmental conditions:
The rolling stock and all its constituent parts shall meet the requirements, as specified in this section and in EN 50125-1:1999, for which it is intended to run; in addition, all electronic equipment installed in CHSTP trainsets shall conform to the requirements set forth in EN 50155:2007.

The requirements at which the vehicle and its equipment shall function shall be based on California environmental parameters, as specified below.

The severities specified are those which will have a low probability of being exceeded. All specified values are maximum or limiting values; these values may be reached, but do not occur permanently. Depending on the situation there may also be different frequencies of occurrence related to a certain period of time.

(b) Altitude:
The equipment shall perform according to class A 1, as defined in EN 50125-1:1999 Section 4.2; this condition is significant in regards to air pressure level and its consequences on, but not limited to, cooling systems. Class A 1 includes the following characteristic:

— altitude range relative sea level: up to 1,400 m (4,593 ft).

The air pressure shall be considered according to HD 478.2.3 S1. Particular local air pressure conditions may exist due to the effects of wind, vehicle movement, fans, etc.; refer to CHSTP System Requirements 5-06.5 and 5-06.7 for these conditions.

(c) Temperature:
The equipment shall operate according to class T1 / TX, as defined in EN 50125-1:1999 Section 4.3. This class contains the following characteristics:

— air temperature external to vehicle: -25 oC (-13 oF) to +50 oC (122 oF);
— inside vehicle compartment temperature: -25 oC (-13 oF) to +60 oC (140 oF);
— inside cubicle temperature: -25 oC (-13 oF) to +75 oC (167 oF).

The values given for the internal temperatures are the extremes that the system or equipment designer is not allowed to exceed in a given part because too much power is dissipated with insufficient cooling. They are also temperatures which the equipment manufacturer shall take into account in the design.

A reference temperature of 25 oC (77 oF) is considered as being the permanent temperature for which the effects on the material ageing are equivalent to those of the climatic temperature during the lifetime.

The yearly average temperature for the inside of the cubicle is conventionally taken as 45 oC (113 oF).

When stated in product standards, particular requirements apply.

The temperatures inside the vehicle and the cubicle are values measured in free air out of the heat emitting elements.

If the equipment is to be installed in a controlled climatic environment, provided that the equipment is not required to operate outside of those conditions, the temperature range shall be agreed upon between purchaser and supplier.

It shall be taken into account that the external ambient air temperature in special locations such as near the ballast or over the roof may exceed the external open air temperature. In this case the temperature level to be considered shall be agreed between the purchaser and supplier.

To ensure correct coordination of the temperature levels indicated above and verification of good thermal design of all installed equipment, the relevant data shall be exchanged between purchaser and supplier. These data include:

—□geometrical characteristics of sub-assemblies;
—□localization of the main heat emitting elements and their heat dissipation;
—□thermal time profile;
—□characteristics of the cooling system.

Deviation from the above temperatures shall be subject to agreement between purchaser and supplier.

(d) Humidity:
The following external humidity levels shall be considered:

—□yearly average: ≤ 75% relative humidity;
—□occasionally: between 75% and 95% relative humidity;
—□maximum absolute humidity: 30 g/m3 (0.002 lb/ft3)occurring in tunnels.

An operationally caused infrequent and slight moisture condensation shall not lead to any malfunction or failure.

The psychometric chart of Figure 1 gives the humidity range that shall not be exceeded for more than 30 days per year:

(See attachment)

At cooled surfaces, 100% relative humidity may occur causing condensation on parts of equipment; this shall not lead to any malfunction or failure.

Sudden changes of the air temperature local to the vehicle may cause condensation of water on parts of equipment with the rate of 3 K/s and a maximum variation of 40 K.

These conditions particularly occurring when entering or leaving a tunnel shall not lead to any malfunction or failure of the equipment.

(e) Air movement:
The maximum speed of wind shall be taken as 35 m/s (78 mph).

Exceptionally higher wind speed, up to maximum 50 m/s (112 mph), may occur. In this case, the equipment and/or vehicle performance may be temporarily affected but no permanent damage shall occur.

Refer to CHSTP System Requirement 5-06.3, 5-06.4, and 5-06.6 regarding the relative movement of surrounding air with respect to the vehicle.

Refer to CHSTP System Requirement 5-06.5 and 5-06.7 regarding pressure pulses (e.g. due to passing of vehicles or entering a tunnel).

(f) Rain:
Rain rate of 6 mm/min (14 in/hr) shall be taken into account according to class 5K3 of EN 60721-3-5.

The effect of rain shall be considered depending on the equipment installation together with wind and vehicle movement (see (p) below).

(g) Snow and hail:
Consideration shall be given to the effect of snow and/or hail. The maximum diameter of the hailstones shall be taken as 15 mm (0.6 in); larger diameter may occur exceptionally.

Consideration shall be given to all forms of snow which may occur (see (p) below). Large quantities of snow in powder form may pass into the vehicle and melt. Rear vehicles of a moving train are most affected. Moreover, during standstill periods, the melted snow may freeze again.

(h) Ice:
The effect of ice forming or falling shall be considered on all equipment installed both inside and outside the vehicle. In such conditions the performance of equipment shall be agreed upon between the purchaser and

supplier.

(i) Solar radiation:
Equipment exposed to the effect of solar radiation shall remain unaffected.

For equipment directly exposed to solar radiation, the maximum level shall be considered as 1200 W/m2.

Care shall be taken for the effect of UV radiation on the equipment exposed to solar radiation.

The maximum duration of the exposure to solar radiation shall be conventionally taken as 8 h unless otherwise specified.

(j) Lightning:
Consideration shall be given to the effects of lightning on the vehicle.

For protection against lightning on the vehicle refer to EN 50124-2.

(k) Pollution:
The effects of pollution shall be considered in the design of equipment and components.

The severity of pollution will depend upon the location of the equipment.

Means may be provided to reduce pollution by the effective use of protection. In this case the protection against water and solid objects shall be specified using the protection degree designation IP54XW as specified in EN 60529.

The effects of the following kinds of pollution shall be considered:

— chemically active substances:
— class 5C2 of EN 60721-3-5;
— salinity;
— other chemical substances;
— cleaning products specified by the purchaser;
— contaminating fluids: class 5F2 (electrical engine) of EN 60721-3-5;
— biologically active substances: class 5B2 of EN 60721-3-5 (flora and fauna);
— dust: defined by class 5S2 of EN 60721-3-5. Due to the presence of carbon and metallic powder, the dust may become electrically conductive with the presence of humidity;
— stones coming from the ballast, other objects of maximum 15 mm (0.6 in) diameter;
— grasses and leaves, pollen, flying insects, fibers, etc. for the design of ventilation ducts;
— fire extinguishing means;
— sand: defined by class 5S2 of EN 60721-3-5.

There are also internal causes of pollution due to the equipment itself (ionization etc).

(l) Vibrations and shocks:
Refer to CHSTP System Requirements 5-02.6, 5-03.4, and 5-07.10 for vibrations and shocks. Refer to EN 61373 for shock and vibration tests.

Refer to CHSTP System Requirement 5-03.4 and 5-08.1 for acceleration sources.

(m) Electromagnetic environment:
The requirements of EN 50121-3 shall be fulfilled. Refer to CHSTP System Requirement 5-06.9 for exterior electromagnetic interference.

(n) Acoustic noise environment:
Refer to CHSTP System Requirements 5-06.8 and 5-07.6 for exterior and interior noise; the noise levels defined within shall not lead to any malfunction or failure.

(o) Supply system characteristics:
Refer to CHSTP System Requirements 5-08 and 5-08.3 for traction power supply.

(p) Additional CHSTP conditions:
In addition to the criteria set forth above, the trainset supplier shall ensure that the equipment will operate, without malfunction or failure, in the conditions tabulated in Tables 1 and 2.

(See attachment)

5-06.2 **Train aerodynamic loads in open air** **(RST)**

Refer to CHSTP System Requirement References 5-06.3, 5-06.4, and 5-06.5.

5-06.3 **Aerodynamic loads on track workers at the line side** **(RST)**

a) Aerodynamic loads on track workers at the lineside:
A full length CHSTP train running in the open air at 300 km/h shall not cause an exceedance of the air speed u2σ at the trackside as set out in Table 1, at a height of 0.2 m above the top of rail and at a distance of 3.0 m from the track center, during the passage of the whole train (including the wake).

As the CHSTP trainsets will operate with a maximum speed higher than 300 km/h, the measures to be taken by the Infrastructure Manager are mentioned in CHSTP System Requirement 3-33.3.
(See attachment)
b) Test conditions:
Tests shall be undertaken on ballasted, straight track. The vertical distance between the top of rail and the surrounding ground level is 0.75 m ± 0.25 m. The value u2σ is the upper bound of the 2σ confidence interval of the maximum resultant induced air speeds in the x-y ground plane. It shall be obtained from at least 20 independent and comparable test samples with ambient wind speeds of less than or equal to 2 m/s.
u2σ is given by:

(See attachment)

with

mean value of all air speed measurements ui, i ≥ 20
σ standard deviation

(c) Conformity assessment:
Conformity shall be assessed on the basis of full-scale tests and with the maximum length of the defined formations.

(d) Detailed specifications:
Measurements shall be taken at 300 km/h.

For a valid set of measurements, conditions for train speed vtr are:

— at least 50 % of the measurements shall be within ± 5 % of 300 km/h and

— 100 % of the measurements shall be within ± 10 % of 300 km/h.

Each measurement umeasured,i shall be corrected by

(see attachment)

The track shall have no obstacles, such as bridges or tunnels, nearer than 500 m ahead and 100 m after the sensors in the longitudinal direction. Groups of sensors are permitted to be used to obtain several independent measurements from one train passage. Such groups shall be spaced at least 20 m apart from each other.

The whole train-passing event shall consist of the time period starting 1 second before the passing of the train head and finishing 10 seconds after the tail passes.

The sampling rate of the sensor shall be at least 10 Hz. The signal shall be filtered using a 1-second window moving average filter. The ambient wind speed shall be determined at the first sensor at a height of 0.2 m above top of rail.

The ambient wind speed is equivalent to the mean wind speed in the 3-second interval occurring before the train head passes the wind sensor. The ambient wind speed shall be less than or equal to 2 m/s.

The uncertainty in the air speed measurements shall be determined and shall not exceed ± 3 %.

The uncertainty in the train speed measurement shall be determined and shall not exceed ± 1 %.

5-06.4 **Aerodynamic loads on passengers on a platform** **(RST)**

(a) Aerodynamic loads on passengers on a platform:
A full length train, running in the open air at a reference speed vtr = 200 km/h, shall not cause the air speed to

exceed value u2σ = 15.5 m/s at a height of 1.2 m above the platform and at a distance of 3.0 m from the track center, during the whole train passage (including the wake).

(b) Test conditions:
The assessment shall be made on a platform that represents the lowest height of a platform passed by the train.

The platform height used in the assessment shall be recorded in the rolling stock register.

The value u2σ is the upper bound of the 2σ confidence interval of the maximum resultant induced air speeds in the x-y platform plane. It shall be based on at least 20 separate measurements and under similar test conditions with ambient wind speeds of less than or equal to 2 m/s.

u2σ is given by:

(See attachment)

with

mean value of all air speed measurements ui, i ≥ 20
σ standard deviation

(c) Conformity assessment:
Conformity shall be assessed on the basis of full-scale tests and with the maximum length of the defined formations.

(d) Detailed specifications:
Measurements shall be taken at vtr = 200 km/h.

For a valid set of measurements, conditions for train speed vtr are:

— at least 50 % of the measurements shall be within ± 5 % of 200 km/h and

— 100 % of the measurements shall be within ± 10 % of 200 km/h.

Each measurement, umeasured,I, shall be corrected by

(see attachment)

The platform shall have no obstacles ahead of and after the sensors in the longitudinal direction. The platform shall have a constant geometry for a distance of 150 m ahead of the sensors in the longitudinal direction and shall not have a roof or canopy or backwall. A number of sensors are permitted to be used to obtain several independent measurements from one train passage. Such sensors shall be separated from each other by a distance of at least 20 m.

The whole train-passing event consists of the time period starting 1 second before the passing of the train head and finishing 10 seconds after the tail passes.

The sampling rate of the sensor shall be at least 10 Hz. The signal shall be filtered using a 1 second window moving average filter.

The wind speed shall be determined by the first sensor on the platform or by a separate wind sensor installed 1.2 m above platform. The ambient wind speed is equivalent to the mean wind speed in the 3-second interval occurring before the train passes the wind sensor. The ambient wind speed shall be less than or equal to 2 m/s.

The uncertainty in the air speed measurements shall be determined and shall not exceed ± 3 %.

The uncertainty in the train speed measurement shall be determined and shall not exceed ± 1 %.

5-06.5 **Pressure loads in open air** **(RST)**

(a) Pressure loads in open air:
A full length train, running at 250 km/h in the open air shall not cause the maximum peak-to-peak pressure of changes to exceed a value Δp2σ as set out in Table 1 over the range of heights 1.5 m (4.9 ft) to 3.3 m (10.8 ft) above the top of rail, and at a distance of 2.5 m (8.2 ft) from the track center, during the whole train passage (including the passing of the head, couplings and tail). The maximum peak-to-peak pressure changes are tabulated below:

(See attachment)

b) Conformity assessment:
Conformity shall be assessed on the basis of full-scale tests and with a maximum length of the defined formations.

(c) Detailed specifications:
Tests shall be undertaken on ballasted, straight track. The vertical distance between the top of rail and the surrounding ground level is 0.75 m ± 0.25 m (2.46 ft ± 0.82 ft). The considered event shall be that of a whole train passing and shall consist of the time period starting 1 second before the passing of the train head and finishing 10 seconds after the train tail passes.

The measurements shall be taken at 1.5 m (4.9 ft), 1.8 m (5.9 ft), 2.1 m (6.9 ft), 2.4 m (7.9 ft), 2.7 m (8.9 ft), 3.0 m (9.8 ft) and 3.3 m (10.8 ft) height above the top of rail and shall be analyzed separately for each measuring position. For any position the Δp2σ requirement needs to be fulfilled.

The value Δp2σ shall be the upper bound of a 2σ interval of (pmax – pmin) based on at least 10 independent and comparable test samples (at a certain measuring height) with ambient wind speeds of less than or equal to 2 m/s (4.5 mph).

Δp2σ is given by:

(See attachment)

with

: mean value of all peak-to-peak pressure measurements Δpi, i ≥ 10
σ: standard deviation

A number of sensors are permitted to be used to obtain several independent measurements from one train passage. Such sensors shall be separated from each other by a distance of at least 20 m (65.6 ft).

For a valid set of measurements, conditions for train speed vtr are:

— at least 50 % of the measurements shall be within ± 5 % of the reference train speed and

— 100 % of the measurements shall be within ± 10 % of the reference train speed.

The wind speed and direction shall be determined using a meteorological station installed near to the pressure measurement location, at 2 m (6.6 ft) above the top of rail and at 4 m (13.1 ft) distance to the track. The ambient wind speed shall be equivalent to the mean wind speed in the 15 second interval occurring before the train head passes the wind sensor. The ambient wind shall be less than or equal to 2 m/s (4.5 mph).

The pressure sensors used shall be capable of measuring the pressure with a minimum of 150 Hz resolution. All pressure sensors shall be connected to the static pressure opening of Prandtl tubes directed in longitudinal x-direction. It is permitted to use a method that is proven to be equivalent.

The uncertainty in the pressure measurements shall be determined and shall not exceed ± 2 %.

The uncertainty in the train speed measurement shall be determined and shall not exceed ± 1 %.

The pressure signal shall be analogue low pass filtered with a 75 Hz 6 pole Butterworth low pass filter or equivalent. For each pressure sensor and run the maximum pressure peak-to-peak value during the whole passage Δpm,i shall be computed and then corrected to the investigated train speed vtr and to standard density ρo. using the following formula

with:

Δpi: the corrected peak-to-peak pressure change

Δpm,i: the measured peak-to-peak pressure change for sample i

ρi: the air density measured at the test site for sample i

vw,x,i: the measured wind speed component in x-direction for sample i

vtr,i: the measured train speed for sample i

vtr: the investigated train speed

ρo: the standard density of 1.225 kg/m3 (0.076 lb/ft3)

5-06.6 Crosswind (RST)

(a) General requirements:
A train is deemed to meet the crosswind requirements if its characteristic wind curves (CWC) of its most wind sensitive vehicle are superior or at least equivalent to a set of characteristic reference wind curves (CRWC).

The set of CRWC to assess conformity of rolling stock is given in the Tables 1, 2, 3 and 4 for CHSTP (Class 1) vehicles for which the CWC shall be calculated according to the method set forth in Annex G of the 2008 TSI for rolling stock.

(See attachment)

Superiority or equivalence to the reference curves is given if all the CWC points relevant for the comparison are equal to or higher than the corresponding values of the reference set.

5-06.7 Maximum pressure variations in tunnels (RST)

(a) Maximum pressure variations in tunnels:
Rolling stock shall be aerodynamically designed so that for a given combination (reference case) of train speed and tunnel cross section in case of a solo run in a simple, non-inclined tube-like tunnel (without any shafts etc.) the requirement for the characteristic pressure variation shall be met. The requirements are given in the Table 1

(See attachment)

where vtr is the train speed and Atu is the tunnel cross sectional area.

(b) Conformity:
Conformity shall be proven on the basis of full-scale tests, carried out at reference speed or at a higher speed in a tunnel with a cross sectional area as close to the reference case as possible. Transfer to the reference condition shall be done with validated simulation software.

When assessing conformity of whole trains or trainsets, assessment shall be made with the maximum length of the train or coupled trainsets up to 400 m.

For the distance xp between the entrance portal and the measuring position, the definitions of ΔpFr, ΔpN, ΔpT, the minimum tunnel length and further information about the derivation of the characteristic pressure variation see EN14067-5:2006.

5-06.8 Exterior noise (RST)

Limits for stationary noise
The limits for stationary noise are defined at a distance of 7.5 m (24.6 feet) from the centerline of the track, 1.2 m (3.94 feet) above the upper surface of the rails. The vehicles under test shall be in service retention mode; that is rheostatic ventilation off and air brake compressor off, HVAC normal (not preconditioning mode) and all other equipment in normal operating condition. The measuring conditions are defined by the standard EN ISO 3095:2005 with the deviations defined in Annex N of the TSI for Rolling Stock. The parameter for the sound pressure level is LpAeq,T. The limiting values for the noise emission of the vehicles under the conditions mentioned above are given in Table 16. The CHSTP trainsets shall comply with the requirements for a Class 1 electric trainset.

(See attachment)

Limits for starting noise
The limits for starting noise are defined at a distance of 7.5 m (24.6 feet) from the centerline of the track, 1.2 m (3.94 feet) above the upper surface of the rails. The measuring conditions are defined by the standard EN ISO 3095:2005 with the deviations defined in Annex N1.2 of the TSI for Rolling Stock. The indicator for the sound level is LpAFmax. The limiting values for the starting noise of the vehicles under the conditions stated above are given in Table 17. The CHSTP trainsets shall comply with the requirements for a Class 1 electric trainset.

(See attachment)

Limits for pass-by noise

The limits for pass-by noise are defined at a distance of 25 m (82.02 feet) from the centerline of the reference track, 3.5 m (11.48 feet) above the upper surface of the rails for a vehicle speed indicated in Table 18 below. The indicator for the A weighted equivalent continuous sound level is LpAeq,Tp. The measurements shall be carried out in accordance with EN ISO 3095:2005 with deviations stated in Annex N1.3 and N1.4 of the TSI for Rolling Stock.

The test train shall consist of trainset itself.

The limiting values for the noise emission of the full test train LpAeq,Tp at 25 m 3.5 m above top of rail are given in Table 18. The CHSTP trainsets shall comply with the requirements for a Class 1 electric trainset.

(See attachment)

A margin of 1 dB(A) is accepted on the values given in table 18

5-06.9 **Exterior electromagnetic interference** **(RST)**

(a) Exterior electromagnetic interference:
For trains, with all forms of traction, the generation and distribution of electrical energy causes interference of high or low intensity by conduction (e.g. through the catenary and rail) and by electromagnetic radiation. In addition, on-board equipment can cause interference.

Electrical and electronic systems of equipment shall be capable of operation in the presence of external electromagnetic noise sources.

(b) Interference generated on the signalling system and the telecommunications network:
The electronic equipment shall not produce electrical noise that interferes with trainline control and communications or with wayside signaling systems.

(c) Electromagnetic interference:
In order to avoid degrading the proper operation of rolling stock due to electromagnetic interference, the requirements of the following standards shall be met:
— EN 50121-3-1:2000 for the total rolling stock subsystem,
— EN 50121-3-2:2000 for the different kinds of on-board equipment susceptible to interference.

In addition, the following requirements shall be met:

To contain electromagnetic interference emissions, suppression of transients shall be at the source wherever possible.

All electronic equipment shall be self-protected from damage or improper operation, or both, due to high voltage transients and long-term over-voltage or under-voltage conditions.

An Electromagnetic Compatibility Program and an Electromagnetic Compatibility Control Plan shall be developed for the CHSTP as per APTA SS-E-010-98 (ed. 2-13-04) – Standard for the Development of an Electromagnetic Compatibility Plan.

5-07 **System protection** **(RST)**

Refer to CHSTP System Requirements 5-07.1, 5-07.2, 5-07.3, 5-07.4, 5-07.5, 5-07.6, 5-07.7, 5-07.8, 5-07.9, 5-07.10, 5-07.11, 5-07.12, 5-07.13, 5-07.14, and 5-07.15.

