CHAPTER VII

REQUIREMENTS OF SIGNALLING

SECTION 'A'

Signals, Generally

7.1. **Location of Signals.**—

7.1.1. Signals shall be so located and aligned as to

(a) display the best possible view of their aspects to Drivers of approaching trains,

(b) to avoid, as far as possible the possibility of the aspect of one signal being mistaken for the aspect of another, and

(c) avoid confusion between the lights of running signals and the lights of subsidiary signals or any other lights.

7.1.2. Signals shall normally be on the left of, or above the line to which they apply, unless authorised by special instructions to the contrary.

7.2. **Size of Lenses.**—The lenses of subsidiary signals shall be of smaller diameter than those of running signals. Subsidiary signals shall not be brighter than running signals.

7.3. **Number of Signals and height.**—The number of signals and their height shall be limited to what is necessary for Safety and operational requirements.

7.4. **Outside interference.**—All apparatus shall be so designed, located and secured as to obviate, as far as possible, outside interference.

7.5. Signals **controlled through slots or disengagers.**—Where a signal is controlled through slots or disengagers, it shall not be possible to take 'off' a signal unless all the controls have been exercised by the controlling agencies. It shall be possible for any one of the controlling agencies to replace the signal to 'ON' position by withdrawal of the control.

7.6. **Standard and type of Signalling on a section.**—It is desirable that the signalling at all block station and interlocked level crossings in the same section conform to the same standard and type.

7.7. **Visibility.**—The minimum visibility distance of various signals shall be as under —

Two Aspect Signals .—

7.7.1. **Outer Signal.**—1200 metres in sections where sectional speed is 100 Kilometres per hour and above. 800 metres where sectional speed is less than 100 Kilometres per hour. Where minimum visibility as above cannot be achieved, warner may be separated. With the warner separated, minimum visibility of outer shall not be less than 400 metres.

7.7.2. Warner Signal on a post by itself	400	Metres
7.7.3. Home Signal	400	,,
7.7.4. Main Starter Signals	400	,,
7.7.5. All other Signals	200	,,

Note.—Where adequate visibility of Stop Signals cannot be provided, repeater or co-acting signals shall be provided to ensure the combined visibility or speed restrictions imposed.

Multiple Aspect Signals.—

7.7.6. **Distant Signal.**—400 Metres. An inner Distant Signal where provided, shall be visible from a minimum distance of 200 metres.

7.7.7. **All Stop Signals.**—200 metres. If it is not possible to ensure 200 metres continuous visibility of any stop Signal while approaching it, a suitable speed restriction shall be imposed.

SECTION ' B '

Semaphore Signals

7.8. **Visibility of a Signal from the place of operation.**—Where a Signal, due to its position is not visible to the Railway Servant operating the signals, the aspect of the Signal and the condition of its light shall be repeated at the place of operation. Repeaters for Home Signal and Last Stop Signal shall be provided in the Station Master's office also if all the following conditions are fulfilled:—

(a) The signals are not vissible from the platform outside his office ;

and

(b) The Station Master operates the Block Instruments ;

and

(c) Stations Master's Control is not provided on the relevant signals.

7.9. **Visibility of front light.**—Where the front light of a signal is not visible from the place of operation a back light or a repeater shall be provided. The back light shall show a white light in the 'ON position, and no light in any other position.

7.10. **Fixed Green Light of Warner Signal.**—The fixed green light above a Warner Signal on a post by itself shall be provided with a back light or it shall be repeated.

7.11. **Unworked warner Signal.**—The position of the arm of an unworked Warner Signal which is not visible, need not be repeated. The condition of the light shall, however, be repeated.

7.12. **Back lights for the' Attention' aspect.**—The arrangement of back lights for a Signal capable of displaying the ' attention ' aspect shall be such that two lights are visible in the ' ON ' position and no light in any other position. However, only one back light of the Main Yellow aspect may be provided for electrically lit Distant Signals, if the arrangement is such that the bottom light is lit only when the arm is displaying the attention aspect.

7.13. **Fixing Signal arms.**—All signal arms shall be fixed on the left hand side of the post.

Two Aspect Lower Quardrant Signalling.—

7.14. **Warner Signals** —

7.14.1. **Semaphore Arm.** —The semaphore arm of a warner Signal shall be fish-tailed. The front of the arm shall be red with a fish-tailed white bar. The back of the arm shall be white with a fish-tailed black bar.

7.14.2. **Day and night indications.**—By day, the arm of a Warner Signal shall be horizontal in the ' ON ' position and 45° to 60° below the horizontal in the ' OFF ' position. By night the Signal shall exhibit a red light in the ' ON ' position and a green light in the ' OFF ' position. When the Warner Signal is placed on a post by itself, a fixed green light shall be displayed 1.5 metres to 2 metres above it by night.

7.14.3. **Conditions for taking ' OFF '.**—A warner Signal shall not be capable of being taken ' OFF ' for any line other than that over which the highest speed is permitted and not untill the levers of all relevant signals have been pulled and the relevant signals have assumed the ' OFF ' aspect.

7.14.4. **Electric lighting.**—On trunk routes and other main lines nominated by the Railway Board, warner signals shall be electrically lit.