5-07.1 **Emergency exits** **(RST)**

(a) Operation:
In the event of an emergency requiring a coach to be evacuated, priority shall be given to exiting the coach by entering an adjacent coach through the coach end doors. As a secondary means of egress, external access doors shall be used as emergency exits. If this is not possible, it shall be possible to use the following as emergency routes either separately or in combination:
— designated windows, by ejection of the window or glazing or by breaking the glass;
— compartment and gangway doors (i.e. coach end doors), by rapid removal of the door or breaking the glass;
— external access doors, by ejecting them or breaking the glass.

(b) Signage:
Emergency exits shall be clearly identified to passengers and rescue teams by means of suitable signs. The design and placement of such signs shall conform to the requirements of APTA SS-PS-002-98, Rev. 3 – Standard for

Emergency Signage for Egress/Access of Passenger Rail Equipment.

All other passenger signs closely connected with safety shall use the unified sign formats given in standard ISO 2864-1:2002.

(c) Low-location exit path marking:
Emergency exits shall be clearly identified to passengers by means of low-location exit path markings, which shall be used in addition to the emergency lighting system (reference CHSTP System Requirement 5-07.12). The design and placement of such markings shall conform to the requirements of APTA SS-PS-004-99, Rev. 2 – Standard for Low-Location Exit Path Marking.

(d) Evacuation via the doors:
Trains shall be equipped with emergency devices (e.g. ladders) allowing the evacuation of passengers via access doors when not present at a platform. The ladder shall be designed with a means to mechanically retain the ladder to the coach, adjacent to the door threshold.

(e) Emergency window exits:
Each single-level passenger car shall have a minimum of four emergency window exits. At least one emergency window exit shall be located in each side of each end (half) of the car, in a staggered configuration where practical (see Figures 1 and 2 below).

(See attachment)

Each main level in a multi-level passenger car is subject to the same requirements specified for single-level passenger cars. Any level other than a main level used for passenger seating in a multi-level passenger car, such as an intermediate level, shall have a minimum of two emergency window exits in each seating area. The emergency window exits shall be accessible to passengers in the seating area without requiring movement through an interior door or to another level of the car. At least one emergency window exit shall be located in each side of the seating area. An emergency window exit may be located within an exterior side door in the passenger compartment if it is not practical to place the window exit in the side of the seating area (see Figures 3 through 5 below).

(See attachment)

The passenger compartment in this example includes the vestibule and extends to the point where the stairs begin because there is an open passageway leading to the vestibule. If an interior door separates the vestibule from the seating area, the passenger compartment would only extend to the interior vestibule door.

Each emergency window exit in a passenger car shall have an unobstructed opening with minimum dimensions of 26 inches horizontally by 24 inches vertically. A seatback is not an obstruction if it can be moved away from the window opening without using a tool or other implement. An emergency window exit located within an exterior side door shall have an unobstructed opening with minimum dimensions of 24 inches horizontally by 26 inches vertically. Any emergency window exit in addition to the minimum number required that has been designated for use by the operator need not comply with the minimum dimension requirements, but must otherwise comply with all requirements in this section applicable to emergency window exits.

Each emergency window exit shall be conspicuously and legibly marked with photo-luminescent material on the inside of each car to facilitate passenger egress. Legible and understandable operating instructions, printed on photo-luminescent material, including instructions for removing the window, shall be posted at or near each such window exit. If window removal may be hindered by the presence of a seatback, headrest, luggage rack, or other fixture, the instructions shall state the method for allowing rapid and easy removal of the window, taking into account the fixture(s); this portion of the instructions may be in written or pictorial format.

(f) Rescue access windows:
Each single-level passenger car shall have a minimum of two rescue access windows. At least one rescue access window shall be located in each side of the car entirely within 15 feet of the car's centerline, or entirely within 7½ feet of the centerline if the car does not exceed 45 feet in length (see Figures 1 and 2 above). If the seating level is obstructed by an interior door or otherwise partitioned into separate seating areas, each separate seating area shall have a minimum of one rescue access window in each side of the seating area, located as near to the center of the car as practical.

Each main level in a multi-level passenger car is subject to the same requirements specified for single-level passenger cars. Any level other than a main level used for passenger seating in a multi-level passenger car, such as an intermediate level, shall have a minimum of two rescue access windows in each seating area. The rescue access windows shall permit emergency responders to gain access to passengers in the seating area without requiring movement through an interior door or to another level of the car. At least one rescue access window shall be located in each side of the seating area. A rescue access window may be located within an exterior side door in

the passenger compartment if it is not practical to place the access window in the side of the seating area (see Figures 3 through 5 above).

If, on any level of a passenger car, the emergency window exits installed to meet the minimum requirements of this section are also intended to function as rescue access windows, the minimum requirements for the number and location of rescue access windows shall be met for that level.

Each rescue access window must be capable of being removed without unreasonable delay by an emergency responder using either:
—□a provided external mechanism; or
—□tools or implements that are commonly available to the responder in a passenger train emergency.

Each rescue access window in a passenger car shall have an unobstructed opening with minimum dimensions of 26 inches horizontally by 24 inches vertically. A rescue access window located within an exterior side door may have an unobstructed opening with minimum dimensions of 24 inches horizontally by 26 inches vertically. A seatback is not an obstruction if it can be moved away from the window opening without using a tool or other implement.

Each rescue access window shall be marked with retroreflective material. A unique and easily recognizable symbol, sign, or other conspicuous marking shall also be used to identify each such window. Legible and understandable window-access instructions, including instructions for removing the window, shall be posted at or near each rescue access window.

(g)□Emergency roof access:
Each passenger car shall have a minimum of two emergency roof access locations, each with a minimum opening of 26 inches longitudinally (i.e. parallel to the longitudinal axis of the car) by 24 inches laterally. Each leading car shall have a minimum of one emergency roof access location, with a minimum opening of 26 inches longitudinally by 24 inches laterally.

Emergency roof access shall be provided by means of a conspicuously marked structural weak point in the roof for access by properly equipped emergency response personnel. Their locations shall be situated as practical so that when a car is on its side:
—□one emergency access location is wholly within each half of the roof as divided top from bottom; and
—□one emergency access location is wholly within each half of the roof as divided left from right (see Figure 6 below

(See attachment)

The ceiling space below each emergency roof access location shall be free from wire, cabling, conduit, and piping. This space shall also be free of any rigid secondary structure (e.g. a diffuser or diffuser support, lighting back fixture, mounted PA equipment, or luggage rack) where practicable. It shall be permissible to cut through interior panels, liners, or other non-rigid secondary structures after making the cutout hole in the roof, provided any such additional cutting necessary to access the interior of the vehicle permits a minimum opening of the dimensions specified to be maintained.

Each emergency roof access location shall be conspicuously marked with retroreflective material of contrasting color. In addition, legible and understandable instructions shall be posted at or near each such location. The retroreflective material shall conspicuously mark the line along which the roof skin shall be cut; a sign plate with a retroreflective border shall also state as follows:
CAUTION—DO NOT USE FLAME CUTTING DEVICES
CAUTION—WARN PASSENGERS BEFORE CUTTING
CUT ALONG DASHED LINE TO GAIN ACCESS
ROOF CONSTRUCTION—[STATE RELEVANT DETAILS]

In addition, the following requirements shall be met:

—□each powered, exterior side door in a passenger car shall be connected to an emergency back-up power system;
—□all door exits intended for emergency egress shall be either lighted or conspicuously and legibly marked with photo-luminescent material on the inside of the car. Clear and understandable instructions shall be posted at or near such exits;
—□all door exits intended for emergency access by emergency responders for extrication of passengers shall be marked with retroreflective material. Clear and understandable instructions shall be posted at each such door;
—□unauthorized opening of emergency exit facilities on vehicles shall be automatically communicated to the operations control center and/or the train operator.

5-07.10 Monitoring and diagnostic concepts (RST)

CHSTP rolling stock requirements shall be as follows:

Monitoring and diagnostic concepts
Electronic equipment installed on CHSTP trainsets shall meet the requirements of EN 50155:2007 Section 6.4.

The functions and equipment specified below, shall be monitored by themselves or externally:
— Door operation as specified in CHSTP System Requirement (SR) 5-02.4
— Instability detection, as specified in CHSTP SR 5-03.4
— On-board axle box health monitoring, as specified in CHSTP SR 5-03.3
— Activation of the passenger alarm as specified in CHSTP SR 5-05.3
— Brake system as specified in CHSTP SR 5-04.3
— Derailment detection as specified in CHSTP SR 5-03.4
— Fire detection as specified in CHSTP SR 5-07.2
— Failure of the driver vigilance device as specified in CHSTP SR 5-07.8
— Train control and communications subsystem information as specified in CHSTP SR 5-07.9

This monitoring of the functions and equipment shall be continuous, or at a frequency to ensure reliable detection of failure. The system shall also be linked to the on-board diagnosis data recorder to allow traceability. The recording related requirements for the train control and communications subsystem as described CHSTP SR 8-18.13 are mandatory

Indication to the driver shall be made of such detection, and shall require reaction by the driver.

Appropriate automatic braking shall be required where a functional failure occurs on the driver vigilance device or on the train control and communications subsystem onboard the trains.

In addition, the following requirements shall be met:

Automated monitoring
(a) In addition to the systems identified above, each train shall be equipped to monitor the performance of the following systems or components:
(1) Head end power status
(2) Horn and bell
(3) Wheel slide
(4) Tilt system, if so equipped

(b) When any such system or component is operating outside of its predetermined safety parameters:
(1) The train operator shall be alerted; and
(2) Immediate corrective action shall be taken, if the system or component defect impairs the train operator's ability to safely operate the train. Immediate corrective action includes limiting the speed of the train.
(c) The monitoring system shall be designed with an automatic self-test feature that notifies the train operator that the monitoring capability is functioning correctly and alerts the train operator when a system failure occurs.

Event recorders
a) All CHSTP trains shall have an in-service event recorder, of the type described in paragraph (b) of this section. The event recorder shall record the most recent 48 hours of operation of the electrical system of the train on which it is installed.

(b) Event recorders shall monitor and record data elements required by this paragraph with at least the accuracy required of the indicators displaying any of the required elements to the engineer. Each CHSTP train shall be equipped with an event recorder with a certified crashworthy event recorder memory module that meets the requirements of Appendix D of 49CFR229. The certified event recorder memory module shall be mounted for its maximum protection. (Although other mounting standards may meet this standard, an event recorder memory module mounted behind the collision posts and above the platform level is deemed to be mounted “for its maximum protection.”) The event recorder shall record, and the certified crashworthy event recorder memory module shall retain, the following data elements:
(i) Train speed;
(ii) Selected direction of motion;
(iii) Time;
(iv) Distance;
(v) Throttle position;
(vi) Applications and operations of the train automatic air brake, including emergency applications. The system shall record, or provide a means of determining, that a brake application or release resulted from manipulation of brake controls at the position normally occupied by the operator. In the case of a brake application or release that is responsive to a command originating from or executed by an on-board computer (e.g. , electronic braking system

controller, locomotive electronic control system, or train control computer), the system shall record, or provide a means of determining, the involvement of any such computer;
(vii) Applications and operations of the independent brake, if so equipped;
(viii) Applications and operations of the dynamic brake;
(ix) Cab signal aspect(s);
(x) Emergency brake application(s);
(xi) Wheel slip/slide alarm activation (with a property-specific minimum duration);
(xii) Lead unit headlight activation switch on/off;
(xiii) Lead unit auxiliary lights activation switch on/off;
(xiv) Horn control handle activation;
(xv) Unit number;
(xvi) Position in consist (lead or trail);
(xvii) Tractive effort;
(xviii) Brakes apply summary train line;
(xix) Brakes released summary train line;
(xx) Cruise control on/off, if so equipped and used; and
(xxi) Safety-critical train control data routed to the operator's display with which the operator is required to comply, specifically including text messages conveying mandatory directives, maximum authorized speeds, PTC system brake warnings, PTC system brake enforcements, and the state of the PTC system (e.g. cut in, cut out, active, or failed). The format, content, and proposed duration for retention of such data shall be specified in the Product Safety Plan or PTC Safety Plan submitted for the train control system under subparts H or I, respectively, of 49CFR236, subject to FRA approval under this paragraph.

The operative event recorder shall also include examples of how the captured data will be displayed during playback along with the format, content, and data retention duration requirements specified in the PTCSP submitted and approved pursuant to this paragraph.

5-07.11 Particular specification for tunnels (RST)

(a) Particular specification for tunnels:
The train crew shall be able to minimize the distribution and inhalation of fumes in the event of a fire. For this purpose it shall be possible to switch off or close all means of external ventilation and switch off air conditioning. It is permissible to trigger these actions by remote control per train, or at the level of a single vehicle.
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5-07.12 Emergency lighting system (RST)

(a) Normal lighting system
The CHSTP recommends following the guidance contained in APTA RP-E-012-99 (ed. 4-1-04) – Recommended Practice for Normal Lighting System Design for Passenger Cars; this recommended practice provides both qualitative and quantitative factors for normal lighting design for passenger cars. It encompasses general performance parameters and the means for measurement and verification of performance.

(b) Emergency lighting system
To provide protection and safety on board in the event of emergency the trains shall be equipped with an emergency lighting system; this system shall be sufficient to enable continued occupation or safe egress from the vehicle and shall provide the minimum light necessary to enable passengers to move about inside vehicles and leave vehicles and, in particular, to recognize the presence of obstacles. It shall also be arranged to ensure that it will be switched on automatically and cannot be made ineffective by passenger. Reduced visibility due to airborne particles, caused by smoke or dust, shall be taken into account when designing the system.

The luminaires of the emergency lighting systems shall be supplied from the vehicle battery by at least one dedicated circuit. If the vehicle is not provided with its own battery and if it can be decoupled in normal service, the emergency lighting system or luminaires shall be equipped with its own power source.

The emergency lighting system shall provide suitable lighting levels in the passenger and in the service areas:
— for a minimum operating time of three hours after the main energy supply has failed;
— with 50% of the required illuminance within 5 seconds and the total required illuminance within 15 seconds;
— with a minimum of 5 lux (0.46 foot-candle) at floor level;
— with a minimum of 30 lux (2.8 foot-candle) at the exit threshold;
— with a minimum value of 50 lux (4.6 foot-candle) for the exit signage.

Other requirements, including illuminance values for other specific areas and testing methods, are defined in APTA SS-E-013-99, Rev. 1 (ed. 10-22-07) – Standard for Emergency Lighting System Design for Passenger Cars and shall be complied with.

In the event of fire, the emergency lighting system shall continue to sustain at least 50% of the emergency lighting in the vehicles not affected by fire for a minimum of 20 minutes. This requirement shall be deemed to be fulfilled by a satisfactory failure mode analysis.

In addition, the following requirements shall be met:

The back-up power system for the emergency lighting shall be capable of:
—operating in all equipment orientations within 45 degrees of vertical;
—operating after the initial shock of a collision or derailment resulting in the following individually applied accelerations:
—longitudinal: 8g
—lateral: 4g
—vertical: 4g

5-07.13 Software (RST)

CHSTP rolling stock requirements shall be as follows:

Software which has an impact on safety related functions shall be developed and assessed in accordance with the requirements of EN50128: 2001 and EN50155:2001/A1:2002.

In addition, the following requirements shall be met:

Hardware and software that controls or monitors a train's primary braking system shall either:
—fail safely by initiating a full service brake application in the event of a hardware or software failure that could impair the ability of the engineer to apply or release the brakes; or
—access to direct manual control of the primary braking system (both service and emergency braking) shall be provided to the engineer.

Hardware and software that controls or monitors the ability to shut down a train's main power system shall either:
—fail safely by shutting down the main power in the event of a hardware or software failure that could impair the ability of the train crew to command that electronic function; or
—the ability to shut down the main power by non-electronic means shall be provided to the train crew.

Elements of the hardware and software safety program that affect the safety of the passenger equipment shall be complied with.

5-07.14 Driver-Machine-Interface (DMI) (RST)

CHSTP System Requirement 5-7.14 remains an open point. The DMI requirements will be developed as CHSTP progresses.

5-07.15 Vehicle identification (RST)

CHSTP System Requirement 5-7.15 remains an open point. The vehicle identification requirements will be developed as CHSTP progresses.

5-07.2 Fire safety (RST)

(a) General requirements:
This System Requirement states requirements to prevent, detect and limit the effects of a train fire.

CHSTP rolling stock shall be designed and tested to the fire safety requirements set forth in 49CFR238 Appendix B and NFPA 130 Section 8. In addition, certain materials identified in Table 1 below, shall be tested to ASTM E 1354, BSS 7239, EN 45545-2, ISO 5658-2, and ISO 5660-1.

CHSTP rolling stock shall also be designed to accommodate category B fire safety; such equipment is designed and built to operate on all infrastructures (including those with tunnels and/or elevated sections with lengths exceeding 5 km (3 mi)) and shall adhere to the measures set out in (f) and (g). These measures are required to improve the probability that a train will continue to operate in the event that a fire is detected as it enters a tunnel and are intended to enable a train to reach a suitable place to stop and allow passengers and staff to be evacuated from the train to a place of safety.

Additional fire safety requirements for rolling stock relating to tunnels are set forth in CHSTP System Requirements 4-05 through 4-05.12.

(b) Measures to prevent fire:
Materials and components selection shall take into account their fire behavior properties. Design measures shall be implemented in order to prevent ignition. Refer to (h), (i), and (j) below.

(c) Fire detection:
The high fire risk areas on rolling stock shall be equipped with a system that can detect fire in an early stage and that can initiate appropriate automatic actions to minimize the subsequent risk to passengers and train staff.

This requirement shall be deemed to be satisfied by the verification of conformity to the following requirements:
—the rolling stock shall be equipped with a fire detection system that can detect a fire in an early stage in the following areas:
—technical compartment or cabinet, sealed or not sealed, containing electrical supply line (the line between the current collector or current source and the main circuit breaker or the main fuse(s) on the vehicle) and/or traction circuit equipment (both the traction module, as defined in CHSTP System Requirement 5-08.1, and the power equipment feeding the traction module from the electrical supply line);
—in staff compartments and gangways;
—upon activation of the detection system of a technical area, the following automatic actions shall be required:
—notification to the train driver;
—shut down of forced ventilation and high voltage energy supply to the affected equipment that could cause the fire to develop.

(d) Fire extinguisher:
Each vehicle unit and operator's cab shall be equipped with an approved portable fire extinguisher, which shall be selected, inspected, and maintained in accordance with the requirements of NFPA 10.

The trainset shall also be equipped with adequate and sufficient fire extinguishers at any additional appropriate locations as identified through the fire safety analysis (see (l) below).

(e) On-board emergency equipment:
The CHSTP trainset on-board emergency equipment shall include, at a minimum:
—one fire extinguisher per passenger car;
—one pry bar per passenger car; and
—one flashlight per on-board crewmember.

Each passenger car shall also include one first-aid kit accessible to crewmembers that contains, at a minimum:
—two small gauze pads (at least 4×4 inches);
—two large gauze pads (at least 8×10 inches);
—two adhesive bandages;
—two triangular bandages;
—one package of gauge roller bandage that is at least two inches wide;
—wound cleaning agent, such as sealed moistened towelettes;
—one pair of scissors;
—one set of tweezers;
—one roll of adhesive tape;
—two pairs of latex gloves; and
—one resuscitation mask.

Auxiliary portable lighting (e.g., a handheld flashlight) shall also be accessible and provide, at a minimum:
—brilliant illumination during the first 15 minutes after the onset of an emergency situation; and
—continuous or intermittent illumination during the next 60 minutes after the onset of an emergency situation.

The CHSTP emergency preparedness plan (see CHSTP System Requirements for Operations) shall state the types of emergency equipment to be kept on board and indicate their location(s) on each passenger car that is in service. This plan shall also provide for scheduled maintenance and replacement of first-aid kits, on-board emergency equipment, and auxiliary portable lighting.

(f) Fire resistance:
The CHSTP rolling stock shall be equipped with adequate fire barriers and partitions at appropriate locations. The conformity with this requirement shall be deemed to be satisfied by the verification of conformity to the following requirements:
—the rolling stock shall be equipped with full cross section partitions within passenger/staff areas of each vehicle, with a maximum separation of 28 m (92 ft) which shall satisfy requirements for integrity for a minimum of 15 minutes (assuming the fire can start from either side of the partition);
—the rolling stock shall be equipped with fire barriers that shall satisfy requirements for integrity and heat insulation for a minimum of 15 minutes:
—between the drivers cab and the compartment to the rear of it (assuming the fire starts in the rear compartment);

— between compartments with electrical supply line and/or traction circuit equipment and passenger/staff area (assuming the fire starts in the electrical supply line and/or the traction circuit equipment).

The partition tests shall be carried out in accordance with the requirements of ASTM E 119.

(g) Measures to improve running capability:
These measures are required to improve the probability that a train will continue to operate for 15 minutes in the event that a fire is detected as the train enters a tunnel. This requirement is necessary so that the train will reach a suitable place to stop and allow passengers and staff to be evacuated from the train to a place of safety.

This requirement shall be deemed to be satisfied by a failure mode analysis relating to the following requirements:
— brakes: the brakes shall not automatically apply to bring the train to a halt as a result of system failure caused by a fire assuming the fire is in a technical compartment or cabinet, sealed or unsealed, containing electrical supply line and/or traction circuit equipment;
— traction: 50 % minimum traction redundancy as defined in CHSTP System Requirement 5-08.1 shall be available in degraded mode running capability, assuming the source of the fire is in a technical compartment/cabinet, sealed or unsealed, with electrical supply line and/or traction circuit equipment. If this redundancy requirement cannot be satisfied for reason of traction equipment architecture (e. g. traction equipment in one single place of the train), an automatic fire extinguishing system shall be provided in the locations described herein.

(h) Materials:
Materials used in constructing CHSTP trainsets shall meet the test performance criteria for flammability and smoke emission characteristics as specified in (j) below, or as specified in alternative standards issued or recognized, by an expert consensus organization, after special approval of the FRA.