7.14.5. **Placing of Warner Signal.**—A warner Signal may be placed, either—

(a) on a post by itself with a fixed green light by night 1.5 metres to 2 metres above it at an adequate distance (not less than 1200 metres unless otherwise permitted by approved special instructions) outside the First Stop Signal or Gate Stop Signal ; or

(b) on the same post, but 1.5 metres to 2 metres below the arm of the outer Signal ; and

(c) on the same post as, but 1.5 metres to 2 metres below the Last Stop Signal of a station in rear.

7.14.6. **Warner Signal below a Stop Signal.**—When the warner Signal is placed below a Stop Signal, the variable light of the Stop Signal shall take the place of the fixed green light of the Warner Signal and the the arrangements shall be such that the Warner Signal cannot be taken 'OFF' while the Stop signal above it is 'ON'.

7.14.7. **Warner Signal in rear of Gate Stop Signal.**—When the Warner Signal applies to a Gate Stop Signal only, it shall not display the 'OFF' aspect unless there is a distance of at least 1200 metres between the Gate Stop Signal and the First Stop Signal of the Station ahead.

7.14.8. Where the distance between the Last Stop Signal of one station and the First Stop Signal of the Station ahead is less than 1200 metres the Warner Signal of the previous station shall be taken 'OFF' only when the First Stop Signal of the Station ahead is in the 'OFF' position.

7.15. **Stop Signals.**—

7.15.1. **Semaphore arm.**—The Semaphore arm of a Stop Signal shall be square ended. The front of the arm shall be red with a white bar. The back of the arm shall be white with a black band. The bars shall be parallel to the end of the arm.

7.15.2. **Day and night indications.**—By day the arm of a Stop Signal shall be horizontal in the 'ON' position and 45° to 60° below the horizontal in the 'OFF' position. By night, the signal shall display a red light in the 'ON' position and a green light in the 'OFF' position.

7.15.3. On trunk routes and other main lines nominated by the Railway Board, outer signals shall be electrically lit.

7.16. **Stop Signals —Location of :—**

7.16.1. **Outer Signals.**—The outer signal where provided or the Home Signal, where an outer Signal is not provided, shall be placed not less than 400 metres in rear of the Points upto which the line may be obstructed after Line Clear has been given to the Station in rear.

7.16.2. **Home Signals.**—The Home Signal shall be placed in rear of all connections, if any, on the line to which it refers.

7.16.3. **Routing Signal.**—A Routing Signal shall be plaecd in the rear of the Points, which it protects.

7.16.4. **Starter Signals.**—

(i) A starter Signal shall be placed at not less than 400 metres in advance of the Home Signal.

(ii) Where a Starter Signal is provided for each converging line, it shall be placed as to protect the adjacent running line or lines.

(iii) Where one starter Signal only is provided for two or more converging lines, it shall be placed outside the connections on the line to which it applies.

7.16.5. **Intermediate Starter.**—An Intermediate Starter Signal shall be placed clear of fouling marks in rear of the points, if any, which it protects.

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7.16.6. **Advanced Starter.**—Unless approved under special instructions, an Advanced Starter Signal shall be placed outside all connections on the line to which it applies. It shall be placed at not less than 180 metres from outermost point in the case of Single Line section. This distance shall be reckoned from the Starter in the case of Double Line Section. If the Advanced Starter is placed at a distance more than 180 metres, the portion of track between the Starter and Advanced starter shall be track-circuited.

7.16.7. **Reduction of distance between Signals.**—The distances laid down in paras 7.16.1, 7.16.4 and 7.16.6 may be reduced under approved special instructions.

7.16.8. **Combined Signals.**—When, owing to their location, it is necessary to combine two Signals, e.g., an Advanced Starter, with an Outer Signal, one Stop Signal only suitably controlled from the points of operation of the two Signals may be provided, under approved special instructions.

7.17. Distinction between Signals: For Diverging lines.

7.17.1. Unless otherwise permitted by approved special instructions, where two or more lines diverge, the signals shall be fixed on a bracket post or any route indicator of approved design shall be provided. In special circumstances or where the number of signals is considerable, they may be fixed on separate posts or dolls carried on a signal bridge or gantry.

7.17.2. If permitted by approved special instructions, two or more signals may be placed on the same post. In such cases, the top arm shall apply to the extreme left hand diverging line and the second arm shall apply to the next line in order from the left, and so on.

7.17.3. Where Signals are carried on bracket posts or gantries, left hand signal in each case shall refer to the left hand line, the second signal from the left shall refer to the next line from the left and so on. The Signal for the main line shall be placed at a higher level than the signal or signals referring to the other running line or lines.

7.18. **Distinction between Signals.—For converging lines.**—When two or more lines converge, the signals shall be fixed on separate posts. Where signals are carried on brackets or bridges under approved special instructions, instructions given in para 7.17.3 will apply.

Subsidiary Signals:

7.19. Calling-on Signals.—

7.19.1. **Type and Function.**—A Calling-on signal has no independent aspect in the 'ON' position and shall be a Semaphore arm. A Calling-on signal when taken 'OFF' calls on the Driver of a train to draw ahead with caution, after the train has been brought to a stop eventhough the Stop Signal above it is at 'ON'. It indicates to the Driver that he should be prepared to Stop short of any obstruction.

7.19.2. **Semaphore arm.**—The Semaphore arm of a Calling-on Signal shall be a short square ended arm. The front of the arm shall be white with a red bar. The back of the arm shall be white with a black bar. The bars shall be parallel to the end of the arm.

7.19.3. *Day indication*—By day, the arm shall be—

(a) Horizontal in the 'ON' position ;

(b) 45° to 60° below the horizontal in the 'OFF' position.

7.19.4. *Night indication*—By night, the signal shall display—

(a) no light in the 'ON' position ;

(b) A miniature yellow light in the 'OFF' position.

7.19.5. *Placing and working.*—

(a) Calling-on Signal shall be placed below a Stop Signal governing the approach of a train. Under approved special instructions, a Calling-on Signal may be provided below any other Stop Signal except the last Stop Signal.

(b) The Calling-on Signal shall not be capable of being worked at the same time as the Stop Signal above or shunt Signal below it, if any.

(c) It is desirable to provide track circuits at a suitable distance and a time delay circuit to ensure that the Calling-on Signal is taken 'OFF' only after the train has been brought to a stop.

(d) A Calling-on Signal shall detect all the Points in the route, which the main signal above it detects excluding overlap in double line section. On Single line section under approved special instructions, a Calling-on signal placed below the first Stop Signal may not detect points in the overlap.

(e) At stations where Station Master controls the reception and despatch of trains, such control shall be extended to Calling-on Signals also.

7.20. Shunt Signals:

7.20.1. *Type*—A shunt signal shall be either—

(a) a Disc Signal or

(b) a Position Light Signal.

Under special instructions, a shunt Signal may be a miniature Semaphore arm.

7.20.2. **Disc Signals.**—The front of the disc shall be white with red bar. The back of the disc shall be white with a black bar. By day, the bar of a disc signal shall be horizontal in the 'ON' position and 45° to 60° below the horizontal in the 'OFF' position in the anti-clockwise position . By night, the signal shall display a red light in the 'ON' position and a green light in the 'OFF' position.

7.20.3. **Position Light Signal.**—Para 7.42.2 may be referred to.

7.20.4. **Miniature Semaphore Signal.**—(a) The Semaphore arm of a shunt Signal shall be square ended. The front of the arm shall be red with a white bar. The back of the arm shall be white with a black bar. The bars shall be parallel to the end of the arm.

(b) The day and night indications of a miniature semaphore shunt signal shall be as in para 7.15.2.

7.20.5. **Location.**—(a) Shunt Signals may be separately located on posts or close to the ground or may be fixed below Stop Signals other than the First Stop Signal of a station.

(b) Where a Shunt Signal is required to be fitted on a Signal post on which a Calling-on signal is also fitted, the Shunt Signal shall be fitted below the Calling-on Signal.

(c) A Shunt Signal placed below a Stop Signal or a Calling-on Signal shall not be capable of being worked at the same time as the relative Stop Signal or Calling-on signal.

(d) Where a Shunt Signal is fixed below a Stop Signal it shall show no light in the 'ON' position.

7.20.6. **Diverging routes.**—More than one shunt signal may be placed on the same post and when so placed, the top most Shunt Signal shall apply to the extreme left hand line and the second shunt signal from the top shall apply to the next line from the left and so on. One shunt Signal with or without a route indicator may also be provided for a number of diverging routes.

7.21. **Repeating Signal**—

7.21.1. A repeating signal is a signal placed in rear of a fixed signal for the purpose of repeating to the driver of an approaching train aspects of the fixed signal in advance. It shall be provided with a marker consisting of a white-enamelled disc with letter 'R' in black.

7.21.2. A repeating signal shall be of :

(a) banner type, or

(b) a square ended Semaphore arm, or

(c) a colour light signal. (Para 7.42.3 may be referred to).

The 'ON' position of the repeating signal indicates that the signal which it repeats is at 'ON' while the 'OFF' position indicates that the signal which it repeats is 'OFF'.

7.21.3. The front of the banner shall be white with two black bars and a yellow bar in between. The banner shall be horizontal in the 'ON' position and 45° to 60° above the horizontal in the 'OFF' position in the anti-clockwise direction.

7.21.4. (a) The arm of a semaphore repeating signal shall be square ended. The front of the arm shall be yellow with a black bar. The back of the arm shall be white with a black bar. The bars shall be parallel to the end of the arm.

(b) By day, the arm shall be horizontal in the 'ON' position and 45° to 60° below the horizontal in the 'OFF' position. By night the signal shall exhibit a yellow light in the 'ON' position and a green Light in the 'OFF' position.

7.22. **Co-acting Signals.**—Co-acting signals are duplicate signals fixed below Stop Signals and are provided where, in consequence of the height of the signal post or of there being an over-bridge or other obstacle, the main arm or light is not in view of the Driver during the wholetime that he is approaching it.

Co-acting signals shall be fitted at such a height that either the main arm or light or the co-acting arm or light, is always visible.

Modified Lower Quadrant Signalling

7.23. **Provision.**—Modified Lower Quadrant Signalling shall be provided only under special instructions issued by the Railway Board. Where the provision of such signalling is permitted, the requirements laid down in this section shall apply.