A materials matrix shall be developed as part of the fire safety analysis (refer to (l)), which indicates compliance with (j). The considerations below shall be examined further if the materials do not meet the criteria set forth in (j):
— type of material (including material safety data sheets);
— how much material used;
— location of materials;
— proximity to ignition source;
— distribution in the car.

It may not be necessary to remove materials that may not meet the performance criteria of (j) below, depending on the quantity, location and distribution of those materials and the proximity of ignitions sources.

(i) Tanks:
Transformer tanks are included only if they contain flammable liquids.

Where partition walls divide tanks internally, the complete tank shall fulfill the requirements. Tanks shall be built, located or protected so that they or their piping cannot be punctured or fractured by debris thrown up from the track.

Tanks shall not be installed in:
— crash energy absorption zones;
— passenger seating areas and areas of temporary occupation by passengers;
— luggage compartments;
— drivers cabs.

Tanks constructed to the following requirements are deemed to satisfy the minimum impact performance. If other materials are used, equivalent safety shall be demonstrated.

The thickness of walls of tanks for flammable liquids shall have a minimum of:

(See attachment)

The temperature of the flammable liquid in the tank shall remain below its flash point according to EN ISO 2719 under all normal operating conditions.

The design of flammable liquid tanks shall ensure, as far as reasonably practicable, that during filling or draining or in the event of leakage from a tank or its pipe work, flammable liquids cannot:
— come into contact with rotating machinery which might result in a spray;
— be drawn into any device in suction e.g. ventilators, coolers etc.;
— come into contact with hot components or electrical devices, which may produce electrical spark;
— penetrate into layers of thermal and acoustic insulation material.

(j) Required test methods and performance criteria for the flammability and smoke emission characteristics of materials:

The materials used in CHSTP trainsets shall be tested according to the methods and meet the performance criteria set forth in Table 1 and the following notes:

(See attachment)

Additional materials (e.g. wires) shall conform to the requirements of NFPA 130 Section 8.

(k) Certification:
The CHSTP requires certification that a representative sample of combustible materials to be used in constructing CHSTP trainsets has been tested by a recognized independent testing laboratory and that the results show the representative sample complies with the requirements of (j) at the time it was tested.

(l) Fire safety analysis for procuring new CHSTP equipment:
In procuring CHSTP equipment, the railroad and the trainset supplier shall ensure that fire safety considerations and features in the design of the equipment reduce the risk of personal injury caused by fire to an acceptable level in its operating environment using a formal safety methodology such as MIL-STD-882. To this end, the railroad shall complete a written fire safety analysis for the passenger equipment being procured. In conducting the analysis, the railroad, with the support of the trainset supplier, shall:
— identify, analyze, and prioritize the fire hazards inherent in the design of the equipment;
— reasonably ensure that a ventilation system in the equipment does not contribute to the lethality of a fire;
— identify in writing any train component that is a risk of initiating fire and which requires overheat protection. An overheat detector shall be installed in any component when the analysis determines that an overheat detector is necessary;
— identify in writing any unoccupied train compartment that contains equipment or material that poses a fire hazard, and analyze the benefit provided by including a fire or smoke detection system in each compartment so identified in (c). A fire or smoke detector shall be installed in any unoccupied compartment when the analysis determines that such equipment is necessary to ensure sufficient time for the safe evacuation of passengers and crewmembers from the train. For purposes of this System Requirement, an unoccupied train compartment, in addition to those areas listed in (c), means any part of the equipment structure that is not normally occupied during operation of the train, including a closet, baggage compartment, food pantry, etc.;
— determine whether any occupied or unoccupied space requires a portable fire extinguisher and, if so, the proper type and size of the fire extinguisher for each location. As set forth in (d) above, each passenger car is required to have a minimum of one portable fire extinguisher. If the analysis performed indicates that one or more additional portable fire extinguishers are needed, such shall be installed;
— on a case-by-case basis, analyze the benefit provided by including a fixed, automatic fire-suppression system in any unoccupied train compartment that contains equipment or material that poses a fire hazard, and determine the proper type and size of the automatic fire-suppression system for each such location. A fixed, automatic fire-suppression system shall be installed in any unoccupied compartment when the analysis determines that such equipment is practical and necessary to ensure sufficient time for the safe evacuation of passengers and crewmembers from the train.

The trainset supplier shall take effective steps to design the equipment and select materials which help provide sufficient fire resistance to reasonably ensure adequate time to detect a fire and safely evacuate the passengers and crewmembers, if a fire cannot be prevented. Factors to consider include potential ignition sources; the type, quantity, and location of the materials; and availability of rapid and safe egress to the exterior of the equipment under conditions secure from fire, smoke, and other hazards. The supplier shall explain how safety issues are resolved in the design of the equipment and selection of materials to reduce the risk of each fire hazard; the supplier shall also describe the analysis and testing necessary to demonstrate that the fire protection approach taken in the design of the equipment and selection of materials meets the fire protection requirements of this System Requirement.

(m) Inspection, testing, and maintenance:
The railroad, with the support of the trainset supplier, shall develop and adopt written procedures for the inspection, testing, and maintenance of all fire safety systems and fire safety equipment on the CHSTP equipment. The railroad shall comply with those procedures that it designates as mandatory for the safety of the equipment and its occupants.

5-07.3 Protection against electric shock (RST)

(a) General conditions:
All electrical systems and components on CHSTP (Class 1) trains shall be free of conditions that endanger the safety of the crew or train. These conditions include, but are not limited to insecure attachment of components, including traction motors and motor gear cases; oil, water, steam, and other leaks and accumulations of oil on electrical equipment that create a personal injury hazard; improper functioning of components, including slack adjusters, pantograph operating cylinders, circuit breakers, contactors, relays, switches, and fuses; and cracks, breaks, excessive wear and other structural infirmities of components, including quill drives, axles, gears, pinions,

pantograph shoes and horns, and traction motor gear cases.

(b) Protection against electric shock:
Electrically live components such as, and not limited to, high-voltage equipment, switches, circuit breakers, contactors, relays, grid resistors, and fuses, shall be designed to be placed in non-hazardous locations and to be equipped with interlocks or guards, such that conscious and unconscious contact with train staff and passengers is prevented, in normal operation and in case of equipment failure. All doors and cover plates guarding high voltage equipment shall be marked “Danger—High Voltage” or with the word “Danger” and the normal voltage carried by the parts so protected.

All hand-operated switches carrying currents with a potential of more than 150 volts that may be operated while under load shall be covered and shall be operative from the outside of the cover. Means shall be provided to show whether the switches are open or closed. Switches that should not be operated while under load shall be legibly marked with the words “must not be operated under load” and the voltage carried.

All unguarded non-current carrying metal parts subject to becoming charged shall be grounded or thoroughly insulated. In addition, all trains shall be equipped with appropriate tools to ground the vehicles. The driver’s manual, which shall be kept on the train, and the maintenance manual shall describe their use.

Jumpers and cable connections at the ends of the trainsets shall be so located and guarded to provide sufficient vertical clearance. They may not hang with one end free.

Cable and jumper connections between trains may not have any of the following conditions:
—broken or badly chafed insulation;
—broken plugs, receptacles or terminals;
—broken or protruding strands of wire.

A motor or a generator may not have any of the following conditions:
—be shorted or grounded;
—throw solder excessively;
—show evidence of coming apart.
—have an overheated support bearing.
—have an excessive accumulation of oil.

Rolling stock shall comply with the requirements of EN 50153: 2002 and the provisions set forth in (c) below.

(c) Grounding principles:
All the metal parts of the vehicle that are:

—liable to be touched by persons, or possibly by animals, and at risk of becoming a source of excessive contact voltages, as the result of a fault in the vehicle’s electrical installation or because of parts of the catenary becoming detached, or

—liable to lead to an accident risk as a result of the arcing of switch-gear subjected to high currents in the presence of dangerous materials, shall be set at the same potential as the rail through connections having resistances as specified below.

(d) Grounding of the vehicle bodyshell:
The electrical resistance between the metal parts of the rolling stock and the rail shall not exceed 0.05 ohms. These values shall be measured with a current maintained constantly at 50 A with a voltage of 50 V or less.

When the use of materials, which are poor conductors of electricity, as in pivot bearings or axles boxes, does not allow the values specified above to be obtained, the vehicles shall be provided, where applicable, with the following protective grounding connections:
—the body to be connected to the frame at least at two different points;
—the frame to be connected to each bogie at least once;

Each bogie shall be grounded reliably through at least one wheelset, for example, through the casing of an axle box or by means of a ground brush.

If there are no bogies, the frame shall be grounded reliably by at least one individual connection for each of the two wheelsets.

Ground connections, permitted to be either bare or insulated, shall be of a flexible material that does not corrode easily, and have a minimum cross-section of 35 mm2. If materials other than copper are used, their behavior in the event of a short circuit shall be equal to or greater than that of 35 mm2 of copper, and their electrical resistance as laid down above shall not be exceeded under any operating circumstances. These connections shall be mounted in

such a way as to be protected from mechanical damage.

(e) Grounding of the vehicle parts:
All conductive elements inside the vehicle, where they might be accessible and connected to metal parts on the roof, shall be bonded to the body of the vehicle in a safe way.

(f) Grounding of electric installations:

All the electrical installations that are connected to the main power circuit, and have metal parts which are likely to be touched and are not switched under power shall have those metal parts bonded with the body of the vehicle in a safe way.

All the metal parts of a vehicle (other than those covered in the previous point) which are susceptible to be touched and, although not switched under power, risk being made live accidentally, shall be bonded in a safe way if the nominal voltage of the part concerned is greater than:

— 50 V direct current;
— 24 V alternating current;
— 24 V between phases for three phase current where the neutral is not bonded; and
— 42 V between phases for three phase current when the neutral is bonded.

The cross-section of grounding bond is a function of current to be conducted; it shall be sized so as to guarantee the safe functioning of the circuit breakers if tripped.

(g) Aerials:
Aerials fitted outside vehicles shall either comply with the following conditions:
— The conductive parts of aerials shall be fully protected from catenary voltages by a protective device made of impact proof insulating material; and
— Aerial systems shall be provided with a single point ground connection (aerial with static grounding); or
— Where it is not possible to comply with the previous conditions an aerial fitted outside the vehicle shall be isolated, by means of high voltage capacitors connected to other over-voltage protection devices, connected to the inside of the vehicle.

5-07.4 **External lights and horn** **(RST)**

(a) Headlamps (headlights)
Two white headlamps, each producing a peak intensity of no less than 200,000 candelas, shall be provided at the front end of the train, arranged on the horizontal axis at the same height above the rail level, symmetrical about the center line, and mounted centrally above and between the marker lamps. One headlamp shall be arranged such that it illuminates a person standing between the rails 244 m (800 ft) ahead of the trainset under clear weather conditions. The second headlamp shall be arranged such that it illuminates a person standing between the rails 457 m (1,500 ft) ahead of the trainset under clear weather conditions. The following lamps meet the standard set forth in this System Requirement: a single operative PAR 56, 200 W, 30 V lamp, or an operative lamp of equivalent design and intensity.

(b) Marker lamps (auxiliary lights)
Two white marker lamps, each producing a peak intensity of no less than 200,000 candelas or no less than 3,000 candelas at an angle of 7.5 degrees and no less than 400 candelas at an angle of 20 degrees from the centerline of the train when the light is aimed parallel to the tracks, shall be provided at the front end of the train to form a triangle with the headlamps. The lamps shall be arranged on the horizontal axis at the same height above the rail level, symmetrical about the center line, and at a minimum of 1,300 mm (51 in) apart. Where the presence of a tapered nose cone means 1,300 mm (51 in) is not achievable it is permissible to reduce this dimension to 1,000 mm (39 in). The marker lamps shall be mounted between 1,500 and 2,000 mm (59 in and 79 in) above the rail level and shall be focused horizontally within 15 degrees of the longitudinal centerline of the train. The marker lamps may be arranged to burn steadily or flash on approach to a station. If the marker lamps are arranged to flash, they shall flash alternately at a rate of at least 40 flashes per minute and at most 180 flashes per minute. The flashing feature may be activated automatically, but shall also be capable of manual activation and deactivation by the train operator. The following lamps meet the standard set forth in this System Requirement: a single operative PAR 56, 200 W, 30 V lamp, a single operative PAR-56, 350 W, 75 V lamp, or an operative lamp of equivalent design and intensity.

(c) Tail lamps (marker lights)
Two red tail lamps, each producing an intensity of not less than 100 candelas nor more than 1,000 candelas as measured at the center of the beam width, shall be provided at the rear end of the train, arranged on the horizontal axis at the same height above the rail level, symmetrical about the center line, and at a minimum of 1,300 mm (51

in) apart. Where the presence of a tapered nose cone means 1,300 mm (51 in) is not achievable it is permissible to reduce this dimension to 1,000 mm (39 in). Tail lamps shall be mounted between 1,500 and 2,000 mm (59 in and 79 in) above the rail level. The tail lamps shall provide a horizontal beam with a minimum arc width of 15 degrees on each side of the vertical centerline and a vertical beam with a minimum arc width of 5 degrees on each side of the horizontal center line as defined in terms of the 50 candelas intensity points. The tail lamps may be arranged to burn steadily or flash. If the tail lamps are arranged to flash, they shall flash alternately at a rate of not less than once every 1.3 seconds nor more than once every 0.7 seconds.

(d) Colorimetric and spectral requirements
The color of light emitted by head and marker lamps shall comply with the requirements of CIE S004/E-2001, as shown in Table 1

(See attached)

The spectral radiation distribution of the light used is substantially responsible for the color recognition of signs. All illuminants shall ensure that there are no significant distortion of color in color recognition of signs and other objects.

In order to demonstrate compliance with this requirement, a ratio kcolor shall apply between the entire visible light range and the individual spectral color ranges to be considered. The ratio kcolor shall be determined according to the equation below:

(See attached)

S(λ) – spectral energy distribution (by spectral measurement) as the spectral radiance in W/m2 sr or as the spectral distribution of the irradiance in W/m2;
V(λ) – relative spectral luminosity (relative luminous efficiency of a monochromatic radiation of wavelength λ);
λcolor – wavelength range of the entire color range to be considered (see Table 2);
λtotal – wavelength range of the entire visible color range 380-780 nm.

(See attached)

The color of light emitted by tail lamps shall comply with the requirements of CIE S004/E-2001, as shown in Table 3:

(See attached)

(e) Combined lamps
Combined lamps (e.g. lamps capable of different functions) shall be permitted only where the requirements for the individual lamp functions are achieved.

(f) Lamp controls
The operator shall be able to control the headlamps and marker lamps from the normal driving position. The following functions shall be provided:
— all lamps off;
— dimmed marker lamps on (daytime and night-time use for bad weather conditions);
— full marker lamps on (daytime and nighttime use in normal weather conditions);
— dimmed headlamps on (daytime and nighttime by driver's choice);
— full-beam headlamps on (daytime and nighttime by driver's choice. Dimmed headlamps shall be used when passing trains and stations.).

The tail lamps at the rear end of the train shall be automatically switched on when any of the latter four functions is selected. This requirement shall not be applicable for variable formations. The external lamps located at intermediate points within the train shall be switched off. In addition to their traditional role as the front and rear lamps, it is permissible in emergency to use the lamps in specific ways and arrangements.

(g) Photometric tests
These tests shall determine the luminous intensity of light emitted by the lamp over the range of angles for which luminous intensities are specified and shall apply over the whole of the lit area of the lamp.

The photometric tests shall be carried out, with at least one lamp of each type at the rated voltage for each, in a suitable darkroom, with controlled ambient temperature within the range 18 °C to 22 °C (64.4 °F to 71.6 °F).

The luminous intensity shall be measured with a photometer with a measuring range of at least 1 to 200,000 candelas.

The f1 error of the photometer with reference to the V(λ) spectral response, according to CIE Publication No. 69 shall not exceed 1.5 %. The photometer shall have a device or devices to reduce internal reflections without covering parts of the detector surface.

The measurement system for the photometry shall be checked before each test with a suitably calibrated light source. The check shall be documented.

The calibration of the photometer and light source shall be traceable to the national standard applicable to the country in which the lamp is tested.

The photometric tests shall be carried out using a suitably calibrated goniometer. The lamp shall be fixed on the goniometer and inclined horizontally and vertically around the mid-point of the lit area of the lamp.

The measurement distance between the lamp and photometer shall be sufficient to ensure that the detector surface is illuminated fully and uniformly without any structural detail of the light beam. This measurement distance shall be documented.

During the tests, the electrically powered lamp shall be operated at a constant test voltage equal to the rated voltage for the lamp. In order to obtain an accurate result, the voltage shall be measured as close to the lamp as possible. The test voltage and current shall be documented.

Electrical light sources shall be aged before being submitted for the tests, and stabilized directly before the tests, for the required periods shown in Table 4.

Where the photometric tests are conducted on light-unit only, a type-test shall be carried out in the as-installed condition to account for variations in power supply, lenses and protective covers.

(See attached)

(h) Colorimetric tests
These tests shall determine the color of light emitted by the lamp over the range of angles for which luminous intensities are specified, and shall apply over the whole of the lit area of the lamp.

The colourimetric tests shall be carried out with at least one lamp of each type, at the rated voltage for each, in a suitable darkroom, with controlled ambient temperature within the range 18 °C to 22 °C (64.4 °F to 71.6 °F).

Testing of the color of the light emitted by the lamps shall be carried out with a precision colorimeter for absolute measurement. CIE Publication No. 15.2 contains information and recommendations on colorimetric practices and formulae, and on the calculation of tristimulus values and chromaticity coordinates. ISO/CIE 10527 contains information on partial filtering for the required 2° field size.

The measurement system for the colorimetry shall be checked before each test with a suitably calibrated light source. The check shall be documented.

The calibration of the colorimeter and light source shall be traceable to the national standard applicable to the country in which the lamp is tested.

The colorimetric tests shall be carried out using a goniometer. The lamp shall be fixed on the goniometer and inclined horizontally and vertically around the mid-point of the lit area of the lamp.

The measurement distance between the lamp and colorimeter shall be sufficient to ensure that the detector surface is illuminated fully and uniformly without any structural detail of the light beam. This measurement distance shall be documented.

During the tests, the electrically powered lamp shall be operated at a constant test voltage equal to the rated voltage for the lamp. In order to obtain an accurate result, the voltage shall be measured as close to the lamp as possible. The test voltage and current shall be documented.

Electrical light sources shall be aged before being submitted for the tests, and stabilized directly before the tests, for the required periods shown in Table 4.

(i) Horns
Each lead unit shall be equipped with warning horns that produce two distinct tones, each at a minimum sound level of 96 dB(A) and a maximum sound level of 110 dB(A) at 100 feet forward of the unit in its direction of travel. The notes of the audible warning horns are intended to be recognizable as being from a train and not be similar to warning devices used in road transport or as factory or other common warning devices. The acceptable warning horn notes shall be either:
— two separately sounded warning horns – the fundamental frequencies of the warning horn notes shall be high note: 370 Hz ± 20 Hz and low note: 311 Hz ± 20 Hz; or
— two warning horns sounded together as a chord (for the high note) – the fundamental frequencies of the chord

notes shall be: high note: 622 Hz ± 30 Hz and low note: 370 Hz ± 20 Hz; or
— two warning horns sounded together as a chord (for the high note) – the fundamental frequencies of the chord notes shall be: high note: 470 Hz ± 25 Hz and low note: 370 Hz ± 20 Hz; or
— three warning horns sounded together as a chord (for the high note) – the fundamental frequencies of the chord notes shall be: high note: 622 Hz ± 30 Hz and middle note: 470 Hz ± 25 Hz and low note: 370 Hz ± 20 Hz.

The warning horns shall be arranged so that they can be conveniently accessed from the operator's usual position during operation of the trainset. The horns and their control systems shall be protected, so far as is practicable, from impact and subsequent blockage by airborne objects such as debris, dust, snow, hail, or birds.

(j) Horn tests
Each CHSTP trainset shall be tested in accordance with this section to ensure that the horn installed on such trainset is in compliance. Trainsets that have already been tested individually or through acceptance sampling, in accordance with this section shall not be required to undergo sound level testing when equipped with a replacement horn, provided the replacement horn is of the same model as the original horn and the mounting location and type of mounting are the same.

Testing of the horn sound level shall be in accordance with the following requirements:
— a properly calibrated sound level meter shall be used that, at a minimum, complies with the requirements of International Electrotechnical Commission (IEC) Standard 61672–1 (2002–05) for a Class 2 instrument;
— an acoustic calibrator shall be used that, at a minimum, complies with the requirements of IEC standard 60942 (1997–11) for a Class 2 instrument;
— the manufacturer's instructions pertaining to mounting and orienting the microphone; positioning of the observer; and periodic factory recalibration shall be followed;
— a microphone windscreen shall be used and tripods or similar microphone mountings shall be used that minimize interference with the sound being measured;
— the test site shall be free of large reflective structures, such as barriers, hills, billboards, tractor trailers or other large vehicles, locomotives or rail cars on adjacent tracks, bridges or buildings, within 200 feet to the front and sides of the trainset. The trainset shall be positioned on straight, level track.
— measurements shall be taken only when ambient air temperature is between 0 °C and 40 °C (32 °F and 104 °F) inclusively; relative humidity is between 20 % and 95 % inclusively; wind velocity is not more than 5 m/s (12 mph) and there is no precipitation;
— with the exception of cab-mounted or low-mounted horns, the microphone shall be located 30.5 m (100 ft) forward of the front of the trainset, 4.5 m (15 ft) above the top of the rail, at an angle no greater than 20 degrees from the center line of the track, and oriented with respect to the sound source according to the manufacturer's recommendations. For cab-mounted and low-mounted horns, the microphone shall be located 30.5 m (100 ft) forward of the trainset, 1 m (4 ft) above the top of the rail, at an angle no greater than 20 degrees from the center line of the track, and oriented with respect to the sound source according to the manufacturer's recommendations. The observer shall not stand between the microphone and the horn;
— background noise shall be minimal; the sound level at the test site immediately before and after each horn sounding event shall be at least 10 dB(A) below the level measured during the horn sounding;
— measurement procedures: the sound level meter shall be set for A-weighting with slow exponential response and shall be calibrated with the acoustic calibrator immediately before and after compliance tests. Any change in the before and after calibration levels shall be less than 0.5 dB. After the output from the horn system has reached a stable level, the A-weighted equivalent sound level (slow response) for a 10-second duration (LAeq, 10 s) shall be obtained either directly using an integrating-averaging sound level meter, or recorded once per second and calculated indirectly. The arithmetic-average of a series of at least six such 10-second duration readings shall be used to determine compliance. The standard deviation of the readings shall be less than 1.5 dB;
— written reports of horn testing required by this part shall be made and shall reflect horn type; the date, place, and manner of testing; and sound level measurements. These reports, which shall be signed by the person who performs the test, shall be retained by the railroad, at a location of its choice, until a subsequent horn test is completed and shall be made available, upon request, to FRA as provided by 49 U.S.C. 20107.