7.24. **Distant Signals**—

7.24.1. **Semaphore arm.**—The Semaphore arm of a Distant Signal shall be fish-tailed. The front of the arm shall be yellow with a fish-tailed black bar. The back of the arm shall be white with a fish-tailed black bar.

7.24.2. **Day and night indications.**—(i) By day, the arm of a Distant Signal shall be horizontal in the 'ON' position displaying the 'caution' aspect. It shall be 45° to 60° below the horizontal in the 'OFF' position displaying 'Proceed' aspect.

(ii) By night, the signal shall display a yellow light in the 'ON' position and a green light in the 'OFF' position.

7.24.3. **Electric lighting of Distant Signal.**—On trunk routes and important main lines nominated by the Railway Board, Distant Signals shall be electrically lit.

7.24.4. **Location.**—On both double and single lines, the Distant Signal shall be placed at an adequate distance in rear of the first Stop Signal, the adequate distance being not less than 1 kilometre.

7.25. **Warner Signals**—

7.25.1. **Semaphore arm.**—The Semaphore arm of a Warner Signal shall be as in para 7.14.1.

7.25.2. **Day and night indications.**—The day and night indication of a Warner Signal shall be as in para 7.14.2.

7.25.3. **Conditions for taking 'OFF'.**—A Warner Signal shall not be capable of being taken 'OFF' for any line other than that over which the highest speed is permitted and not until the levers of all relevant signals have been pulled and the relevant signals have assumed the 'OFF' aspect.

7.25.4. **Placing.**—Warner Signal shall be placed on the same post as but 1.5 meteres to 2 metres below the Main Home Signal. The arrangement shall be such that the Warner Signal cannot be taken 'OFF' while the stop Signal above it is 'ON'.

7.26. **Stop Signals.**—The Semaphore arm of a Stop Signal and day and night indications shall be as indicated in paragraphs 7.15.1 and 7.15.2.

7.27. **Stop Signals—Location of**

7.27.1. **Home Signals.**—The Home Signal shall be placed not less than 180 metres in rear of the points upto which the line may be obstructed after Line Clear has been granted to the station in rear.

7.27.2. **Routing Signal.**—A Routing Signal shall be placed as in para 7.16.3.

7.27.3. **Starter Signals.**—When one Starter Signal is provided for each coverging line, it shall be so placed as to protect the adjacent running line or lines.

7.27.4. **Intermediate Starter Signal.**—An Intermediate Starter Signal shall be placed as in Para 7.16.5.

7.27.5. **Advanced Starter Signal.**—Unless approved under special instructions. an Advanced Starter Signal shall be placed outside all connections on the line to which it applies.

It shall be located at a distance of not less than120 meters from the outermost points in the case of Single Line section. This distance shall be reckoned from the starter in case of Double Line Section.

If the Advanced Starter is placed at a distance of more than 120 metres, the entire portion between the Starter and the Advanced Starter shall be track-circuited.

7.28. **Distinction between Signals.**—Requirements shall be the same as indicated in Paragraphs 7.17 and 7.18.

7.29. **Subsidiary Signals.**—Requirements shall be as in Paragraphs 7.19 to 7.22.

Multiple Aspect Semaphore Signalling

7.30.1. *Semaphore arm.*—The semaphore arm of a Distant Signal shall be as in Para 7.24.1.

7.30.2. *Day and night indications.*—(a) By day, the arm of a Distant Signal shall be horizontal in the 'ON' position displaying the 'caution' aspect. It shall be 40° to 45° above the horizontal in the 'OFF' position displaying 'Attention' aspect. It shall be 85° to 90° above the horizontal in the 'OFF' position displaying the 'Proceed' aspect.

(b) By night, the signal shall display one yellow light for the 'Caution' aspect, two yellow lights in a vertical line 1.5 metres apart for the 'Attention' aspect and one green light for the 'Proceed' aspect.

7.30.3. *Electric Lighting of Distant Signal.*—Distant Signals shall be electrically lit on the trunk routes and important main lines nominated by the Railway Board.

7.30.4. *Location.*—On both double and single line sections, the Distant Signal shall be placed at an adequate distance in rear of the First Stop Signal, the adequate distance being not less than 1 kilometre.

7.31. **Stop Signals :**

7.31.1. *Semaphore arm.*—The semaphore arm of a Stop Signal shall be as in Para 7.15.1.

7.31.2. *Day and night indications.*—(a) By day, the arm of a Stop Signal shall be horizontal in the 'ON' position displaying the 'STOP' aspect. It shall be 40° to 45° above the horizontal in the 'OFF' position displaying the 'Caution' aspect. It shall be 85° to 90° above the horizontal in the 'OFF' position dispalying the 'Proceed' aspect.

7.32. **Stop Signals—Location of—**

7.32.1. *Home Signal.*—The Home Signal shall be placed in rear of all connections, if any, on the line to which it refers.

The Home Signal shall be placed not less than 180 metres in rear of the points upto which the line may be obstructed after line clear has been granted to the station in rear.

7.32.2. *Routing Signal*—A Routing Signal shall be placed as in Para 7.16.3.

7.32.3. *Starter Signal.*—A Starter Signal shall be placed as in Para 7.27.3.

7.32.4. *Intermediate Starter Signal.*—An Intermediate Starter Signal shall be placed as in Para 7.16.5.