5-07.5 **Lifting/rescue procedures** **(RST)**

(a) Lifting and rescue procedures:
The train manufacturer shall provide the relevant technical information to the CHSTP.

5-07.6 **Interior noise** **(RST)**

Interior noise
The noise level within the driver’s cab shall be in accordance with the values defined in Table 19.
(See attached)
The measurements shall be done under the following conditions:
— the doors and windows shall be closed;
— the hauled loads shall be equal to at least two-thirds of the maximum permissible value;

— for the measurements at maximum speed, the microphone shall be positioned at the height of the ear of a seated driver's head, at the center of a horizontal plane extending from the front windowpanes to the rear wall of the cab;
— for measurements of the horn's impact, 8 evenly spaced microphone positions around the position of the ear of a seated driver's head with a radius of 25 cm (9.84 in) shall be used, in a horizontal plane. The arithmetic mean of the 8 values shall be assessed against the limit;
— the wheels and track shall be in good running order;
— the maximum speed shall be maintained for at least 90 % of the measurement time.

It is permissible to subdivide the measurement time into several short periods in order to comply with the above-mentioned conditions.

Should the noise within the driver's cab exceed 85 dB(A) at any time, the requirements of 49CFR227 shall be adhered to.

5-07.7 **Air conditioning** **(RST)**

(a) Air conditioning:
Driving cabs shall be ventilated by a fresh airflow of 30m3/hr per person. It is permitted to interrupt this airflow when running in tunnels providing the carbon dioxide concentration does not exceed 5,000 ppm, assuming the initial carbon dioxide concentration is lower than 1,000 ppm.

In addition, the following requirements shall be met:

The cab shall be provided with proper ventilation and with a heating arrangement that maintains a temperature equivalent to that found in the passenger compartment. A minimum temperature of at least 50 degrees Fahrenheit, 6 inches above the center of each seat in the cab shall be maintained.

5-07.8 **Driver's vigilance device** **(RST)**

Driver's vigilance device (Alerter)

Any lack of driver vigilance shall be detected within 30 to 60 seconds and shall lead, in the absence of driver reaction, to, as a minimum, an automatic full service brake application on the train and a cessation of re-filling of the main brake pipe.

5-07.9 **Control-command and signaling system** **(RST)**

(a) General
The interface characteristics between the rolling stock and the train control and communications subsystem are included in CHSTP System Requirements (SR) 8-18 through 8-18.7 and 8-18.9 through 8-18.17. Amongst others, the following CHSTP System Requirements are relevant:
— The minimum braking characteristics for the train specified in CHSTP SR 5-04.1;
— Compatibility between the ground-based train detection systems and the rolling stock, specified in CHSTP SR 5-06.9;
— Compatibility between the detectors fixed under vehicles and the dynamic clearances of those vehicles specified in CHSTP SR 5-03.1;
— The environmental conditions for the on-board equipment are specified in CHSTP SR 5-06.1.
— Electromagnetic compatibility with on-board control-command equipment specified in CHSTP SR 5-06.9;
— Train characteristics concerning braking (specified in CHSTP Section 5-04), and train length (specified in CHSTP SR 5-03.5);
— Electromagnetic compatibility with the ground-based systems specified in CHSTP SR 5-06.9;
— The functionality identified in CHSTP SR 8-02.

In addition, the following functions are directly linked with parameters defined by the train control and communications subsystem:
— Operation in particular failure/degraded mode conditions as specified in CHSTP SR 8-02.
— In the event the automatic train control system is isolated, the maximum speed of the trainset shall be limited to 59 mph (final speed based upon the FRA PTC final rule).
— Monitoring to ensure that the train speed is at all times less than or at most equal to the maximum permitted speed in the operating environment.

Information about the characteristics of these interfaces, including references to additional standards and specifications to be used as part of the assessment procedure for conformity are given in CHSTP SRs 8-18 through 8-18.7 and 8-18.9 through 8-18.17.

Position of the train control and communications on-board antennae is specified in CHSTP SR 8-18.4.

(b) Wheelset location
The requirements for wheelset location linked to the train control and communications subsystem are specified in CHSTP SR 8-18.1.

(c) Wheels
The requirements for wheels linked to the train control and communications subsystem are specified in CHSTP SR 8-18.1.
In addition, the following requirements shall be met:
Each trainset shall be equipped with a speed indicator which is accurate within ±3 miles per hour of actual speed at speeds of 10 to 30 miles per hour and accurate within ±5 miles per hour at speeds above 30 miles per hour; and clearly readable from the engineer's normal position under all light conditions.

5-08 **Traction and electrical equipment** **(RST)**

Refer to sections 5-08.1, 5-08.2 and 5-08.3 for relevant CHSTP system requirements. The guidance contained in APTA RP-E-009-98 (ed. 2-13-04) – Recommended Practice for Wire used on Passenger Equipment and APTA RP-E-002-98 (ed. 2-13-04) – Recommended Practice for Wiring of Passenger Equipment shall be considered during the design of all traction and electrical equipment. The guidance contained in EN 50155:2007 – Railway Applications – Electronic Equipment Used on Rolling Stock shall be considered during the design of all electronic equipment.

The electronic equipment shall not produce electrical noise that interference with trainline control, communications or with on-board or wayside signaling systems.

In addition, the following requirements shall be met:

(a) Circuit protection
The main propulsion power line shall be protected with a lightning arrestor, automatic circuit breaker, and overload relay. The lightning arrestor shall be run by the most direct path possible to ground with a connection to ground of not less than No. 6 AWG. These overload protection devices shall be housed in an enclosure designed specifically for that purpose with the arc chute vented directly to outside air.

Head end power, including trainline power distribution, shall be provided with both overload and ground fault protection.

Circuits used for purposes other than propelling the equipment shall be connected to their power source through circuit breakers or equivalent current-limiting devices. Each auxiliary circuit shall be provided with a circuit breaker located as near as practical to the point of connection to the source of power for that circuit; however, such protection may be omitted from circuits controlling safety-critical devices.

The insulation integrity of all circuits on new equipment and vehicles shall be checked and tested per requirements set forth in APTA SS-E-001-98 (ed. 2-13-04) – Standard for Insulation Integrity.

The minimum safe gap and creepage distances for passenger rail vehicle circuits and cabling shall adhere to APTA RP-E-004-98 (ed. 2-13-04) – Recommended Practice for Gap and Creepage Distance.

All electrical equipment and enclosures shall be grounded and bonded per requirements of APTA SS-E-005-98 (ed. 2-13-04) – Standard for Grounding and Bonding.

(b) Main battery system
The qualification of storage batteries and the design of battery connectors and compartments shall conform to APTA RP-E-007-98 (ed. 2-13-04) – Recommended Practice for Storage Batteries and Battery Components. In addition, the following requirements shall be met:

The main batteries shall be isolated from the cab and passenger seating areas by a non-combustible barrier.

Battery chargers shall be designed to protect against overcharging.

Battery circuits shall include an emergency battery cut-off switch to completely disconnect the energy stored in the batteries from the load.

If batteries are of the type to potentially vent explosive gases, the batteries shall be adequately ventilated to prevent accumulation of explosive concentrations of these gases.

(c) Power dissipation resistors
Power dissipating resistors shall be adequately ventilated to prevent overheating under worst-case operating conditions.

Power dissipation grids shall be designed and installed with sufficient isolation to prevent combustion between resistor elements and combustible material.

Power dissipation resistor circuits shall incorporate warning or protective devices for low ventilation air flow, over-temperature, and short circuit failures.

Resistor elements shall be electrically insulated from resistor frames, and the frames shall be electrically insulated from the supports that hold them.

5-08.1 **Traction performance requirements** **(RST)**

(a) Traction performance requirements:
In order to guarantee proper compatibility with other train operations, the mean minimum accelerations calculated over time on a level track shall be as set out in Table 1 below.
(See attachment)
At the maximum service speed and on level track, the train shall still be capable of an acceleration of at least 0.05 m/s2.

For reasons of availability, traffic flow, and safe clearance of tunnels, trains shall meet all the following conditions:

— performance shall be achieved with the nominal voltage;
— one failed traction module shall not deprive a train of more than 25% of its rated output on a CHSTP (Class 1) train;
— on a CHSTP (Class 1) train a single failure of power equipment feeding the traction modules shall not deprive the train of more than 50% of its traction power.

A traction module is defined as power electronic equipment feeding one or several traction motors and which is able to operate independently of the others.

Under these conditions it shall be possible for a train under normal load (as defined in CHSTP System Requirement 5-03.2) with one traction module out-of service to start on the maximum gradient it is likely to encounter with an acceleration of approximately 0.05 m/s2. It shall be possible to move the train in this condition on the same gradient for ten minutes and to reach 60 km/h.

5-08.2 **Traction wheel/rail adhesion requirements** **(RST)**

(a) Traction wheel/rail adhesion requirements:
To ensure a high availability of traction, the design of the train and the calculation of its traction performance shall not make use of wheel/rail adhesion exceeding the values given in Table 1 below.
(See attachment)
Linear interpolation shall be made for intermediate speed values.

These figures are required only for design and calculation purposes and not for assessment of anti-slip systems.

Traction axles shall be equipped with an anti-slip system.

5-08.3 **Functional and technical specification related to the electric power supply** **(RST)**

Voltage and frequency of the power supply

Power supply
Trains shall be able to operate within the range of voltages and frequencies set forth in CHSTP System Requirement 6-02 and specified in clause 4 of EN50163:2004. (NOTE: It is very likely the nominal line voltage for CHSTP will be 25 kV, 60 Hz. EN 50163:2004 has a category 25 kV but at the 50 Hz imposed by the European grid. Therefore the 60 Hz frequency will be specified after discussions with the vehicle manufacturers regarding the 10 Hz difference and its effect on the vehicle electrical design, if any.)

Energy recuperation
The general conditions for the return of energy to the overhead contact line from regenerative braking are specified in CHSTP System Requirement 5-04.3, CHSTP System Requirement 6-04, and clause 12.1.1 of EN50388:2005. Conformity assessment shall be carried out according to the requirements of EN50388:2005, clause 14.7.1.

Maximum power and maximum current that is permissible to draw from the overhead contact line
The installed power on a high-speed line determines the permissible power consumption of trains. Therefore, current limitation devices shall be installed on board as required in Section 7 of EN50388:2005. Conformity assessment shall be carried out in accordance EN50388:2005, clause 14.3.

Power factor
The design data to be used for the power factor is set out in EN50388:2005, Section 6 with the following exception in yards, sidings and depots:
The power factor of the fundamental wave shall be ≥ 0.8 under the following conditions:
— the train is hotelling with traction power switched off and all auxiliaries running
and
— the active power being drawn is greater than 200 kW.
Conformity assessment shall be carried out according to the requirements of Section 6 and clause 14.2 of EN50388:2005.

System energy disturbances

Harmonic characteristics and related over-voltages on the overhead contact line
A traction unit shall not cause unacceptable overvoltages by generating harmonics. A compatibility assessment on the traction unit shall be undertaken in accordance with the requirements of clause 10 of EN50388:2005 to demonstrate that the traction unit does not generate harmonics beyond the defined limits.

Effects of DC content in AC supply
The AC electric traction units shall be designed so that they are immune for small DC current the value of which is specified in CHSTP System Requirement 6-24.

Rolling stock subsystem requirements linked to pantographs

Pantograph contact force
(a) Requirements for mean contact force
The mean contact force Fm is formed by the static and aerodynamic components of the contact force with dynamic correction. Fm represents a target value to be achieved in order to ensure current collection quality without undue arcing and to limit wear and hazards to contact strips. The mean contact force is a characteristic of the pantograph for given rolling stock, its position in the train consist and a given vertical extension of the pantograph.

Rolling stock and pantographs fitted on rolling stock shall be designed to exert the mean contact force on the contact wire (at speeds above 80km/h) as described in CHSTP System Requirement 6-15 (Line category I, II and III).

In the case of trains with multiple pantographs simultaneously in operation, the contact force Fm for any individual pantograph shall be no higher than the value given by the applicable curve in CHSTP System Requirement 6-15 (for AC).

(b) Adjustment of pantograph mean contact force and integration into the Rolling Stock Sub-System
Rolling stock shall permit adjustment of the pantograph to enable it to comply with the requirements specified in this clause. Conformity assessment shall be carried out in accordance with CHSTP System Requirement 6-16.2.

The pantograph shall be designed to be capable of operating with a mean contact force value (Fm) of the target curves as defined in CHSTP System Requirement 6-15. To ensure that Rolling Stock and its operating pantograph are suitable for its intended lines of operation, assessment of the mean contact force shall include measurements according to the CHSTP's requirements as follows:

For every line on which the train is intended to be operated, tests shall be undertaken at the range of nominal contact wire heights, and, up to the maximum speed.

For these tests, the speed shall be increased from 150 km/h to the maximum speed with intermediate steps not greater than 50 km/h each for the maximum and minimum height. The minimum number of speed levels for CHSTP (Class 1) Rolling Stock is 5 steps. No tests are required for intermediate heights of the same category of line.

The Rolling Stock Register shall state the maximum successfully tested operating speed for the Rolling Stock/Pantograph combination for each of the line categories and for the range of heights of the OCL for this line and therefore define the operating range Rolling Stock.

(c) Pantograph dynamic contact force
The requirements on dynamic contact force are set out in CHSTP System Requirement 6-16.

Arrangement of pantographs
Trains shall be designed to be able to move from one power supply system or from one phase section to an adjacent one without bridging either system or phase separation sections. It is permissible for more than one pantograph to be simultaneously in contact with the overhead contact line equipment. Figure 3 illustrates the requirements for arrangement of pantographs. (NOTE: The diagram shows the pantograph arrangement with the knuckle of the right hand car in the same direction as the left hand car. In practice, all cars will be built the same in a train so the knuckles should be facing the left hand car pantographs)

In accordance with the maximum train length, the maximum spacing between the first and last pantograph (L1) shall be less than 400 m in order to negotiate the specified types of separation sections. Where more than two pantographs are simultaneously in contact with the overhead contact line, the spacing between any pantograph and the third consecutive one marked as (L2) shall be more than 143 m. The spacing between any two consecutive pantographs in contact with the overhead contact line shall be greater than 8m for these specified types of separation sections.

The CHSTP trainset pantograph arrangement shall comply with the requirements of CHSTP System Requirement 6-19.

If the spacing between any pantographs does not meet the previous requirement then there shall be an operational rule to lower pantographs to permit trains to negotiate separation sections.

The number of pantographs and their spacing shall be selected taking into consideration the requirements of current collection performance (as defined in CHSTP System Requirement 6-16). The intermediate pantograph may be arranged at any position

When operating on AC power systems, trains with multiple pantographs shall not have electrical links between the pantographs in use.

Where the spacing of consecutive pantographs is less than the spacing shown in CHSTP System Requirement 6-19 rolling stock shall demonstrate by testing that, for the overhead contact line equipment defined in CHSTP System Requirements 6-01 through 6-25, the current collection quality, as defined in CHSTP System Requirement 6-16.1, is met for the poorest performing pantograph.

(See attached)

Insulation of pantograph from the vehicle
The pantographs shall be assembled on the roof of the vehicles and insulated from earth. The insulation shall be adequate for all system voltages. References for data to be verified are in EN50163:2004, clause 4, for system voltages and EN50124-1:2001, Table A2, for insulation coordination requirements.

Pantograph lowering
CHSTP rolling stock shall be equipped with a device that lowers the pantograph in case of a failure meeting the requirements of EN50206-1:1998, clause 4.9. The CHSTP rolling stock shall lower the pantograph in a period meeting the requirements of EN50206-1:1998, clause 4.8 and to the dynamic insulating distance according to EN 50119:2001 table 9 either by initiation by the driver or in response to control-command signals. The pantograph shall lower to the housed position in less than 10 seconds.

Conformity assessment shall be made in accordance with the requirements of EN50206-1: 1998, clauses 6.3.2 and 6.3.3.

Quality of current collection
In normal operation the quality of current collection shall meet the requirements of CHSTP System Requirement 6-16. The conformity assessment shall be made with a reference catenary. Definition of a reference catenary remains an open point in the High Speed Energy TSI.

NQ, the percentage of arcing duration, is defined in CHSTP System Requirement 6-16. If, in the event of a failure of the normal operating pantograph, continued operation at normal speed using a backup pantograph is required, the value of NQ shall not exceed 0.5. If operation at normal speed is not required, the train shall operate at such a speed that maintains the normal value of NQ.

Electrical protection coordination
Electrical protection coordination design shall comply with the requirements detailed in clause 11 of EN50388:2005. Conformity assessment shall be carried out according to the requirements of clause 14.6 of EN50388:2005.

Running through phase separation sections
Trains intended to operate on lines that are fitted with control-command and signaling devices that communicate the

requirements of separation sections on a line to trains shall be fitted with systems able to receive this information from these devices.

For CHSTP trains, the subsequent actions shall be triggered automatically.

As a minimum, these devices shall enable power consumption (both traction and auxiliaries, and for the no load current of the transformer) to be automatically brought to zero and the main circuit breaker opened before the traction unit enters a separation section, without the intervention of the driver. On leaving the separation section, the devices shall cause the main circuit breaker to be closed and power consumption to be resumed.

Additionally, where phase separation sections require pantographs on a train to be lowered and subsequently raised, these additional actions are permitted to be automatically initiated. These functions shall respond to input signals from the control-command and signaling subsystem.

Running through system separation sections
The available options for running through system separation sections are described in CHSTP System Requirement 6-22.2 and 6-22.3.

Before running through system separation sections the traction unit's main circuit breaker shall be opened.

When pantographs are not lowered from the contact wire, only those electric circuits on the traction units, which instantaneously conform to the power supply system at the pantograph, may remain connected. After running through a system separation section, a traction unit shall detect the new system voltage at the pantograph. The modification of the configuration of traction equipment shall be made either automatically or manually.

Height of pantographs
The installation of a pantograph on a traction unit shall allow interaction with contact wires at heights between 4 800 mm (15.75 ft) and 6 500 mm (21.33 ft) above rail level.

Interoperability constituent pantograph

Overall design
The pantograph shall meet the specified performance as far as maximum running speed and current carrying capacity are concerned. Pantograph requirements are specified in clause 4 of EN50206-1:1998.

Requirements on dynamic behavior and quality of current collection shall be assessed in accordance with CHSTP System Requirement 6-16.2.

Pantograph head geometry
Pantograph heads with the same principal dimensions shall be used on all categories of lines. The profile of the pantograph head shall be as depicted in Figure 4.

(See attached)

1. Horn made of insulating material (projected length 200mm)
2. Minimum length of the contact strip 800 mm
3. Conducting range of collector head 1 200 mm
4. Pantograph head length 1 600 mm

Pantograph heads fitted with contact strips having independent suspensions shall remain compliant to the overall profile with a static contact force of 70N applied to the middle of the head. The permissible value for pantograph head skew is defined in EN 50367:2006 clause 5.2.

Contact between contact wire and pantograph head is possible outside the contact strips and within the whole conducting range over limited line sections under adverse conditions (e.g. coincidence of vehicle swaying and high winds).

Pantograph static contact force
The static contact force is the vertical contact force exerted upward by the pantograph head on the contact wire and caused by the pantograph-raising device, whilst the pantograph is raised and the vehicle is at standstill.

The static contact force exerted by the pantograph on the contact wire, as defined in EN50206-1:1998 clause 3.3.5, shall be adjustable within the range of 40N to 120N for AC supply systems.

The pantographs and their mechanisms that provide the necessary contact forces shall ensure that a pantograph is capable of being used on overhead line equipment compliant to the CHSTP energy system requirements.

For details and assessment, reference shall be made to EN 50206-1:1998, clause 6.3.1

Working range of pantographs
Pantographs shall have a working range of at least 1 700 mm. Conformity assessment shall be made in accordance with the requirements of clauses 4.2 and 6.2.3 of EN 50206-1: 1998.

Current capacity
Pantographs shall be designed for the rated current to be transmitted to the vehicles. The manufacturer shall state the rated current. An analysis shall demonstrate that the pantograph is able to carry the rated current. Conformity assessment shall be made in accordance with the requirements of clause 6.13 of EN50206-1:1998.

Interoperability constituent contact strip
General
Contact strips are the replaceable parts of the pantograph head, which are in direct contact with the contact wire and as a consequence, are prone to wear. Conformity assessment shall be carried out in accordance with the requirements of clauses 5.2.2 to 5.2.4, 5.2.6 and 5.2.7 of EN50405:2006.

Contact strip geometry
The length of the contact strips is defined in Figure 4.