7.32.5. *Advanced Starter Signal.*—An Advanced Starter Signal shall be placed as in Para 7.27.5.

7.33. **Aspects—Sequence—**

7.33.1. When a Signal is displaying the 'Stop' aspect, the signal next in rear shall not display a less restrictive aspect than 'Caution'.

7.33.2. Every Multiple Aspect Signal, whether automatic, semi-automatic, or manually operated which is required to display 'caution' aspect to a train shall normally be placed at an adequate distance from the next signal in advance. This adequate distance shall not be less than 1 kilometre. Where the adequate distance cannot be provided and the 'caution' aspect is being dispalyed, the next signal in rear shall dispaly the 'attention'/'caution' aspect.

7.33.3. If necessary, the 'Attention'/'Caution' aspect shall be repeated back on successive signals in rear until the adequate distance is obtained.

7.33.4. In all cases the signal next in rear of a Signal protecting diverging lines shall display 'Attention'/'Caution' aspect in the 'OFF' position, when the points are set for any line other than the line over which the higher speed is permitted. When this signal cannot be placed sufficiently in rear of the 'STOP' signal protecting the Points to permit the Driver of an approaching train to reduce to the sanctioned speed, the 'Attention'/'Caution' aspect shall be repeated back on successive signals in rear until the required distance is obtained.

7.34. **Combined Signals**—When owing to their location, it is necessary to combine two signals, one Stop Signal only may be provided under approved special instructions, capable of displaying any or all the following aspects :—

(a) Danger.

(b) Caution.

(c) Attention.

(d) Clear.

7.35. **Distinction between Signals.—For Diverging Lines.**—Requirements shall be as in para 7.17.1. to 7.17.3.

7.36. **Distinction between Signals—For Converging Lines.**—Requirements shall be as in para 7.18.

Subsidiary Signals

7.37. **Calling on Signals**—

7.37.1. The type and function of 'Calling on Signals' shall be as in Para 7.19.1.

7.37.2. The Semaphore arm of a Calling-on Signal shall be as in Para 7.19.2. By day, the Semaphore arm of a Calling-on Signal shall be—

(a) Horizontal in the 'ON' position, and

(b) 40° to 45° above the horizontal in the 'OFF' position.

By night, the signal shall display—

(i) No light in the 'ON' position ; and

(ii) A miniature yellow light in the 'OFF' position.

7.37.3. The placing and working of the Calling-on Signal shall be as in Para 7.19.5.

7.38. **Shunt Signals**—

7.38.1. Type of Shunt Signals shall be as in Para 7.20.1.

7.38.2. *Disc Signal.*—The front of the Disc Signal shall be white with a red bar and the back of the Disc Signal shall be white with a black bar. By day the bar of a Disc signal shall be—

(a) horizontal in the 'ON' position, and

(b) 40° to 45° above the horizontal in the 'OFF' position in the clock-wise direction.

By night, the signal shall exhibit a red light in the 'ON' position and a yellow light in the 'OFF' position.

7.38.3. *Position Light Shunt Signals.*—Para 7.42.2 may be referred to.

7.38.4. *Miniature Semaphore Shunt Signal.*—(a) The arm of a miniature Semaphore shunt signal shall be as in Para 7.20.4 (a).

(b) By day the arm shall be horizontal in the 'ON' position and 40° to 45° above the horizontal in the 'OFF' position. By night, the signal shall exhibit a red light in the 'ON' position and a yellow light in the 'OFF' position.

7.38.5. *Location.*— The location of the Shunt Signals shall be as in Para 7.20.5.

7.38.6. *Fixing of Shunt Signal below a Stop Signal.*— Where a Shunt Signal is fixed below a Stop Signal, it shall show no light in the 'ON' position.

SECTION 'C'

Colour Light Signals

7.39. **General**—

7.39.1. The signals shall be free from the possibility of phantom indication.

7.39.2. Colour Light signals shall normally be of multiple aspect type.

7.40. **Aspects of Signals**—

7.40.1. *Warner Signal.*—The day and night aspects of a colour light Warner Signal shall conform to the night aspects of a semaphore warner signal. The colour light warner signal shall be provided with a marker consisting of a white-enamelled disc with letter 'P' in black when the Warner is provided on a post by itself.

7.40.2. *Distant Signal.*—The day and night aspects of a colour light Distant Signal in modified lower quadrat/multiple aspect territories shall conform to the night aspects of a semaphore Distant Signal. The Colour Light Distant Signal shall be provided with a marker consisting of a white-enameled disc with letter ' P ' in black.

7.40.3. *Stop Signal.*—The day and night aspects of a Colour Light Stop Signal in two aspect/ modified lower quadrant/multiple aspect territory shall conform to the night aspects of a semaphore Stop Signal in the same territory.

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7.41. **Route Indicator** :—

The type of Route Indicator to be provided instead of separate signals shall be as under —

(a) Two Aspect Colour Light Signalling Section : Any route indicator of approved design.

(b) Multiple Aspect Colour Light Signalling Section :
For speeds in excess of 15 km. p. h.—Direction type Route Indicator.
For speeds not exceeding 15 km. p. h.—Any Route Indicator of approved design.

7.42. **Subsidiary Signals** —

7.42.1. *Calling-on Signal.*—A Colour Light Calling-on Signal shall display no light in the ' ON ' position and a miniature yellow light in the ' OFF ' position. The colour light Calling-on Signal shall be provided with a marker consisting of a white enamelled disc with letter ' C ' in black.

7.42.2. *Shunt Signal.*—Shunt Signals shall be of the Position Light type. The lights of a Position Light Signal shall be white. By day and by night, the two lights of a Position Light signal shall be horizontal in the ' ON ' position and 45° above the horizontal in the ' OFF ' position.

7.42.3. *Repeating Signal* :—A colour light type repeating signal shall exhibit a yellow light in the ' ON ' position and a green light in the ' OFF ' position. It shall be provided with a marker which shall show a white illuminated letter ' R ' against a black background.

7.42.4. *Starter Indicator* :—Starter Indicators may be provided to repeat the aspect of the Starter as an aid to the Guard to enable him to know the aspect of the Starter. This repeater may be provided at a convenient place. The Starter Indicator shall exhibit no light when Starter is at ' ON ' and yellow light when it is ' OFF '.

SECTION ' D '

Gate Signals

7.43. A Gate Stop Signal shall be fixed at an adequate distance from the gate, this adequate distance not being less than the value stipulated in Para 7.45.1 and 7.45.2.

7.44. The Gate Stop Signal shall be provided with ' G ' marker except where prohibited under special instructions.

The ' G ' marker shall consist of letter ' G ' in black on yellow circular disc. The instructions in Para 7.168.2 shall apply to signals protecting level crossing gates in automatic block territory.

Interlocked Level Crossing gates outside station limits

7.45.1. On sections provided with two aspect lower Quadrant Signalling, a Stop Signal at 400 metres from the gate shall be provided. Where the section is otherwise provided with separate Warner signals, such a signal shall be provided at a distance of not less than 1.2 km. from the Gate Stop Signal.

7.45.2. On Sections provided with multiple aspect/modified lower quadrant signalling, a Stop Signal at 180 metres from the gate and a Distant signal at 1 km. in rear of the Stop Signal shall be provided.

7.46. **Interlocked Level crossing Gates inside station limits or in the vicinity** :—

7.46.1. On sections provided with two aspect Lower Quadrant Signalling.

(a) The Outer Signal shall be located at a minimum distance of 400 metres from the gate ;

(b) Where the Outer Signal cannot be so located and the Outer Signal falls in between Home Signal and Gate, a separate Gate signal may be located at a distance of 400 metres in rear of the gate ;

(c) Where there is adequate visibility of the Outer Signal as prescribed in Para 7.7.1, the Gate Signal shall work independent of the Outer Signal ;

(d) Where the visibility of Outer Signal is not adequate, the Outer Signal shall be shifted and combined with the Gate Signal where feasible or inter-slotting arrangement shall be provided between the Outer Signal and the Gate Signal.

7.46.2. On sections provided with Multiple Aspect/Modified Lower Quadrant Signalling, when the interlocked gates are situated between distant and Home Signal—

(a) The Gate Signal shall be located at 180 metres in rear of the gate ;

(b) The Distant Signal shall be located at not less than one kilometre in rear of the Gate Signal and will function as Gate Distant as well.

SECTION 'E'

Warning Boards

(C.S.N. 13)

7.47. A Warning Board to warn the driver of his approaching a Stop Signal shall be provided at a distance of 1.4 km. in rear of the First Stop Signal of a station and Gate Stop Signal. This distance may be increased suitably to cater for gradient.

(C.S.N. 789)

7.48. On sections where emergency braking distance of more than 1.6 km. is to be catered for, a second approach signal shall be provided failing which suitable speed restriction imposed.

7.49. In cases where Gate Signals and station signals happen to be located close to each other, only one warning board shall be provided at a distance of not less than 1.4 km. from the First Stop Signal.

7.50. Where inter-signal distance between two signals is less than the distance required for warning Board, the signals in rear shall either be controlled by the signal in advance or they shall be combined.

7.51. Self reflecting sheets of approved type or reflectors shall be provided on the warning board as per approved drawings.

7.52. The warning board shall normallly be on the left of the line to which it applies unless there are special reasons to the contrary.

SECTION 'F'

Indication Board

7.53. Indication Boards are provided to give warning to drivers about changes in type of signalling or type of Block Working.

7.54. Where a Block station, which is provided with two aspect signalling without a warner signal in rear of the First Stop Signal, is approached from a section provided with Multiple Aspect Signalling or with two aspect signalling with a Warner signal in rear of the First Stop Signal, an Indication Board bearing alternate yellow and black diagonal stripe shall be fixed at not less than 1.4 km. in rear of the First Stop Signal. The Board shall have a legend "Approaching unwarned Stop Signal".

7.55. When a station provided with single line token block is approached from a Double Line or a Single Line section equipped with tokenless block working, an indication board with symbol "Entering Token Territory" shall be provided at the First Stop Signal of the station.

7.56. Where the block working at one end of a station is automatic and the other end is absolute, an indication board with suitable legend shall be provided at the First Stop Signal of the station.

The legend on the board shall be "Entering Absolute Block Territory" or "Entering Automatic Block Territory" as appropriate.