Material
The material used for the contact strips shall be mechanically and electrically compatible with the contact wire material (as specified in CHSTP System Requirement 6-11), in order to avoid excessive abrasion of the surface of the contact wires, thereby minimizing wear of both contact wires and contact strips.

Plain carbon or carbon impregnated with additive material shall be used in interaction with contact wires made from copper or copper alloys. Contact strip material shall comply with clause 6.2 of EN 50367: 2006.

Detection of contact strip breakage
Contact strips shall be designed so that any damage that is sustained which is likely to damage the contact wire initiates the automatic lowering device. Conformity assessment shall be carried out in accordance with the requirements of EN50405:2006 clause 5.2.5.

Current capacity
The material and cross-section of contact strips shall be selected according to the maximum current requirement. The rated current shall be stated by the manufacturer. Type tests shall demonstrate the conformity as specified in clause 5.2 of EN50405:2006.

Contact strips shall be capable of transmitting the current drawn by traction units at standstill. Conformity assessment shall be carried out in accordance with EN50405:2006 clause 5.2.1.

5-09 **Servicing** **(RST)**

Refer to CHSTP System Requirements 5-09.1, 5-09.2, 5-09.3, 5-09.4, 5-09.5, 5-09.6, 5-09.7, and 5-09.8.

5-09.1 **General** **(RST)**

(a) General:
Servicing and minor repairs necessary to ensure a safe return journey shall be able to be carried out on parts of the network distant from the vehicles' home base.

Trains shall be capable of being stabled, with no crew onboard, with power supply from the catenary or auxiliary power supply maintained for lighting, air conditioning, refrigerated cabinets, etc.

5-09.2 **Train external cleaning facilities** **(RST)**

(a) Train external cleaning facilities:
It shall be possible for the front windows of drivers' cabs to be cleaned both from the ground and from platform heights of 550 mm and 760 mm using suitable (with particular regard to health and safety aspects) cleaning equipment, in all stations and facilities at which the trains call or are stabled.

It shall be possible for the speed at which the train passes through the train washing plant to be adapted to suit each washing plant, i.e. between 2 and 6 km/h.

5-09.3 Toilet discharge system (RST)

(a) On board discharge system:
The design of the toilet discharge system shall allow sealed toilets (using clear or recycled water) to be emptied at sufficient intervals, so that the emptying operations can be performed on a scheduled basis at designated depots.

The following connections on the rolling stock are interoperability constituents.

— the 3″ evacuation nozzle (Inner part) is defined in Figure 1 below;
— the flushing connection for the toilet tank (Inner part), the use of which is optional, is defined in Figure 2 below.
(See attachment)
(b) Mobile discharge trolleys:
Mobile discharge trolleys are interoperability constituents.

Mobile toilet discharge installations shall be compatible with the characteristics of at least one on board discharge system (using clean or recycled water).

Mobile discharge trolleys shall perform all of the following functions:

— discharge;
— suction (the limit value for the suction vacuum is set at 0.2 bar);
— rinsing (only applies to retention toilet discharge equipment);
— pre-loading or filling with additive (only applies to retention toilet discharge equipment).

The connections on the discharge trolleys (3″ for emptying and 1″ for rinsing) and their seals shall comply with Figures 3 and 4 below.
(See attachment)

5-09.4 Train interior cleaning (RST)

(a) Train interior cleaning:
A 110/220 V, 60 Hz electrical power supply connection shall be provided in each coach for powering industrial cleaning equipment. This power shall be available simultaneously in all the coaches of a trainset. Electric power sockets inside the train shall be spaced such that no part of the coach that needs to be cleaned is more than 12 meters from one of the sockets.

(b) Electrical sockets:
CHSTP trains shall contain and utilize North American standard plugs and sockets for industrial cleaning equipment.

5-09.5 Water restocking equipment (RST)

Water restocking equipment

General

CHSTP trainsets shall be supplied with drinking water. Its mode of operation shall ensure that water delivered at the last element of the fixed part of these installations complies with the EPA Regulations and California Health and Safety Code for water intended for human consumption.

Water filling adapter
The water filling adapters are interoperability constituents, which are defined in Figure 1 below:

(See attachment)

5-09.6 Sand restocking equipment (RST)

(a) Sand restocking equipment:
Sandboxes are normally filled during scheduled maintenance operations in specialized workshops in charge of trainset maintenance. However, if required, sand meeting CHSTP specifications for this use shall be made available to fill sand boxes so that rolling stock can continue in commercial service until it returns to its maintenance center.

5-09.7 Special requirements for stabling of trains (RST)

(a) Special requirements for stabling of trains:
Rolling stock shall be designed so that:

—periodic monitoring is not necessary when stabled and connected electrically to an electrical supply system;
—it can be configured for different functional levels (e.g. standby, preparation, etc.);
—an absence of voltage does not damage any rolling stock constituent.

5-09.8 Refueling equipment (RST)

Refueling equipment is not applicable to CHSTP as the trainsets shall be powered by an overhead contact system.

5-10 Maintenance (RST)

Refer to CHSP System Requirements 5-10.1, 5-10.2, 5-10.3, 5-10.4, and 5-10.5.

5-10.1 Responsibilities (RST)

CHSTP rolling stock requirements shall be as follows:

(a) Responsibilities:
All maintenance activities undertaken on rolling stock shall be performed in accordance with the provisions of the CHSTP System Requirements for rolling stock.

All maintenance shall be undertaken in accordance with the maintenance file applicable to the rolling stock.

The maintenance file shall be managed in accordance with the provisions specified in CHSTP System Requirement 5-10.3.

After delivery of the rolling stock by the supplier, and acceptance thereof, a single entity shall assume responsibility for the management of changes affecting the design integrity, for the maintenance of the rolling stock and for the management of the maintenance file.

The rolling stock register shall state the entity responsible for the maintenance of the rolling stock and the management of the maintenance file.

5-10.2 The maintenance file (RST)

CHSTP rolling stock requirements shall be as follows:

(a) The maintenance file:
The maintenance file shall be composed of:
—the maintenance design justification file; and
—the maintenance documentation.

(b) The maintenance design justification file:
The maintenance design justification file:
—describes the methods used to design the maintenance;
—describes the tests, investigations, calculations carried out to design the maintenance;
—gives the relevant data used for this purpose and justifies its origin;
—describes the resources needed for the maintenance of rolling stock.

This file shall contain:
—name and department of the manufacturer and/or the entity undertaking responsible for the maintenance file;
—precedents, principles and methods used to design the maintenance of the vehicle;
—utilization profile (Limits of the normal utilization of the vehicle (e.g. km/month, climatic limits, authorized types of loads etc.) taken into account for the design of the maintenance);
—tests, investigations, calculations carried out;
—relevant data used to design the maintenance and origin of these data (return of experience, tests, etc);
—responsibility and traceability of the design process (name, skills and position of the author and approver of each document);
—resources needed for the maintenance (e.g. required time for inspections, replacement of parts, life time of components etc.).

(c) The maintenance documentation:
The maintenance documentation consists of all the documents necessary to carry out the management and execution of the maintenance of the vehicle. It shall be composed of the following:
—component hierarchy and functional description: The hierarchy sets up the boundaries of the rolling stock by

listing all the items belonging to the product structure of that rolling stock and using an appropriate number of discrete levels. The last item shall be a replaceable unit;
—schematic circuit diagrams, connection diagrams and wiring diagrams;
—parts list: Containing the technical descriptions of the spare parts (replaceable units) in order to allow identification and procurement of the correct spares;
—safety/interoperability-relevant limits: For the safety/interoperability relevant components or parts according to the CHSTP requirements for rolling stock, this document shall give the measurable limits not to be exceeded in service (to include operation in degraded mode). Safety critical data relating to the maintenance schedule of the vehicle shall be included in the rolling stock register;
—where components or systems are subject to specific legal obligations these obligations shall be listed.
—maintenance plan
—list, schedule and criteria of all planned preventative maintenance operations;
—list and criteria of conditional preventative maintenance operations;
—list of relevant corrective maintenance operations;
—maintenance operations depending on specific conditions of use.

The level of the maintenance operations shall be described.

Some maintenance operations like overhauls and very heavy repairs may not be able to be defined at the moment when the vehicle is put into service. In this case, the responsibility and the procedures to define such maintenance operations shall be described.
—maintenance manuals and leaflets
For each maintenance operation listed in the maintenance plan, the manual explains the list of the tasks to be carried out.

Where maintenance tasks are common to different operations or common to different vehicles it is permissible to explain them in specific maintenance leaflets.

The manuals and leaflets shall contain the following information:
—specific tools and facilities including service software;
—standardized or statutory specific staff competencies required (welding, non destructive testing …);
—general requirements relative to mechanical, electrical, fabrication and other engineering competencies;
—occupational and operational health and safety provisions (including applicable legislation appertaining to the controlled use of substances hazardous to health and safety);
—environmental provisions;
—details of the task to be carried out as a minimum:
—disassembly/assembly instructions;
—maintenance criteria;
—checks and tests;
—tools and materials required to undertake the task;
—consumables required to undertake the task;
—personal protective safety equipment;
—necessary tests and procedures to be undertaken after each maintenance operation before putting into service;
—traceability and records;
—troubleshooting (fault diagnosis) manual including functional and schematic diagrams of the systems.

5-10.3 **Management of the maintenance file.** **(RST)**

CHSTP rolling stock requirements shall be as follows:

(a) Management of the maintenance file:
The maintenance file shall be supplied with the first train or vehicle of a series, either by the manufacturer or/and the railway undertaking and submitted to the processes, as specified in (b) below, before putting into service. This section does not apply to prototypes when they are being used for evaluation purposes.

After putting the first train or vehicle of a series into service the railway undertaking is responsible for the management of the maintenance file appertaining to rolling stock for which it has management responsibility relative to the provisions specified. This includes a process of regular review of the maintenance file to ensure compliance with the essential requirements.

The maintenance file shall be managed in accordance with the processes defined in the certified safety management system of the railway undertaking.

In the case where railway undertakings carry out maintenance on the rolling stock they use, the railway undertaking shall ensure processes are in place to manage the maintenance and operational integrity of the rolling stock, including:

—information in the rolling stock register;
—asset management, including records of all maintenance undertaken and due on the rolling stock (which shall be subject to specified retention periods for differing levels of archive storage);
—software where relevant;
—procedures for the receipt and processing of specific information related to the operational integrity of rolling stock, arising as a result from any circumstance including but not limited to operational or maintenance incidents, that have a potential to affect the safety integrity of rolling stock;
—procedures for the identification, generation and dissemination of specific information related to the operational integrity of rolling stock, arising as a result from any circumstance including but not limited to operational or maintenance incidents, with a potential to affect the safety integrity of rolling stock, and which is identified during any maintenance activity;
—operational duty profiles of rolling stock (including but not limited to total miles travelled);
—processes for the protection and validation of such systems.

The safety management system of the railway undertaking shall demonstrate that suitable maintenance arrangements are in place, thereby ensuring on-going compliance with the essential requirements and the requirements of, but not limited to, CHSTP System Requirement 5-10.2.

In the case of entities other than the railway undertaking using rolling stock, being responsible for the maintenance of this rolling stock, the railway undertaking using the rolling stock shall ascertain that all relevant maintenance processes are in place and are actually applied. This process shall also be suitably described within the safety management system of the railway undertaking.

The entity responsible for the maintenance of the rolling stock shall ensure that reliable information about maintenance processes and data are available for the operating railway undertaking, and shall demonstrate on request of the operating railway undertaking that these processes ensure the compliance of the CHSTP rolling stock requirements.

(b) Assessment of maintenance:
A notified body shall be presented with the maintenance file, which forms part of the technical file and shall only verify that the information contained in the maintenance file is per according to CHSTP System Requirement 5-10.2. The notified body is not required to verify the information contained.

5-10.4 **Management of maintenance information.** **(RST)**

CHSTP rolling stock requirements shall be as follows:

(a) Management of maintenance information:
The entity responsible for the maintenance of rolling stock shall ensure that it has processes for the management of, and secured access rights to, information relative to the management, maintenance and operational integrity of rolling stock. Other parties operationally involved in this process shall provide the required maintenance information. This information shall include:

—rolling stock register;
—configuration management information;
—maintenance management information systems including records of all maintenance undertaken and maintenance, due on rolling stock, for which it is responsible (which shall be subject to specified time periods for differing levels of archive storage);
—management procedures for the receipt and processing of specific information relative to the operational integrity of rolling stock including operational and/or maintenance incidents with a potential to affect the safety integrity of rolling stock;
—management procedures for the identification, generation and dissemination of specific information relative to the operational integrity of rolling stock, including operational and/or maintenance incidents, with a potential to affect the safety integrity of rolling stock, and which is identified during any maintenance activity including repair of parts;
—operational duty profiles of rolling stock (e.g. miles).
—security management processes for protection and validation of the information systems.

5-10.5 **Implementation of the maintenance** **(RST)**

CHSTP rolling stock requirements shall be as follows:

(a) Implementation of the maintenance:
The railway undertaking shall schedule rosters so that each train returns at staggered intervals to designated bases where the major maintenance operations will be carried out at frequencies compatible with the design and reliability of high-speed trains.

When a train is in a degraded state, the conditions under which some repair work can be undertaken to allow its safe return to a designated base and the special operating conditions shall be agreed, case by case, between the infrastructure managers and the railway undertaking.

5-14.40 **Rolling Stock - Operating rules** **(OPS)**

The Timetable Special Instructions (TTSI) shall include appropriate directives regarding the safety, reliability, and technical compatibility of the equipment for both normal operation and a degraded state.

5-14.41 **Rolling Stock - Maintenance rules** **(OPS)**

Design criteria of the rolling stock for the CHSTP will meet or exceed the requirements of the CFR. The maintenance plan elements will also be designed to ensure that the rolling stock is maintained in order to meet or exceed the requirement of the CFR and maintained to maximize the life of the rolling stock and components.

5-14.42 **Rolling Stock - Professional competencies** **(OPS)**

CHSTP staff (including contractors) must have attained appropriate professional competence to undertake all necessary safety-related duties in normal, degraded and emergency situations. Such competence comprises professional knowledge and the ability to put this knowledge into practice Only qualified employees may operate a locomotive or train, or install, maintain, repair, modify, inspect, or test safety critical elements of the rolling stock. These functions are covered service and fall under the provisions of the Hours of Service Law (HOS).
CHSTP will provide appropriate training that meets the requirements of the regulations and the particular circumstances of the CHSTP operation.
For purposes of training and qualification, a unqualified employee may perform service under the close supervision of a qualified employee. The term qualified employee applies to the designated service that the employee is endeavoring to render and has no regard or reference to formal job titles or organizational position.

5-14.43 **Rolling Stock - Health and safety conditions** **(OPS)**

CHSTP equipment will conform to appropriate life safety standards and applications required by law, regulation and proven best practice.

5-15 **ADA Accessibility Requirements for Rolling Stock** **(RST)**

(a) Level boarding:
The design of CHSTP trainsets shall be coordinated with the boarding platform design such that the horizontal gap between a car door at rest and the platform shall be no greater than 3 inches (76 mm) and the height of the car floor shall be within plus or minus 5/8 inch (16 mm) of the platform height under all normal passenger load conditions. Vertical alignment may be accomplished by car suspension or other suitable means of meeting the requirement.

(See attachment)

(e) Doorways:
Clear width: At least one doorway, on each side of the car from which passengers board, of each car are required to be accessible, and at least one adjacent doorway into coach passenger compartments shall have a minimum clear opening width of 32 inches (815 mm). Doorways at ends of cars connecting two adjacent cars shall have a clear opening width of 32 inches (815 mm) to permit wheelchair and mobility aid users to enter into a single-level dining car, if available.

Passageway: Doorways required to be accessible by the clear width requirement above shall permit access by persons using mobility aids and shall have an unobstructed passageway at least 32 inches (815 mm) wide leading to mobility aid seating locations. In cars where such doorways require passage through a vestibule, such vestibule shall have a minimum width of 42 inches (1065 mm) (see Figure 3).

(See attachment)

Signals: If doors to the platform close automatically or from a remote location, auditory and visual warning signals shall be provided to alert passengers of closing doors.

Signage: The International Symbol of Accessibility shall be displayed on the exterior of all doors complying with this section unless all cars and doors are accessible and are not marked by the access symbol (see Figure 4). Appropriate signage shall also indicate which accessible doors are adjacent to an accessible restroom, if applicable.

(See attachment)

(f) Restrooms:
Accessible restrooms shall be provided in single-level rail passenger coaches and food services cars adjacent to the accessible seating locations. Accessible restrooms are required in dining and lounge cars only if restrooms are provided for other passengers.

If a restroom is provided for the general public, an accessible restroom shall also be provided and shall be designed, so as to allow a person using a wheelchair or mobility aid to enter and use such restroom, as specified below:
— the minimum clear floor area shall be 35 inches (890 mm) by 60 inches (1525 mm). Permanently installed fixtures may overlap this area a maximum of 6 inches (150 mm), if the lowest portion of the fixture is a minimum of 9 inches (230 mm) above the floor, and may overlap a maximum of 19 inches (483 mm), if the lowest portion of the fixture is a minimum of 29 inches (737 mm) above the floor. Fixtures shall not interfere with access to and use of the water closet. Fold-down or retractable seats or shelves may overlap the clear floor space at a lower height provided they can be easily folded up or moved out of the way;
— the height of the water closet shall be 17 inches (432 mm) to 19 inches (483 mm) measured to the top of the toile seat. Seats shall not be sprung to return to a lifted position;
— a grab bar at least 24 inches (610 mm) long shall be mounted behind the water closet, and a horizontal grab bar at least 40 inches (1015 mm) long shall be mounted on at least one side wall, with one end not more than 12 inches (305 mm) from the back wall, at a height between 33 inches (383 mm) and 36 inches (915 mm) above the floor;
— faucets and flush controls shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate controls shall be no greater than 5 lbf (22.2 N). Controls for flush valves shall be mounted no more than 44 inches (1118 mm) above the floor;
— doorways on the end of the enclosure, opposite the water closet, shall have a minimum clear opening width of 32 inches (815 mm). Doorways on the side wall shall have a minimum clear opening width of 39 inches (991 mm). Door latches and hardware shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist.

Restrooms required to be accessible shall be in close proximity to at least one seating location for persons using mobility aids and shall be connected to such a space by an unobstructed path having a minimum width of 32 inches (815 mm).

(g) Interior circulation, handrails and stanchions:
Where provided, handrails or stanchions within the passenger compartment shall be placed to permit sufficient turning and maneuvering space for wheelchairs and other mobility aids to reach a seating location. The diameter or width of the gripping surface of interior handrails and stanchions shall be 1 1/4 inches (32 mm) to 1 1/2 inches (38 mm) or shall provide an equivalent gripping surface. Handrails shall be placed to provide a minimum 1 1/2 inches (38 mm) knuckle clearance from the nearest adjacent surface.

Where provided, handrails and stanchions shall also be sufficient to permit safe boarding, on-board circulation, seating and standing assistance, and alighting by persons with disabilities.

(h) Floors, steps and thresholds:
Floor surfaces on aisles, step treads and areas where wheelchair and mobility aid users are to be accommodated shall be slip-resistant.

All step edges and thresholds shall have a band of color(s) running the full width of the step or threshold which contrasts from the step tread and riser or adjacent floor, either light-on-dark or dark-on-light.

(i) Public information system:
Each car shall be equipped with a public address system permitting transportation system personnel, or recorded or digitized human speech messages, to announce stations and provide other passenger information. Alternative systems or devices which provide equivalent access are also permitted.

(b) Lighting:
Any doorway or stepwell shall have, when the door is open, at least 2 foot-candles (21.5 lux) of illumination measured on the door threshold, step tread, ramp, bridge plate or lift platform.

(c) Accessibility:
CHSTP single-level dining and lounge cars shall have at least one connecting doorway with a 32 inch (815 mm) clear opening connected to a car accessible to persons using wheelchairs or mobility aids, and at least one space complying with the requirements for wheelchair or mobility aid spaces, to provide table service to a person who wishes to remain in the wheelchair, and space to fold and store a wheelchair for a person who wishes to transfer to

an existing seat.

CHSTP bi-level dining and lounge cars shall have doors on the lower level, on each side of the car from which passengers board, with a 32 inch (815 mm) clear opening, an accessible restroom, and at least one space complying with the requirements for wheelchair or mobility aid spaces, to provide table service to a person who wishes to remain in the wheelchair and space to fold and store a wheelchair for a person who wishes to transfer to an existing seat.

Passenger coaches or food service cars shall have the number of spaces complying with the requirements for wheelchair or mobility aid spaces.

(d) Mobility aid accessibility:
Seating: CHSTP rail cars shall provide at least one, but not more than two, mobility aid seating location(s) complying with wheelchair or mobility aid spacing requirements; and at least one, but not more than two, seating location(s) complying with “other spaces” requirements which adjoin or overlap an accessible route with a minimum clear width of 32 inches (815 mm).

Wheelchair or mobility aid spaces: Spaces for persons who wish to remain in their wheelchairs or mobility aids shall have a minimum clear floor space 48 inches (1220 mm) by 30 inches (760 mm). Such spaces shall adjoin, and may overlap, an accessible path. Not more than 6 inches (150 mm) of the required clear floor space may be accommodated for footrests under another seat provided there is a minimum of 9 inches (230 mm) from the floor to the lowest part of the seat overhanging the space. Seating spaces may have fold-down or removable seats to accommodate other passengers when a wheelchair or mobility aid user is not occupying the area, provided the seats, when folded up, do not obstruct the clear floor space provided (see Figures 1 and 2).

Other spaces: Spaces for individuals who wish to transfer shall include a regular coach seat or dining car booth or table seat and space to fold and store the passenger's wheelchair.

6-01 **General provisions** **(TES)**

The Traction Power Supply and Distribution System shall meet the ultimate power demands of CHST operating at maximum line speed and to the prescribed level of service.

6-02 **Voltage and frequency** **(TES)**

The CHSTP traction power supply system shall be a 2x25kV AC, 60Hz system using autotransformers.

6-03 **System performance and installed power** **(TES)**

The traction power supply and distribution system shall be designed to meet the required performance with respect to the line speed, the minimum possible headway, the maximum train current, the power factor of traction units, the timetable and planned services, and the mean useful voltage.

6-04 **Regenerative braking** **(TES)**

The traction power supply system and the associated overhead contact system shall be designed to permit the use of regenerative braking as a service brake, able to exchange power seamlessly either with other trains or by any other means. The substation control and protection devices shall allow regenerative braking.

6-05 **Harmonic emissions towards the power utility** **(TES)**

Harmonic emissions towards the high-voltage power utilities shall be controlled within the limits prescribed in USA standards and the requirements of the power utilities concerned.

6-06 **External electromagnetic compatibility** **(TES)**

The CHST traction electrification system installations shall be electromagnetically compatible with the other CHST equipment and with the outside world.

6-07 **Continuity of power supply in case of disturbances** **(TES)**

TThe traction power supply and the overhead contact line system shall be designed to enable continuity of operation in case of disturbances.

This shall be achieved by sectioning of the overhead contact system into electrical sections and by the installation of redundant power supply transformers in the traction power supply substations. Redundant HV utility supply circuits shall supply each traction power substation and redundant HV switchgears shall be installed to allow either utility supply circuit to supply either power transformer.

The Overhead Contact System shall be sectioned into electrical sections and sub-sections so as to ensure electrical continuity from substation to substation and flexibility for sectionalization of the OCS for operations and maintenance purposes.
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6-08 **Protection of the environment** **(TES)**

Protection of the environment is covered by Project Compliance with the National Environmental Policy Act (1969).

6-09 **Overhead contact line** **(TES)**

Please refer to System Requirements 6-09.1 and 6-09.2.

6-09.1 **OCS Overall design** **(TES)**

The function of an overhead contact line system is to transmit energy from the fixed installations of an electric railway to the moving traction units. The OCS shall be designed in a manner to fulfil this function to the required standards of reliability and economy.
The design and operation of overhead contact lines presumes that pantographs are equipped with an automatic dropping device (ADD)

6-09.2 **Geometry of overhead contact line** **(TES)**

The overhead contact system shall be designed for use by pantographs with the head geometry (pantograph head profile) conforming to the CHSTP Rolling Stock System Requirements (SRs), and trains as specified in the CHSTP Rolling Stock SRs.
The contact wire shall be installed and maintained with a minimum contact wire height of 16 ft. 8 in. (5080 mm) and a maximum height 17 ft. 5 in. (5308 mm), at supports along dedicated track sections operating at speeds above 125 mph (200 km/h). The contact wire height difference at each adjacent structure shall be less than 1/2 in. (13 mm) to ensure the constant contact wire height required for satisfactory pantograph current collection at high speed. In shared track conditions, the nominal contact wire height at supports could be increased to 18 ft. 9 in. (5715 mm) so as to permit passage of conventional passenger equipment and, for operating speeds less than 125mph (200 km/h), contact wire gradients are permitted.

For pantograph security purposes, the permissible lateral deflection of the contact wire under the action of crosswind (defined as the maximum operational weed speed for which unrestricted operation is possible) shall be the smaller of 15 ¾ in. (400 mm) or (55 - L2) inches [(1.4 – L2) m], where L2 is the half-width of the dynamic envelope of the pantograph passage (as defined in Appendix A.3 of EN50367).

6-10 **Compliance of the overhead contact line system with infrastructure gauge** **(TES)**

The overhead contact system design shall comply with the kinematic envelope of the vehicles and also comply with the vehicle structure gauge.

The design of structures shall take into account the space necessary for the passage of pantographs in contact with the overhead contact system and for installation of the OCS itself. The dimensions of tunnels and other structures shall be mutually compatible with the geometry of overhead contact system and the kinematic envelope of the pantograph.

6-11 **Contact wire material** **(TES)**

Permissible materials for contact wires are copper and copper-alloy. The contact wire shall comply with the requirements of EN 50149:2001 clauses 4.1 to 4.3 and 4.5 to 4.8.

6-12 **Contact wire wave propagation speed** **(TES)**

The speed of wave propagation in contact wires is a characteristic parameter for assessing the suitability of overhead contact line for high-speed operation. This parameter depends upon the specific mass and the tensile stress in the contact wire. The line speed shall not be greater than 70 % of the wave propagation speed.

6-14 **Static contact force** **(TES)**

The pantograph static contact force is the mean vertical force exerted upward on the contact wire by the pantograph collector head on the catenary and caused by the pantograph raising device, whilst the pantograph is raised and the vehicle is at standstill.
The high speed overhead contact line shall be designed for a static contact force of 70N (15.7 pounds force) nominal value.

6-15 **Mean contact force** **(TES)**

The design of overhead contact line equipment must allow for the occurrence of maximum and minimum contact forces between the pantograph and the contact wire while taking into account the aerodynamic effects that occur at the maximum permissible speed of the vehicle. Force values vary with different combinations of pantograph and overhead contact system. The minimum contact force shall be positive to ensure no loss of contact between the pantograph and the overhead contact line.

The mean contact force is the mean value of the forces due to static and aerodynamic actions. It is equal to the sum of static contact force and the aerodynamic force caused by airflow on the pantograph elements at the considered speed. The mean uplift force is a characteristic of the given rolling stock pantograph. In this context, Fm represents a target value which should be achieved to ensure current collection without undue arcing, but which should not be exceeded to limit wear and hazards to current collection strips.

The overhead contact line shall be designed to be capable of sustaining this level of force for all pantographs on a train.

In the case of trains with multiple pantographs simultaneously in operation, the mean contact force Fm for any pantograph shall be not higher than the target value since for each individual pantograph the current collection criteria shall be met.

The maximum contact force (Fmax) is usually within the range of Fm plus three standard deviations (σ) for level grade open route sections, while higher values may occur elsewhere.

In addition to the minimum and maximum contact forces, the statistical value Fm – 3□ (which represents the value at which loss of contact between the pantograph and the contact wire is likely to occur) permits the assessment of the regularity of the contact between the pantograph and the overhead contact system. The value Fm – 3□ shall be positive to avoid contact losses.

6-16 **Dynamic behavior and quality of current collection** **(TES)**

Please refer to System Requirements 6-16.1 and 6-16.2.

6-16.1 **Dynamic behavior and quality of current collection - Requirements** **(TES)**

Safety, train performance, and wear of the contact strips and contact wire are all influenced by the dynamic interaction between the pantograph and the overhead contact line. The dynamic behaviour depends on the characteristics of the pantograph and overhead contact line and the operating conditions. The principal operating conditions to be considered are the train speed, and the number, spacing and positioning of the pantographs.

The acceptable number of pantographs and their minimum spacing are limited by the dynamic performance of pantograph and overhead contact line. The overhead contact line shall be designed for operation at maximum line speed with two adjacent operating pantographs spaced at 656 ft (200 m).

For safe operation of the system, the space needed to allow for contact wire uplift at the support shall be a minimum of twice the calculated, simulated or measured uplift (S0) of the contact wire at a steady arm, generated in normal operating conditions with one or more pantographs operating at the mean contact force Fm at the maximum line speed.

Good quality interactive dynamic performance with minimum wear can be assured by consideration of the quality of current collection. The quality of current collection has a fundamental impact on the life of a contact wire and shall, therefore, comply with agreed and measurable parameters:
— Contact wire uplift
— □Mean contact force Fm and standard deviation σmax
— □Percentage of arcing

6-16.2 **Dynamic behavior and quality of current collection - Conformity Assessment** **(TES)**

The Overhead Contact System of the CHSTP shall be a proven system capable of current collection at maximum operating speed of 220 mph in the dedicated operating environment, and at maximum operating speed of 125 mph in the shared track conditions. Previous records of the assessment validating by simulation and by on site testing of the Overhead Contact System shall be provided to ensure it is effectively a proven system capable of current collection for operation at 220 mph. On this basis the OCS design shall not be a new design.

Notwithstanding the above, the measurement in accordance with EN 50317 of the interaction of the overhead contact system and the pantograph is required on the CHSTP new high-speed line at the testing and commissioning phase to check the correct installation and to prove the safety and the quality of the current collection system on the CHSTP.

The CHST pantograph shall be of a proven design capable of current collection at maximum operating speed of 220 mph in dedicated operating environment and at maximum operating speed of 125 mph in the shared track conditions.. Previous records of the assessment validating the CHSTP pantograph shall be provided to ensure it is a proven design and capable of current collection for operation at 220 mph.
Pantographs used in the shared use corridors by other passenger vehicles such as Caltrain passenger cars, shall either be of a proven design capable of current collection 125 mph, or shall be assessed by simulation according to EN 50318.
When a pantograph of a proven design is to be installed on new rolling stock, testing shall be limited to the mean contact force requirements. The tests shall be carried in accordance with EN 50317:2002 or EN 50206-1:1998. If the tests are passed successfully, the pantograph mounted on that particular train or locomotive can be used on the CHSTP high-speed line.

6-17 **Vertical movement of the contact point** **(TES)**

The contact point is the point of the mechanical contact between a contact strip and a contact wire.
The vertical height of the contact point above the track shall be as uniform as possible along the span length; this is essential for high-quality current collection.
The maximum difference between the highest and the lowest dynamic contact point height within one span shall be less than 3.15 in. (80mm) on dedicated track at the maximum operating speed of 220 mph, and less than 3.94 in. (100mm) in shared track conditions at the maximum operating speed of 125mph.

This shall be verified by measurements according to EN 50317:2002 or simulations validated according to EN 50318:2002:
— for the maximum line speed of the overhead contact line,
— by using the mean contact force Fm (see 6-15 “Mean contact force” requirements),
— for the longest span length.

6-18 **Current capacity of the overhead contact line system: AC and DC systems, trains in motion** **(TES)**

This is an AC high-speed rail system.

The current capacity of the overhead contact system shall comply at least with the current requirements specified for the trains.

The overhead contact system shall be designed to cater for the electrical current loading (steady and fault) defined by the system design, including return circuits and feeder connections, under all environmental operating conditions defined in annex A to EN 50119:2001. The system shall be assessed for short circuit faults.

The most unfavourable wind conditions on which the calculation of the current capacity shall be based shall be stipulated by the contracting entity.
The electrical resistance per unit length of copper and copper alloy grooved contact wire at 20 0C shall not exceed the resistance value specified in Table 4 of EN 50149:2001.

The maximum temperature rise in the conductors caused by the load currents shall not lead to conductor temperature at which the mechanical properties are impaired. The maximum permissible temperatures are given in the Table B.1, Annex B of EN 50119:2001. The melting point of any grease used in the strands of the conductors shall be higher than the temperature limits specified in this table.

A design study shall be undertaken to confirm the overhead contact line system complies with the specified requirements.

Conformity assessment shall be carried out by design review.

6-19 **Pantograph spacing used for the design of the overhead contact line** **(TES)**

The overhead contact line design for high speed lines and shared use corridors shall be based on rolling stock operating with two raised pantographs spaced at 656 ft (200 m) apart for simulation assessments and measurement of the OCS, as indicated in SR 6-16.1. OCS design shall be coordinated with the Pantograph and Rolling Stock designers.

6-20 **Current capacity, DC systems, trains at standstill** **(TES)**

This is not applicable to CHSTP because CHSTP shall be an AC system and not a DC system.

6-21 **Phase separation sections** **(TES)**

The design of phase breaks shall ensure that TSI compliant trains can move from one electrical section to an adjacent electrical section without bridging between two electrical phases or two separate utility supply systems. Adequate means shall be provided to allow a train that is stopped within the phase break section to be restarted. The neutral section shall be configurable such that it can be connected to and energized from either of the adjacent electrical sections by remotely controlled disconnect switches.

6-22 **System separation sections** **(TES)**

The design of phase breaks shall ensure that TSI compliant trains can move from one power supply system to an adjacent different power supply system without bridging between two different systems.

6-22.1 **General** **(TES)**

This is covered in System Requirement 6-22.

6-22.2 **Pantographs raised** **(TES)**

This is covered in System Requirement 6-22.

6-22.3 **Pantographs lowered** **(TES)**

This is covered in System Requirement 6-22.

6-23 **Electrical Protection Coordination Arrangements** **(TES)**

Electrical protection coordination design of the Energy subsystem shall comply with the requirements detailed in EN 50388:2005, clause 11. The infrastructure register shall contain information on protection arrangements of the overhead contact line system to permit the High Speed Rolling Stock subsystem to demonstrate compatibility.

Conformity assessment shall be carried out for design and operation of substations in accordance with EN 50388:2005, clause 14.6.

6-24 **Effects of DC operation on AC systems** **(TES)**

The fixed installations of CHSTP shall be designed so that they are immune to low value dc leakage currents flowing out of the adjoining dc power supply systems.

6-25 **Harmonics and Dynamic Effects** **(TES)**

The High Speed Energy subsystem shall withstand overvoltages generated by rolling stock harmonics up to the limits stated in EN 50388:2005 clause 10.4.

Conformity assessment shall consist of a compatibility study that demonstrates that the subsystem element can withstand harmonics up to the defined limits according to EN 50388:2005, clause 10. Conformity assessment shall be conducted according to EN 50388:2005 clause 10.

6-31.1 **Energy - Management of power supply in case of danger** **(OPS)**

CHSTP will develop, test, implement, and train affected employees in the operating and electric traction disciplines in methods and procedures to manage power supply adequately in an emergency.

6-31.2 **Energy - Execution of works** **(OPS)**

In addition to the technical qualifications of the discipline, employees empowered to de-energize and re-energize catenary or employees who request electric trains hold clear or de-energize and take catenary out of service for maintenance, or who operate on track wire repair equipment and their direct supervisors must qualify on the Code of Operating Rules and physical characteristics of the railroad and re-qualify annually

6-31.3 **Energy - Day-to-day management of power supply** **(OPS)**

Operating Rules and Timetable Instructions (TTSI) will address what actions need to be taken by engineers as a result of varying voltage. Internal procedures will address communication between the power director and the train dispatcher.

6-33 **Energy - Professional competences** **(OPS)**

All field electric traction employees and power directors and load dispatchers must be qualified on the Code of Operating Rules and the Timetable Special Instructions (TTSI) as they relate to electrical operation.

Employees must demonstrate their competence with respect to operation in normal and degraded conditions. This competence must be certified (and periodically re-certified) through oral and written examination and through periodic practical exercises or drills.

The Code of Operating Rules and the TTSI will contain procedures and instructions relating to electrical operations and issues such as catenary failure, de-energization, grounding, and life safety matters.

6-34 **Energy - Health and safety conditions** **(OPS)**

Electrical safety of the traction power supply systems shall be achieved by designing and testing these installations according to appropriate standards and best practice.

6-34.1 **Energy - Protective provisions of substations and posts** **(OPS)**

1. Electrical safety of the traction power supply system shall be achieved by the following means:
a. The installations shall be designed and tested such that the permissible touch/accessible voltages caused by the traction system under fault conditions or in operating conditions shall not exceed values shown in the Table below as a function of time conditions:
(See attachment)
b. A direct connection shall be made between the return circuit and the earthing system of the traction power facilities (substations, switching stations and paralleling stations).
c. Circuit breakers in switchgear installations for contact lines shall be installed:
i. only in one conductor of each supply circuit in switchgear installations;
ii. in the connection with the overhead contact line.
d. Each traction power facility shall be connected to the running rails and the aerial ground wire by at least two return cables. The return cables shall be sufficient for the maximum load current, thereby allowing for the failure of one return cable. The connection to the running rails will be through impedance bonds.
e. Fuses, non-lockable switches and joint straps which can be released without a tool shall not be installed in the return circuit.
f. Whenever a switch is installed in the return circuit, another switch shall be installed in the supply circuit, and the return circuit switch shall be interlocked so that it can not be opened before the supply switch is open.

2. For insulation coordination the requirements given in EN 50124-1 shall apply.

3. All traction power facilities shall be barred against unauthorized access.

4. The earthing of traction power facilities shall be integrated into the general earthing system along the route to comply with the requirements for electric shock as specified above (clause 1).

5. For each installation it shall be demonstrated that the return current circuits and earthing conductors are adequate by design review. It shall be demonstrated that the provisions for protection against electric shock and rail potential, as designed, have been installed.

6. Conformity assessment shall be carried out within the assessment of the energy subsystem.

6-34.2 **Energy - Protective provisions of overhead contact line system** **(OPS)**

The overhead contact line system design shall be based on consideration of the electrical characteristics of the traction power supply system design. In overhead contact line systems, protection of persons against direct contact with energized parts shall be achieved by means of adequate clearances or by the installation of protective barriers. Protection of persons against indirect contact shall be provided for exposed conductive parts and components of overhead contact line systems. Protection of persons against the danger of elevated rail potentials shall be provided for touch voltages under fault conditions or accessible voltages under operating conditions.

6-34.3 **Energy - Protective provisions of current return circuit** **(OPS)**

Electrical safety and functionality of the current return circuit shall be achieved by appropriate design to applicable standards.

6-34.4 **Energy - Other general requirements** **(OPS)**

Precautions must be taken to ensure health and achieve a high level of safety for electric traction staff, This is particularly true when employees are working in the track area, in the substations, in the overhead catenary, and with the current return circuitry. Persons working on or near the track shall wear appropriate high-visibility clothing. The System Safety Plan must specify what tools and other personal protective equipment such as rubber gloves, are appropriate for particular circumstances.

6-34.5 **Energy - High Visibility Clothing** **(OPS)**

Staff engaged in the maintenance or inspection of the right of way, when working on or near the track, shall wear high-visibility,reflective clothes that are distinctive to CHSTP and are further distinguished by the functional area (operations, track, electric traction, communications and signals, contractors) to which the employee belongs.

7-01.1 **Operations - General requirements (staff)** **(OPS)**

Operations staff in safety sensitive positions will be governed by a Code of Operating Rules and the federal Hours of Service (HOS) Act. Safety sensitive positions include train and engine crews, hostlers, train dispatchers and other employees authorized to move trains, as well as signal maintenance employees.

7-01.2 **Operations - Required Reference Material for Train and Engine Crews** **(OPS)**

CHSTP will provide the necessary reference material and employees whose duties are affected shall maintain and have with them while on duty a copy of the following books and publications.
1. The Code of Operating Rules
2. The Safety Rules for their department
3. The Air Brake Instructions, if their duties are affected by them
4. The current Employees Timetable With Special instructions.
5. The current General Orders, Bulletin Orders, Movement Permits, and messages addressed to them.
6. A book of blank forms in order to comply with the Code of Operating Rules.

This material may also be contained in properly protected and controlled electronic media.
CHSTP will periodically test and examine those employees whose duties are affected by the Code of Operating Rules and design, maintain, and administer a program of observations and operational tests to assess rules compliance.

7-01.3 **Operations - Required Reference Material for Railroad Staff other than Train and Engine Employees** **(OPS)**

CHSTP requirements for railroad operating staff, other than train and engine crews shall follow the structure, format, content and process for preparation according to the specifications set out in CHST System Requirement 7-01.2 Required references for Train and Engine Employees

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7-01.4 **Operations - Documentation for Infrastructure Manager’s staff authorizing train movements** **(OPS)**

CHSTP requirements for railroad operating staff authorizing train movements shall CHSTP follow the structure, format, content and process for preparation according to the specifications set out in CHST System Requirement 7-01.2 Required references for Train and Engine Employees

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7-01.5 **Operations - Safety-related communications between train crew, other Railway Undertaking staff and staff authorizing train movements** **(OPS)**

The operating language of CHSTP shall be American English. All safety-related communication between operating employees and the train dispatcher shall be in English.

7-02.1 **Train visibility** **(OPS)**

Trains on CHSTP will be equipped with headlights and marking devices that comply with federal regulations. One end of a locomotive or lead car will be nominally designated as the “front” and marked by the letter “F”.

7-02.2 **Train audibility** **(OPS)**

CHSTP locomotives or lead cars will be equipped with an audible device that can be operated by the head end crew in order to warn of the train’s approach and for other purposes such as signaling.

7-02.3 **Vehicle identification** **(OPS)**

CHST will develop a numbering protocol suitable for high speed equipment as well as on track maintenance equipment.
The initials will be CHST (Must be applied for to AAR)
The equipment will be uniquely numbered on order that
• There is no duplication of numbers
• The numbering scheme will be such that specific number series are used for specific equipment types or unit (coach, club, diner, snack car, etc.) in order to make it easier to identify the composition of the train. To know the equipment number is to know what kind of equipment the number designates.
• The number will consist of five (5) digits.

7-02.4 **Requirements for Passenger vehicles** **(OPS)**

Passenger equipment on CHSTP must be designed and built for safety, speed, and comfort. In full compliance with the Americans with Disability Act and appropriate regulations pertaining to design, safety features, crashworthiness, and survivability. Interior furnishings will be flame retardant and designed for passenger and employee safety through selection of materials, anti-slip features, grab holds, and luggage storage that help prevent slips, trips and falls, flying or falling debris, as well as loose and moving seats.
Equipment will be fitted with suitable emergency exits, assessable from inside or outside the equipment and adequate emergency lighting to handle an evacuation in the dark.

7-02.5 **Train composition** **(OPS)**

CHSTP will publish a standard consist book and equipment register which will include the standard makeup and equipment turns for all CHST regularly scheduled trains. Equipment register will include exterior dimensions and interior configurations, maximum speed, and any particular operating restrictions. CHSTP will assemble this book, update it regularly, and make it available to those employees whose responsibilities include train make-up and control of train movements.
Timetable Special instructions will include any permanent civil restrictions, weight restrictions, and any other technical constraints such as clearances.