7.57. **Shunting Limit Board.**—A Shunting Limit Board shall be provided at Class 'B' stations over a single line section worked on Absolute Block System where shunting in the face of an approaching train is permitted and where an Advanced Starter is not provided. The Shunting Limit Board shall be fixed at a distance of not less than 400 metres in case of two aspect lower quadrant signalling territory and 180 metres in case of multiple aspect and modified lower quadrant signalling territory in advance of the First Stop Signal.

7.58. **Block Section Limit Board** :—

7.58.1. At Class 'B' stations worked on Double Line Absolute Block System with multiple aspect or modified lower quadrant signalling a Block Section Limit Board shall be provided where there are no points or the Outermost points are trailing.

7.58.2. The Block section Limit Board shall be located at 180 metres in advance of the Home Signal and protecting the fouling mark of the trailing points, if any.

7.59. The Block section Limit Board or the Shunting Limit Board shall be so located that the legend is facing towards the station. They shall be fitted with lamps showing white light in both directions during night.

Note.—Chapter XII may be referred to for the painting details.

SECTION 'G'

Points

7.60. All double wire worked Point and Lock mechanisms shall be provided with broken wire locks and electrical detection in addition to mechanical detection. In the case of Point mechanism, the broken wire lock shall function before the opening between the tongue rail and the stock rail exceeds 5 mm. at 150 mm. from the toe.

Note.—In all new installations, Points, Locks and Bars shall not be operated by wire but by rodding or by electrical means.

7.61. **Permissible Distances.**—The distance at which Points may be worked by rodding must not exceed 320 metres except where the stroke at the lever tail is not less than 200 mm. in which case the above distance may be increased to 460 metres. For special type of switches, the Chief Signal and Telecommunication Engineer may stipulate the permissible distance.

Note.—No new installation shall be commissioned with Points mechanically operated and locked by the same lever.

7.62. **Obstruction test.**—The insertion of a 5 mm. obstruction between the switch rail and the stock rail of a Facing Point, approximately 150 mm. from the toe of the switch shall prevent the Point from being locked and the relative signal or signals, where provided, being taken 'OFF' for movements in the facing direction.

7.62. Detection by Shunt Signals—

7.63.1. In all new installations, Points on a running line used in the facing direction for shunting movement shall be provided with a Facing Point Lock.

7.63.2. The Shunt Signal shall lock and detect all Points in the route in electrically interlocked installation, where required.

7.63.3. Single switch detection is permitted for shunt signals movement.

7.64. **Operation of Facing Point lock.**—The operation of the facing point lock shall depend on the correct operation of the lock bar. This lock bar shall form a part of the transmission and be in series with it.

7.65. **Length of Lock Bars.**—The length of lock bar shall exceed the greatest distance between any two adjacent axles of any vehicle likely to be used on the section.

7.66. **Point Indicators**—

7.66.1. *Type.*—Point Indicators shall be of the target type.

7.66.2. *Provision.*— (a) Point indicators shall be provided at all Points on running lines which are not interlocked with Signals, unless the position of Points is otherwise proved.

(b) Point Indicators shall be provided on interlocked facing points which are protected by only a single arm Home Signal instead of separate signals on a bracket post or a route indicator.

7.66.3. *Indications.*— (a) When the points are set for the straight line, the indicator shall display a white target by day and a white light by night, in each direction.

(b) When the points are set for the diverging line, the indicator shall display the edge of the disc by day and a green light by night, in each direction.

At Points where a green light would give a misleading indication to a Driver, a red light may be permitted under special instructions.

7.67. **Trap Indicators.**—

7.67.1. *Type.*—Trap indicators shall be of the target type.

7.62.2. *Provision.*—Trap indicators shall be provided at all trap Points on running lines which are not interlocked with signals unless the position of trap points is otherwise proved.

Note.—Points leading to a short dead end and used solely for the purpose of trapping the runing line or sidings shall be treated as derailing switch.

7.67.3. *Indications.*— (a) When the Trap Points or derailing awitches are open, the Indicator shall display a red target by day and a red light by night in each direction.

(b) When the trap Points or derailing switches are closed, the indicator shall display the edge of the disc by day and a green light by night, in each direction.

At trap points where a green light would give a misleading indication to a Driver, a white light may be permitted to indicate trap " CLOSED " position only.

7.68. **Size of lights and placing.**—Points and trap Indicators shall be provided with miniature lights and as a rule be placed as close to the ground as circumtances permit.

7.69. **Shunting Permitted Indicator**—

7.69.1. *Type.*—Shunting Permitted Indicator may be of the disc type or of the light type.

7.69.2. *Provision.*—Shunting Permitted Indicator may be provided to permit uninterrupted to and fro movements towards shunting neck or other connected lines.

7.69.3. *Indications.*—Day and night indications of the Shunting Permitted Indicator shall be as follows :—

Type	Indication when shunting is permitted in the direction to which it refers		Indication when shunting is not permitted in the direction to which it refers	
	Day Indication	Night Indication	Day Indication	Night Indication
Disc Type ..	Black disc with a yellow cross painted on it.	Yellow cross light ..	Edge of disc	No light.
Light type ..	Yellow cross light ..	Yellow cross light ..	No light	No light.