7-02.6 **Train braking** **(OPS)**

The braking system shall be capable of stopping the train set within the prevailing signal spacing from its maximum authorized speed under test conditions of adhesion as defined in UIC (Union Internationale de Chemins de Fer) Leaflet 541.05
CHSTP is responsible for ensuring that the train has sufficient braking performance by providing braking rules for its operating employees to follow. All affected employees who operate, inspect, or repair brake equipment shall be furnished with the Air Brake Rules and must pass periodic examinations to qualify and re-qualify.
In the event of an enroute failure of the electric or friction portion of the brake, or both, a train may proceed at a safe speed to be determined and incorporated into the Operating Rules. Locomotive engineers will notify the train dispatcher of any such brake failure
.
The brake system design will allow a disabled train’s pneumatic brakes to be controlled by a rescue locomotive through brake pipe control alone. Timetable Special instructions and the Operating Rules will define the procedure for accomplishing this safely.

7-02.7 **Ensuring that the train is in running order** **(OPS)**

Ensuring that the train is in running order is aimed at the prevention of collisions, derailments and serious

equipment failure that could result in the death or injury of railroad passengers, employees, contractors, or members of the public through a regimen of regular safety tests on safety-critical appliances such as brakes and train control equipment by qualified employees in accordance with current applicable federal regulations and equipment manufacturers' guidelines that might be stricter than the federal regulations and any rule of particular applicability that might pertain to CHSTP. CHSTP System Requirements will incorporate the CFR standards by reference since the CFR goes beyond what is in the TSI.

7-03.2 **Identification of trains** **(OPS)**

CHSTP shall use a definitive method of identification for all trains.

7-03.3 **Train departure** **(OPS)**

A Qualified Maintenance Person (QMP) will perform a Class I Initial Terminal Inspection in each car and an onboard train control signal inspection on each train once each calendar day or every 1500 miles, whichever comes first. Normally, the Class I Test and the on board train signal test are performed as part of the overnight layover before the first run. . A train and engine crew coming on duty must ascertain that the locomotives and the cars have been properly inspected. They will accept the QMP's written inspection report.
No train will leave an initial terminal with less than 100% effective brakes or with cab signals/PTS inoperable. At turnaround locations, where the control of the train is changed from one end to the other, a Class II Test will be performed.

7-03.4 **Traffic management** **(OPS)**

CHSTP will adhere to a Code of Operating Rules developed specifically for California High Speed Train System to insure the safe, efficient, and on time operations in the conduct of transportation. The Operating Rules shall encompass normal operation and operation under various degrees of degradation. Further documentation will be developed and given to each class of employee involved covering the timetable and special instructions, safety rules and practices.

The actual data will be gathered before, during, and after the event and be used to support the following systems:
1. Dispatchers Record of Train Movements
2. Hours of Service Data
3. Operational tests and inspections
4. Public information and train status systems.

7-03.5 **Data recording** **(OPS)**

Vital operating data will be continuously recorded by devices on the equipment and by the signal system software so that vital information regarding a train's operation can be recorded, summarized, archived, and form the basis for further actions as warranted.

7-03.6 **Degraded operation** **(OPS)**

Safety is of the highest importance at all times, but particularly when there is a degraded operation to be dealt with and managed. CHSTP will use safe, reliable, and immediate means of communication to communicate to the appropriate parties the particular circumstances that impede the safety, performance, and availability or environment of the rail network and to issue formal instructions to conductors and engineers of what measures to take in order to overcome the degradation safely.

CHSTP will communicate to its passengers and members of the public the circumstances affecting the performance of trains in a timely, professional manner.

In support of this requirement, CHSTP will develop suitable protocols for call out and notification of employees, contractors, and local authorities for various emergencies. CHSTP will also develop standard operating procedures for various emergencies to call out and guide those employees involved.

7-03.7 **Managing an emergency situation** **(OPS)**

CHSTP will manage emergency situations with the highest regard for passenger, employee, and the public's safety in achieving the objective of loss and damage mitigation and the quickest safe restoration of normal operations. CHSTP is committed to the prompt notification of necessary first responders, CHSTP staff, and regulatory agencies as appropriate, while providing prompt information to affected passengers and the general public of the nature, expected duration, and resolution of the emergency.

7-03.8 **Aid to train crew in the event of an incident or of a major rolling stock malfunction** **(OPS)**

This requirement is covered in 7-03.7 and does not need separate treatment.

7-09 **Operations - Operating rules** **(OPS)**

The rules and procedures shall be identical throughout the CHSTP system where identical situations exist. In areas of joint operations, the CHSTP Code of Operating Rules shall apply.
Employees shall receive training in the theory and the practical application of operating rules, with emphasis on their particular craft or the employees they supervise.
The Code of Operating Rules and the Timetable and Timetable Special Instructions (Route Book) shall apply equally to all crafts and all supervisors engaged in train movements and the conduct of transportation.
Basic qualification for operations employees involves being qualified on the Operating Rules and related documents, being qualified on the physical characteristics of the route on which they operate, supervise or dispatch, and being qualified on the equipment or control apparatus used in the performance of their duties. Operations Employees in the following categories must be initially qualified on the Operating Rules and re-qualified annually.
• Train Dispatchers, Assistant Chief Train Dispatchers
• Train and Engine Service employees and Yardmasters
• Supervisors and managers who directly supervise any of the above employees
Employees must demonstrate their competence with respect to operation in normal and degraded conditions. This competence must be certified (and periodically re-certified) through oral and written examination and through periodic practical exercises or drills.
Employees returning to duty after an absence from railroad service of 180 days or more must attend and pass an operating rules requalification before they perform service that requires operating rules qualification. If the absence from railroad service exceeds 365 days, then the employee must complete a program of requalification as determined by the Rules Department based on the particular employee's needs and circumstances.
The requirement for operating rules qualification applies to those employees performing the functions described above, without reference to particular job title or responsibilities.
Any freight operation on CHSTP lines will be temporally separate from the high-speed passenger operation.

7-11.1 **Operations - Professional competence** **(OPS)**

CHSTP will establish a competence management system for operations employees to ensure that the individual competence of their staff involved is assessed and maintained. Additionally, training shall be provided, as necessary, to ensure that knowledge and skills are kept current, especially in relation to weaknesses or deficiencies in system or individual performance.
Basic qualification for operations employees involves being qualified on the Operating Rules and related documents, being qualified on the physical characteristics of the route on which they operate, supervise or dispatch, and being qualified on the equipment or control apparatus used in the performance of their duties. Operations Employees in the following categories must be initially qualified on the Operating Rules and re-qualified annually.
• Train Dispatchers, Assistant Chief Train Dispatchers
• Train and Engine Service employees and Yardmasters
• Supervisors and managers who directly supervise any of the above employees
Employees must demonstrate their competence with respect to operation in normal and degraded conditions. This competence must be certified (and periodically re-certified) through oral and written examination and through periodic practical exercises or drills.

7-11.2 **Operations - Linguistic competence** **(OPS)**

The CHSTP operating language is North American English. All safety-sensitive communications and mandatory directives will be in English.

7-11.3 **Operations - Initial and ongoing assessment of staff** **(OPS)**

CHSTP is an equal opportunity employer. CHSTP selection and training process must be comprehensive and proven. Where there is proven technology there is proven training that can either be adapted or further refined and improved. Operations selection and training must designed, implemented, and conducted in accordance with applicable federal and state laws. Some operations work assignments require specific competences, skills, and medical clearance. The objective of training is superior safety performance and sustained operational excellence. This is rarely achieved by simply copying what someone else has done, but existing successful programs give CHSTP the opportunity to mirror other property's success and build on that success for even better results. The specific competences relate to a demonstrated proficiency in the Code of Operating Rules, the physical characteristics of the railroad and the ability to operate the machinery or apparati associated with the job assignment. A physical examination will be required of operations employees to assess their general health and physical condition, vision and hearing acuity, and also to measure specific physical competence to perform the job

to which the applicant aspires.
Drug & Alcohol testing shall be a part of the application and employment condition. A drug-free environment is necessary for a safe operation. No employee may use or possess alcohol or any controlled substance while assigned by a railroad to perform service. An applicant and employee must remain drug free to be employed or remain employed.
Remedial or refresher training will be developed and deployed to address any deficiencies in individual or system performance.
Periodic physical examinations and requalification on the Code of Operating Rules and Physical Characteristics are required. In particular, for those staff undertaking the task of [operating] a train, re-assessment of competence shall be undertaken at least on an annual basis. In the case of a locomotive engineer, the engineer shall be given at least one unannounced operational monitoring observation by a qualified supervisor of locomotive engineers semi-annually.

7-12 **Operations - Health and Safety Conditions** **(OPS)**

This section is redundant and is covered in 7-13 OPS—Health and Safety Conditions. See 7-13.

7-12.1 **Operations - Introduction** **(OPS)**

This requirement has been incorporated into 7-12.2 Operations—Recommended Criteria for Approval of Occupational Doctors and Medical Organizations.

7-12.2 **Operations - Recommended criteria for approval of occupational doctors and medical organizations** **(OPS)**

Staff performing safety critical tasks must have the appropriate fitness to perform those tasks safely.
CHSTP shall set up and document the process that is put in place to meet the medical, psychological and health requirements for their staff within their Safety Management System.
Staff must not perform safety critical work while vigilance is impaired by substances such as alcohol, drugs or psychotropic medication.
CHSTP shall have procedures in place to control the risk that staff report for duty or perform service under the influence of such substances, or consume such substances while on duty.

7-12.3 **Operations - Criteria for approval of psychologists involved in psychological assessment and psychological assessment** **(OPS)**

Psychologists involved in psychological assessment must be certified and recognized by the State of California.

7-12.4 **Operations - Medical examinations and psychological assessments** **(OPS)**

Employees in the following classes must satisfactorily pass a pre-employment and regular or special periodic physical examination: Train and Engine Service, Assistant Chief Dispatchers, Train Dispatchers, Load Dispatchers, Power Directors and employees who operate self-propelled on track vehicles and others who may be directed by their immediate supervisors. All pre-employment, periodic, and special physicals shall include a drug screen.
Periodic examinations are required as follows:
Locomotive Engineers: Annually regardless of age
All Others mentioned above: Every three (3) years, until age 50
Every two (2) years, age 50-59
Annually—age 60 and older
Employees who have not performed service as a result of furlough, illness, accident or injury are subject to a special periodical medical examination according to the judgment of the Medical Department.
Employees must notify the railroad's Medical Department of any condition not already on record with the railroad which could impair their ability to perform their duties. This notification is to be made immediately upon the employee receiving knowledge of the condition and is not limited to conditions discovered in required physical examinations.

7-12.5 **Operations - Medical requirements** **(OPS)**

CHSTP will develop, implement, and maintain suitable medical criteria relating to vision and hearing that are relevant to the specific job so that employees are sufficiently physically fit to perform their job duties safely

7-12.6 **Operations - Specific requirements regarding the task of driving a train** **(OPS)**

Locomotive engineers shall take a periodic physical annually, regardless of age. The annual physical examination shall include those specified by regulation (49 CFR 240) for the certification of engineers and other tests such as

electrocardiogram (EKG). A locomotive engineer is also subject to anthropometric evaluation in order to insure that the engineer can physically perform the job tasks without incurring injury.
CHSTP will offer peer support and formal counseling to any locomotive engineer involved in a traumatizing accident involving death or serious injury.

7-13 **Operations - Health and safety conditions** **(OPS)**

Staff performing safety critical tasks defined as Covered Service in accordance with 49 CFR 219 must have appropriate fitness to ensure that overall operational and safety standards are met.

CHSTP shall set up and document the process they put in place to meet the medical, psychological and health requirements for their staff within their Safety Management System.

Medical examinations and any associated decisions on the individual fitness of staff must be conducted by a recognized occupational doctor licensed to practice in the State of California

Staff must not perform safety critical work while vigilance is impaired by substances such as alcohol, drugs or psychotropic medication. Therefore, CHSTP shall have procedures in place in accordance with 49 CFR 219 to control the risk that staff work under the influence of such substances, or consume such substances at work.

8-01 **TCC safety characteristics relevant to interoperability** **(TCC)**

This Basic Parameter describes the safety requirements for the ATC On-board assemblies and the safety requirements on wayside assemblies.
With reference to the Essential Requirement ‘safety’ (see section 3.2.1, Safety), this Basic Parameter establishes the mandatory requirements for interoperability:
•□To ensure that the solutions to achieve safety do not jeopardise interoperability the requirements of TSI 2006/860/EC Annex A, Index 47 shall be respected.
•□For the safety related part of one On board Assembly as well as for one wayside Assembly, the safety requirement for the ATC system is: tolerable hazard rate (THR) of 10E-9/hour (for random failures) corresponding to Safety Integrity Level 4. The detailed requirements for Class A equipment are specified in Annex A, Index 27. Less restrictive safety requirements on THR values for wayside equipment may be adopted, provided that the safety objective for the service is met.
•□The reliability and availability requirements of TSI 2006/860/EC Annex A, index 28 shall be respected

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8-02 **On-board ATC functionality** **(TCC)**

The relative TSI is written to describe the on-board subsystem requirements for a train control system complying with the ERTMS/ATC system. The CHTSP train control system will demonstrate functional requirements similar to ERTMS but the System requirements are being written without specifying an ERTMS system. It is understood that an ERTMS system may eventually be proposed and accepted. The train control system is being described as an Automatic Train Control (ATC) system. ATC includes all functions of a train control system including safety critical and non-safety critical. The functions of Positive Train Control are an integral part of the ATC system.

This Basic Parameter describes the ATC on-board functionality. It contains all ATC functionality to establish and continuously supervise a specific train movement along a safe path established by the wayside ATC subsystem. The performance of the functions shall conform to the requirements of the CHSTP ATC Performance Specification. These functions shall be implemented in accordance with the CHSTP ATC Functional Requirement Specification and in compliance with the CHSTP Systems Design Manual and in compliance with all relevant parts of 49CFR Part 236. On-board functionality of the ATC system shall include the following elements:
—□Communicating with the ATC trackside and wayside mounted equipment may include;
o□Transponder (Eurobalise or other)
o□Track circuit conveyed signals in the form of coded information transmitted in the running rails of a track circuit occupied by a specific train
o□Radio transmission from wayside and remote mounted antennas.
—□Communicating information and alarms to the Train Operator via the Operator’s display(s)
—□Provision of Automatic Train Protection (ATP) functions
o□Locating the train in the database coordinate system which is used as the basis for supervising the dynamic speed profile
o□Ensuring the on-board database is the correct one and modifying it correctly with temporary limits transmitted from the wayside and updating the database when permanent updates are transmitted from the wayside.
o□Calculating the dynamic speed profile from the trains present position to its limit of movement authority
o□Supervising the dynamic speed profile continuously
o□Correctly selecting the mode of operation
o□Providing the necessary intervention actions in accordance with the status of the speed supervision function

o Providing the necessary intervention actions in accordance with the status of commands sent from the wayside ATC system in response to the interfaced defect sensors including seismic activity, intrusion, excessive wind speed, landslide, flood, excessive rainfall, etc. detectors
o Supervising berthing of trains at station platforms and ensuring right-side door operation
o Correctly establishing the train dynamic and static characteristics
— Provision of Automatic Train Operation (ATO) Functions;
o Interfacing with propulsion and brake subsystems on the rolling stock to control train movement along the right of way subject to station stop schedule, main line to and from yard moves, subject at all time to the ATP limits of the movement authority.
o Adjusting acceleration and braking rates, and speeds in response to commands from the wayside system to meet schedule regulation requirements
— ATC and train equipment health monitoring and reporting to the ATC wayside and central; includes interfacing to on-board non-ATC subsystems to transmit subsystem health data to the wayside and central.
— Degraded mode operations support including:
o Initializing the on-board ATC functionality
o Providing degraded mode operations when selected by external input
o Isolating on-board ATC functionality when selected by external input
— Supporting data recording for regulatory purposes
— Supporting data recording and transmittal to the wayside for maintenance purposes
— Forwarding information and commands to the Operator Displays and to train subsystems as required including:
o Opening and closing ventilation flaps
o Raising and lowering the pantograph(s)
o Opening and closing the main power switch
— Interfacing with defect sensors on the rolling stock and conveying alarms and events to central control and correctly responding with an ATC intervention where required (emergency brake application, service brake application, etc.)

8-03 **Wayside ATC functionality** **(TCC)**

The relative TSI is written to describe the requirements for a train control system complying with the ERTMS/ATC system. The CHSTP train control system will demonstrate functional requirements similar to ERTMS but the System requirements are being written without specifying an ERTMS system. It is understood that an ERTMS system may eventually be proposed and accepted. The train control system is being described as an Automatic Train Control (ATC) system. ATC includes all functions of a train control system including safety critical and non-safety critical. The functions of Positive Train Control are an integral part of the ATC system.

This Basic Parameter describes the ATC wayside functionality. It contains all ATC functionality to provide a safe path to a specific train. The performance of the functions shall conform to the requirements of the CHSTP ATC Performance Specification. These functions shall be implemented in accordance with the CHSTP ATC Functional Requirement Specification and in compliance with the CHSTP Systems Design Manual and in compliance with all relevant parts of 49CFR Part 236. Wayside functionality of the ATC system shall include the following elements:
— Route setting and locking by means of interlocking functions
— Positive Train Control (PTC) functions enforcing speed limits, train separation, compliance with route limits, and protection of roadway workers on or about the tracks
— Communication with track-side signaling equipment including interlockings, wayside signals and, track circuits
— Communication with wayside defect detectors (where provided) including hot box, dragging equipment, landslides, seismic activity, intrusion, excessive wind speed, flood, excessive rain etc.
— Locating a specific train in a database co-ordination system
— Translating the status information received from wayside signaling equipment into a standard format for the ATC On-board Assembly.
— Generating movement authorities including track description, speed limits (permanent and temporary), and orders assigned to a specific train.
— Communicating with the Control-Command On-board Assembly. This includes:
— Transponder (Eurobalise or similar) transmission. See SR 8-07.4.
— Safety critical Wayside ATC zone controller communication by radio or by coded track circuit to include temporary and permanent database updates
— Non-safety critical information Wayside ATC zone controller communication by radio.
— Communicating with the Automatic Train Supervision system to facilitate route setting and other supervision functions, alarm and event notification, schedule regulation, and subsystem maintenance functions.

8-04 **ATC, Voice and Other Data Radio Subsystem Functions** **(TCC)**

A Wireless Radio Communication System that shall ensure and guarantee train operator/driver radio voice and data communication for train control and other subsystems.

8-05 **ATC radio air gap interfaces** **(TCC)**

The air gap interfaces between the wayside and on-board radios, the wayside transponders and the on-board antennas, and the track circuit transmissions and the on-board pick-up antennas shall be specified so as to fully support the functional and performance requirements of the CHST system.

8-06 **On-Board Interfaces Internal to TCC** **(TCC)**

This Basic Parameter consist of three parts which are covered in 8.06.1, 8.06.2, and 8.06.3

8-06.2 **ATC Data Radio** **(TCC)**

The interface between the voice and data radio and the on-board ATC functions shall fully support the functional and performance requirements of the CHST system.

8-06.3 **Odometry** **(TCC)**

The interface between the odometry function and the ATC on-board subsystem shall meet the relevant availability, reliability, and accuracy requirements of the ATC system. Rolling stock shall provide the necessary mounting locations and cables between the sensor equipment and the on-board ATC package location as defined by the interface. Where rolling stock supplied odometry sensors are used for ATC purposes, they shall also meet the availability, reliability, and accuracy requirements of the ATC system. Where odometry sensors are supplied by the ATC contractor, they shall be compatible with the environmental parameters of the mounting locations on the rolling stock.

8-07 **Trackside Interfaces Internal to TCC** **(TCC)**

The ATC wayside system elements shall interface to other ATC elements as described in SR 8-07.1 through SR 8-07.6 inclusive.

8-07.1 **Functional interface between RBCs** **(TCC)**

The train control system is being described as an Automatic Train Control (ATC) system. ATC includes all functions of a train control system including safety critical and non-safety critical elements. In the event that a radio based ATC system is implemented, (ERTMS or similar), the functional interfaces between adjacent RBCs, or equivalent, shall ensure that data to be exchanged between neighboring RBCs shall be able to handle the transition of a train from one RBC area to another in a safe manner.

The ATC system shall manage in this manner:
— Information from the ‘Handing Over’ RBC to the ‘Accepting’ RBC
— Information from the ‘Accepting’ RBC to the ‘Handing Over’ RBC

8-07.2 **Technical interface between RBCs** **(TCC)**

The train control system is being described as an Automatic Train Control (ATC) system. ATC includes all functions and technical requirements of a train control system including safety critical and non-safety critical elements. In the event that a radio based ATC system is implemented, (ERTMS or similar), the technical interfaces between adjacent RBCs, or equivalent, shall ensure that data to be exchanged between neighboring RBCs shall be able to handle the transition of a train from one RBC area to another in a safe manner.

8-07.3 **ATC Radio Block Controlling** **(TCC)**

The train control system is being described as an Automatic Train Control (ATC) system. ATC includes all functions and technical requirements of a train control system including safety critical and non-safety critical elements. In the event that a radio based ATC system is implemented, (ERTMS or similar), the interfaces between the wayside radio and the wayside ATC functions shall be determined by the detail designer but shall generally comply with the requirements of the relevant UNISIG specifications.

8-07.4 **Eurobalise/LEU** **(TCC)**

The CHST ATC may use the Eurobalise or a similar transponder in its signal system. The ATC transponder shall contain data that shall be able to be read in a secure fashion by the transponder antenna mounted on the rolling stock. The transponder size and data transfer rate shall be compatible with the maximum design speed of 250 MPH.

8-07.5 **Euroloop/LEU** **(TCC)**

Euroloops will not be specified. This particular System Requirement for an interface between the Loop and the Lineside Electronic Unit (LEU) is Not Applicable

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8-07.6 **Requirements on pre-fitting of ATC wayside equipment** **(TCC)**

The CHSTP Automatic Train Control system (ATC) includes all functions and technical requirements of a train control system including safety critical and non-safety critical elements. The ATC specifications are functional and performance based set of requirements; as such the wayside ATC elements are integral and a specific interface between different ATC elements to be developed by the system supplier so as to meet the defined system functional and performance (including safety) requirements. Furthermore, the ATC system shall be implemented as a complete system and pre-fitting does not require a definition.

8-08 **ATC Key Management** **(TCC)**

This Basic Parameter concerns the safety-related data transmitted via radio, in the event that a radio based ATC system is implemented, that must be protected by mechanisms that need cryptographic keys. A management system shall be implemented that controls and manages the keys.

The FRA regulations concerning design, maintenance, and distribution of cryptographic keys shall be conformed with.

8-09 **ATC-ID Management** **(TCC)**

The ATC subsystem shall incorporate a function whereby unique identities are assigned for all of the wayside and on-board assemblies. The details of the scheme, including the actual identities, shall be proposed by the subsystem designer and approved by CHSTP.

8-10 **HABD (Hot axle box detector)** **(TCC)**

This requirement defines the requirements on trackside components of Hot Axle Box Detection Systems (HABD) and deals only with the Class A system. Rolling stock concerned are those which are intended to be used on 1435mm (4.708") track gauge. Vehicles equipped with onboard hot wheelset bearing detection and shielded against trackside hot wheelset bearing detection need therefore not to be considered here.

The target area is defined as that surface of the wheelset bearing box which has a temperature related to the axle bearing temperature and is completely visible for vertical trackside scanning.

The target area of vehicles is described by transverse and longitudinal dimensions. The target area is therefore defined as a
characteristic of rolling stock and is originally defined in vehicle-side co-ordinates.

The scanning range is as a characteristic of the HABD System and its mounting and originally defined in track-side coordinates.

Target area (rolling stock) and scanning range (HABD) are interfacing each other and have to overlap.

Figure a) (see TSI document) gives an overview and shows details for the following definitions.

SCANNING RANGE (HABD) AND TARGET AREA (ROLLING STOCK) IN TRANSVERSE DIRECTION
HABD Systems shall have a scanning range being able to measure a hot target area of 50mm within de1 = 1 040mm to de2
= 1 120mm related to the centre-line of the vehicle at a height above top of rail between h1 = 260 mm and h2 = 500 mm
(minimum range).

SCANNING RANGE (HABD) AND TARGET AREA (ROLLING STOCK) IN LONGITUDINAL DIRECTION
HABD-System shall measure axle boxes in a longitudinal scanning range corresponding with longitudinal target area dimensions from 80 mm up to 130 mm in the velocity range from 3 km/h up to 330 km/h.

For higher speeds the values will have to be defined when necessary.

MOUNTING DIMENSIONS IN THE TRACK
The centre of the detection area of the HABD shall be mounted at a distance from the track centre line which

guarantees the
given scanning ranges.

A vertical scanning is highly recommended.

ALARM-TYPES AND -LIMITS
The HABD shall build the following alarm-types:
— hot-alarm
— warm-alarm
— difference-alarm or other type of alarm

According to annex C
— the values for alarm limits have to be stated in the infrastructure register,
— the corresponding rolling stock side axle box surface temperatures have to be stated in the rolling stock register.

In case future track-side equipment is able to safely identify the train according to its temperature limits, a automatic adjustment of the alarm limits could be performed.

8-11 **Compatibility with Wayside Train Detection Systems** **(TCC)**

The ATC wayside train detection subsystem(s) shall be compatible with the rolling stock and with the requirement to detect broken rails.

8-12.1 **Internal TCC Electromagnetic compatibility** **(TCC)**

Control equipment shall not interfere with other Control equipment.

8-12.2 **Electromagnetic Compatibility between Rolling Stock and Control-Command Track-side equipment** **(TCC)**

These requirements cover electromagnetic immunity limits (conducted and induced traction current and other train originated currents, radiated electric and magnetic fields, as well as static fields) to be respected by rolling stock, to ensure correct functioning of the wayside Train Control and Communications (TCC) equipment. It includes the procedures for measuring the values.
The electromagnetic immunity characteristics of the wayside equipment selected for CHST use must be documented and converted into corresponding emission limits for rolling stock. The rolling stock must be tested and demonstrated to conform to the emission limits.

8-13 **ATC DMI (Driver Machine Interface)** **(TCC)**

The human machine interface (HMI) for ATC shall be developed to effectively display ATC functions and interactive controls device using ergonomic considerations.

8-14 **ATC and Voice Radio DMI (Driver Machine Interface)** **(TCC)**

The human machine interface (HMI) for ATC and Voice Radio functions shall be developed to effectively display the radio functions and interactive controls using ergonomic considerations. The HMI shall also comply with 49 CFR Part 236, Appendix E.

8-15 **Interface to Data Recording for Regulatory Purposes** **(TCC)**

The ATC system shall send data to recorders on the wayside, at central control, and on-board from the respective ATC subsystems in compliance with the CFR.

8-16 **Visibility of wayside TCC objects** **(TCC)**

This Basic Parameter is split into two parts.
SR 8-16.1 covers Wayside Signals and SR 8-16.2 covers Wayside Signs. The requirements are covered in these two System Requirements.

8-16.1 **Wayside Signals** **(TCC)**

This requirement concerns the visibility of wayside signals installed along the right-of-way for Train Control purposes

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8-16.2 **Wayside Signs** **(TCC)**

This requirement concerns the visibility of retro-reflective signs installed along the right-of-way for Train Control purposes

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8-18.12 **Odometry** **(TCC)**

The interface between the odometry function and the ATC on-board subsystem shall meet the relevant availability, reliability, and accuracy requirements of the ATC system. Rolling stock shall provide the necessary mounting locations and cables between the sensor equipment and the on-board ATC package location as defined by the interface. Where rolling stock supplied odometry sensors are used for ATC purposes, they shall also meet the availability, reliability, and accuracy requirements of the ATC system. Where odometry sensors are supplied by the ATC contractor, they shall be compatible with the environmental parameters of the mounting locations on the rolling stock

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8-18.13 **Interface to data recording for regulatory purposes** **(TCC)**

Description of interfaces held in database

The on-board ATC subsystem shall interface to the on-board data and event recorders and be in compliance with 49 CFR Parts 229.135 and 236 Subpart I.

8-18.14 **On-Board Pre-Fitting** **(TCC)**

Rolling stock will be specified with space, power, mechanical, electrical, and logical interfaces that will allow the installation of ATC on-board equipment with a minimum of modification to the rolling stock or the ATC equipment. ATC equipment, functions and performance shall be specified with rolling stock interface requirements that match the provisions of the Rolling Stock specifications covering these interfaces.

8-18.15 **Driver's External Field of View** **(TCC)**

Description of interfaces held in database
This requirement covered in its entirety by TCC SR 8-16.2 & RS SR 5-02.6

8-18.16 **Automatic Train Operation and Emergency Brake interfaces** **(TCC)**

This interface to the Rolling Stock subsystem describes the Train Control and Communications Subsystem functionality:

—To command the closing or opening of the air flaps as required by Rolling Stock for pressure maintaining when entering and leaving tunnels.
—To command to open and close the main power switch as required by Traction Power and OCS.

This is an interface to rolling stock as part of the on-board and wayside ATC functionality covered by SR 8-02 and SR 8-03.

8-18.3 **Guaranteed train braking performance and characteristics** **(TCC)**

The ATC system requires a Safe Braking Model (SBM) for each type of train that can operate on the CHST system that is equipped with an on-board ATC subsystem and is subject to ATC enforcement. This includes CHST passenger trains of variable consists, and maintenance trains that are equipped with CHST-compatible ATC. Non-ATC-equipped maintenance trains and failed-equipped trains will operate under rule and procedures to mitigate hazards.
The ATC system requires a guaranteed train braking performance with a specified level of worst case wheel-rail adhesion. SR 5-04.1; RST Minimum Braking Performance defines minimum braking performance levels. The Rolling Stock (RS) sub-system shall confirm the braking performance of the selected rolling stock equipment permitted to operate on CHSTP conforms with the SBM including brake rates, build up times, variation in rate application versus time and train speed, spin slide control parameters, and an agreed level of degradation of braking effort due to failure(s) within the braking system. Guaranteed braking performance shall be determined for both passenger trains and maintenance trains that are equipped with the on-board ATC subsystem. Acceleration and other functional elements of the Rolling Stock will be taken into consideration in the SBM. The safe braking characteristics of the ATC subsystem shall be defined in the SBM.
Non-CHSTP rolling stock operating on shared tracks must also comply with guaranteed train braking performance and other characteristics specified in the SBM for that specific rolling stock.
SBM shall also take account of the service brake performance of the selected Rolling Stock.

Management of the safety critical interface between ATC and Rolling stock will be defined in detail by the CHST System Safety Program Plan. The SBM shall be documented and updated as the detailed design is progressed and for each modification to subsystems that impact the SBM. Coordination and concurrence with the Rolling Stock subsystem shall also be documented for each release of the SBM document.

8-18.4 **Position of TCC antennas** **(TCC)**

Description of interfaces held in database

The position of all antennas on the rolling stock including ATC data radio, ATC balise readers, and voice and other data radio, shall be such that reliable communication is assured at the extremes of the track geometry and route geography that the rolling stock traverses. The movement and dynamic and static behavior of the rolling stock shall be taken into account. The communication systems performance shall fully support the functionality and performance requirements of the on-board ATC subsystem, the voice communication subsystem, and the other subsystem data communications.

8-18.5 **Physical environmental conditions for TCC equipment** **(TCC)**

The climatic and physical environmental conditions of TCC (ATC and communications subsystems) equipment installed at the wayside shall comply with AREMA C&S Manual of Recommended Practices and the relevant portions of EN 50125-3. In the event that the requirements are in conflict, the more arduous and restrictive conditions shall apply.

The climatic and physical environmental conditions of TCC (ATC and communications subsystems) equipment installed on-board passenger and works trains shall comply with EN 50125-1.

8-18.6 **Electromagnetic Compatibility between Rolling Stock and TCC On-Board equipment** **(TCC)**

Description of interfaces held in database

Onboard Train Control and Communication equipment and rolling stock equipment shall not interfere with each other.

8-18.7 **Isolation of On-Board ATC functionality** **(TCC)**

Description of interfaces held in database

It shall be possible to move the train, after ATC is isolated, without ATC intervention.

Speed limit enforcement shall be the responsibility of the Rolling Stock subsystems when on-board ATC is isolated.

8-18.8 **Data Interfaces** **(TCC)**

The data interface requirements between the ATC subsystem and the Rolling Stock subsystem shall be implemented generally as per the UNISEG SUBSET-034 specification.
The data interfaces between the radio communications and the Rolling Stock Subsystem shall be implemented generally as per the EIRENE SRS GSM-R Systems Requirements Specification.

8-19.1 **Interfaces to Subsystem Infrastructure – Train Detection Systems** **(TCC)**

The infrastructure, including track construction, rail fastening systems, direction fixation, and ballast materials installation must support the requirements necessary to ensure the proper operation of train detection systems including track circuits and (if provided) axle counters.

8-19.2 **Wayside TCC Equipment** **(TCC)**

Wayside TCC communications equipment (balises, loops, etc.) must be located so that reliable data communications is assured at the extremes of the track geometry taking into account the motion and behavior of the rolling stock.

The positioning of wayside TCC equipment including balises, signals, marker boards, signs, enclosures, switch machines, etc. must comply with the limits imposed by the minimum infrastructure gauge.

8-22 **TCC - Maintenance rules** **(TCC)**

Maintenance Rules and Procedures shall be developed and implemented such that they ensure that the Automatic Train Control (ATC) system parameters are maintained within their design limits throughout the lifetime of the system.

While corrective and preventive maintenance is being conducted, and the ATC system might be unable to perform its full functions, the rules and procedures shall ensure that safety is not prejudiced during those maintenance activities.

The following shall be respected:

a) Responsibility of Manufacturers of Equipment
The manufacturer of ATC subsystem equipment shall specify:
— All maintenance requirements and procedures (including supervision of troubleshooting, diagnostic and test methods and tools) necessary for the achievement of essential requirements and values of the ATC subsystem during the whole equipment life-cycle (transport and storage before installation, normal operation, failures, repair actions, verifications and maintenance interventions, decommissioning etc.)
— All the health and safety risks that may affect the maintenance staff, passengers and third parties
— The conditions for first line maintenance (i.e. the definition of Line Replaceable Units (LRUs), the definition of approved compatible versions of Hardware and Software, the substitution of failed LRUs, and conditions for storage of LRUs and for the repair of failed LRUs
— The technical conditions for running a train with failed equipment to its terminal or to the workshop (degraded mode with functions partially or fully isolated).
— The verifications to be performed in case equipment is subject to exceptional stress (e.g., exceeding of environmental conditions including shock and vibration).

b) Responsibility of Contractors
Contractors shall:
— Ensure that, for all ATC subsystem components supplied as part of their respective contract, the maintenance requirements as described above for the manufacturers of equipment are defined as part of the contract.
— Set up the necessary maintenance rules relevant for all ATC subsystem components taking account of risks due to interactions of different equipment inside the subsystem and interfaces to other sub-systems.

c) Responsibility of the Authority
The Authority (or its Operating and Maintenance Contractor) shall establish an ATC Maintenance Plan as defined in d) below.

d) Maintenance plan
The maintenance plan shall be based on the provisions specified above in section 4.5.1 (Responsibility of manufacturers of equipment), section 4.5.2 (Responsibility of Contractors) and section 4.5.3 (Responsibility of the Authority) and address at a minimum, the following:
— Conditions for the use of equipment, according to the requirements indicated by the manufacturers.
— Specification of the maintenance programs (e.g. definition of preventive and corrective maintenance categories, maximum time between preventive maintenance actions and corresponding precautions to be taken for the safety of the Subsystem and of the maintenance staff, considering interference of maintenance actions with the operation of the ATC Subsystem).
— Requirements for the storage of spare parts.
— Definition of first line maintenance.
— Rules for the management of failed equipment.
— Requirements related to the minimum professional competences of maintenance staff, with reference to the risks for health and safety.
— Requirements related to personal protective equipment.
— Definition of responsibilities and authorization of maintenance staff (e.g., for access to equipment, management of limitations and/or interruptions of system operation, replacement of LRUs, repair of failed LRUs, testing requirements, and the placing of repaired and restored equipment back into normal system operation).
— Procedures for the management of ATC equipment-identities. See SR 8-09 (ATC-ID Management).
— Methods for reporting information on safety-critical defects and frequent system failures to the manufacturers of equipment.

8-23 **TCC - Professional competences** **(TCC)**

This requirement relates to train control and communications employees, normally considered part of the Communications and Signals group within the Infrastructure department whose duties include installing, maintaining, repairing, modifying, inspecting, and testing safety-critical elements of the railroads' products, including central office, wayside, and on-board subsystems
For similar requirements pertaining to train dispatchers and other operating employees, see OPS 7-11

For similar requirements pertaining to maintenance of equipment employees, see OPS 5-14.42

CHSTP will establish a competence management system for train control and communications employees (TCC) to ensure that the individual competence of their staff involved is assessed and maintained. Additionally, training shall be provided, as necessary, to ensure that knowledge and skills are kept current, especially in relation to weaknesses or deficiencies in system or individual performance.

Basic qualification for TCC employees performing the duties of a Signal Maintainer and their direct supervisors involves being qualified on the Operating Rules and related documents, being qualified on the physical characteristics of the route on which they work, and being qualified on the appliances used in the performance of their duties. They shall receive training for their specific duties and must demonstrate the necessary knowledge and skills to effectively complete their duties with respect to processor based signal and train control equipment. Employees must demonstrate their competence with respect to operation in normal and degraded conditions. Rules competence must be certified (and annually re-certified) through oral and written examination.

8-24 **TCC - Health and safety conditions** **(OPS)**

The ATC system design and implementation shall reflect suitable precautions to ensure health and safety for the instillation, operations and maintenance staff. In compliance with applicable federal and state regulations, including OSHA. When the control system is under testing or repair so that the safety of employees and trains which depend on the normal functioning of the signal devices must not be compromised. Persons working on or near the tracks will wear high-visibility clothing.

8-25 **Yard Train Control (TC)** **(TCC)**

Yard tracks shall be equipped with a signal system including track circuits or axle counters, wayside signals, power switch machines, and interlocking functions that shall control train movements within Yard limits. Power operated derails may be required to enforce safe movements and blue flag protection.

PTC functionality is not required in a yard, safety of train movements shall be assured by means of wayside signals, power-operated derails, operating rules, and procedures. Blue flag protection for workers in the yards shall be achieved through the use of power operated derails and/or switches on inspection tracks being lined and locked away from the tracks on which inspections are taking place. Protection against trains entering the main track from the yard without proper ATC authority shall also be enforced, possibly by power-operated derails at the turnout from the Departure Lead track to the main line.

Train location shall be detected by means of track circuits. Other train detection systems such as axle counters may be used in addition to, or as an alternative to, track circuits.

Wayside signals shall be controlled by the interlocking equipment so as to provide visual indication of the status of routes through switches and occupation of layup tracks to the train Engineers. Fixed wayside signs may also be used for indications to Engineers of key locations within lay-up tracks.

Control and supervision of the yard signal system shall be through a dedicated yard control workstation/facility.

Yard tracks shall be separated from main line tracks by means of Departure Lead tracks. Train movements between the Departure Lead track and mainline tracks shall be under the control of the ATC system. Train movement between the yard tracks and the Departure Lead tracks shall be under the control of the yard signal system.

Maximum speed in the yard shall be enforced by the on-board ATC subsystem.

8-26 **Automatic Train Control (ATC) Centralized Control (ATC-ATS)** **(TCC)**

The CAHST centralized control and supervision (Automatic Train Supervision (ATS) functions will be implemented by the office subsystem. ATS functionality, subsystem performance, and hardware requirements will be specified as part of the ATC system. Many of the functions of ATS; including automatic dispatching of trains and routing through interlockings and terminals, and schedule regulation, will be accomplished automatically with manual intervention required only in the event of equipment failures and other unplanned occurrences.
The ATS prime location will be in a central Operations Control Center (OCC) with remote workstations at other locations such as Regional Control Centers (RCCs), terminals, and stations that will allow for geographical distribution of dispatching functions. Availability requirements may dictate that the ATS office subsystem core equipment, including communications and database servers, be distributed between the OCC, Regional Centers, and possibly other sites with options for cold, warm, and hot standby of the back-up systems. In certain emergencies and failure scenarios, the control of any interlocking can be taken from any of the OCC and RCCs. Temporary speed restrictions will be entered through the ATS into the Positive Train Control portion of the ATC

system for enforcement by the on-board portion of the ATC at the OCC or the RCC controlling the portion of the track on which the temporary speed restriction is to be effective.
Under degraded operation, switch and signal commands can be made using local control panels in station control rooms and in the ATC equipment houses. Although local control facilities will be specified for the ATC in the stations, the anticipated reliability and availability requirements of the communications subsystem makes the loss of control from the ATS (and therefore the OCC and RCCs) highly unlikely.
Degraded mode operations will also include an automatic field-fallback mode for the emergency (universal crossover) interlockings in which they will revert to through routes being cleared and fleeted in the event of a loss of communications with the ATS. A local control panel in each interlocking equipment house will also be provided for emergencies and for maintenance related testing needs.
There will be a local tower for each yard with controls and displays allowing manual route setting for trains within the yard tracks and shops. Handover of trains between the main lines and the yard tracks will be accomplished with an interface between the Yard control system and the ATS system or by means of a remote ATS workstation which may also be located within the Yard towers.

8-27 **ATC - Operating Modes - Main Line** **(TCC)**

The ATC system shall be implemented so as to support the following operating modes:

-□ATC Manual; Trains are operated by the Engineer under safety supervision of the ATC Automatic Train Protection (ATP) functions. Positive Train Control functions are fully active in this mode.
-□ATC Automatic Train Operation (ATO); Trains are under supervision of the ATC ATP functions, power and brake applications are commanded by the ATO automatic driving functions of the on-board ATC subsystem.
-□Restricted Manual; Trains are operated by the Engineer subject to a maximum speed of 20 MPH supervised and enforced by the on-board ATC subsystem.
-□Yard; Trains are operated by the Engineer subject to a maximum Yard speed supervised and enforced by the on-board ATC subsystem. Train movements within the yard limits will be authorized by visual wayside signals. Transitions from Yard to ATC shall be automatic upon arrival at the Departure Lead track (when departing the Yard for the main line).
-□ATC Bypass; Trains are operated by the Engineer subject to a maximum speed of 59 MPH (as per 49CFR 236 Subpart I) supervised by a Rolling Stock propulsion governor function.

8-28 **Degraded Mode Wayside Signal Control** **(TCC)**

The Automatic Train Control (ATC) system shall be implemented with a minimum number of wayside signals so as to support degraded modes of operation in the event of failures of the ATC subsystems and components for main line operations.

Wayside signals shall be provided in interlocking areas governing train movement through switches and crossings.

Train location shall be detected by means of track circuits. Other train detection systems such as axle counters may be used in addition to track circuits.

Wayside signals shall be connected to the interlocking equipment so as to provide visual indication to the locomotive engineers of trains not operating in ATC Manual and ATC ATO modes, of route status through switches and crossings. When ATC trains are operating in ATC Manual and ATC ATO Modes, the same signals may display a dedicated ATC aspect.

8-29 **Interlocking Functions** **(TCC)**

Interlocking functions shall be implemented in accordance with the Federal Railroad Administration (FRA) regulations 49CFR236 Subparts A through I, except as specifically approved by the Rule of Particular Applicability from the FRA.