7.69.4. *Working.*—Shunting permitted Indicator may be operated by a ground lever which works in conjuction with a Stop Signal so that either the shunting permitted indicator or the associated stop signal can be taken off at a time.

7.70. **Spring Points**—

7.70.1. Spring points shall be used only in exceptional cases where the same purpose cannot be achieved conveniently by other means.

7.70.2. Spring Points if used in the facing direction must be fitted with facing point locks. They may be operated from a Cabin or from a ground lever. In the latter case, the ground lever shall be of such a type that it will not move when the Points are being trailed through.

7.71. **Movable Diamond Crossing.**—Movable Diamond Crossings on passenger lines shall be provided with complete facing point equipment of approved type.

7.72. **Means of Isolation.**—

7.72.1. Sand humps, trap points, or other approved means of isolation shall be provided on all goods lines and sidings at their junctions with passengers lines, the normal setting being such as to prevent the passenger lines from being fouled.

7.72.2. At interlocked layouts the means of isolation shall be interlocked with the relative signals.

7.72.3. In order to maintain safety for through running Points for trap sidings shall not be inserted in the main or through line.

An exception may, however be allowed under approved special instructions in cases where, owing to grades in or near stations, it is necessary to prevent—

(a) trains being brought to a stand at a Stop Signal on a rising grade, or

(b) vehicles running away from the station.

An exception may also be allowed under approved special instructions, where it is considered necessary in the interest of working to receive trains from opposite directions at the same time.

At stations where trap siding are inserted on Main lines, through running shall be permitted only under approved special instructions.

7.73. **Provision of Isolation**—

7.73.1. At block stations where trains are permitted to run at speeds in excess of 50 kilometres an hour, the line on which that speed is permitted, shall be isolated from all connected lines during the passage of the train.

7.73.2. Such isolation need not be provided at Block stations where trains are permitted to run at a speed of 50 km. an hour or below provided GR. 4.11(2) is complied with.

7.73.3. The provisions of Para 7.73.1 do not apply to–

(a) junctions where two block section lines meet at the same end of a station and system of Block Working with adjacent stations on both lines is done by one of the approved means and the junction is equipped with full complement of signals.

At such junctions, the First Stop Signal on Single Line sections shall be placed at an adequate distance from the outermost facing point/fouling mark, the adequate distance not being less than the sum total of the adequate distances prescribed in GR. 8.01 in regard to condition for granting Line Clear and GR. 3.40 in regard to the condition for taking off the Home Signal. On Double Line section, the First Stop Signal shall be palced at an adequate distance from the outermost facing point/fouling mark, his distance not being less than the adequate distance prescribed in GR. 8.01 in regard to the conditions for granting Line Clear.

(b) Block stations where track circuits or other appliances have been provided to prove whether the connected non-isolated lines are clear or occupied and the signalling is such that a distinctive aspect is given to the Driverof a run through train, restricting the speed to 50 kilometre san hour when a connected ine is occupied.

(c) Catch and Slip Sidings and Sidings provided for isolation purposes only.

7.74. **Arrangements of Sidings.**—Sidings shall be so arranged that shunting operations upon them involve the least possible use of, or obstruction, to running lines.

Siding Points on Passenger running lines outside station limits

7.75. **Facing Points (Single Line).**—

7.75.1. Where Siding Points take off a runing line in a facing direction, the following minimum equipment shall be provided :—

(a) A gauge tie plate where steel sleepers are not provided ;

(b) A facing point lock, or equivalent mechanism the plunger of which shall lock each switch independently.

7.75.2. The control of the points shall be made by means of a key or other suitable device which shall secure the bolting mechanism of the Points in the plunged or locked positions, *i. e.*, when the Points are set and locked for the running line. The means for control of the Points shall be interlocked with the block system in force.

7.75.3. Where Siding Points are provided only with the minimum equipment specified in Para 7.75.1, an appropriate speed limit over the facing points shall be imposed for all trains passing over such Points in the facing direction only and an ' S ' marker at the Points and a speed indicator at not less than 30 metres from the Points shall be provided, neither of which need be lighted. In addition, a caution and termination indicator shall also be provided as for open line speed restrictions. Where the sanctioned speed of the section does not exceed 50 kilometres per hour, the ' Marker ' at the points and the Indicators need not be provided.

CS-II 7.75.4 added

7.76. **Facing Points (Double Line).**—The minimum equipment for Points taking off a running line in the facing direction on Double Line shall be in accordance with the provisions of Para 7.75.

7.77. **Trailing Points (Double Line).**—Where Points take off a running line in a trailing direction the following minimum equipment shall be provided for unrestricted speed :—

(i) A gauge tie plate where steel sleepers are not provided ;

(ii) A suitbale type of key lock or equivalent mechanism, the key of which can only be extracted when the Points are set and locked for the running line. The points shall be controlled through the block system in force ;

(iii) An 'S' Marker at the Points which need not be lighted.

SECTION 'H'

Signal Cabins and Interlocking

7.78. **Location and elevation of cabins.**—Signal cabins shall be so located, elevated and built as to provide the Operator with sufficient space and to enable him to have an adequate view of signals operated from the cabin as well as of the movements taking place in the portion of the yard controlled by him unless a substitute for direct vision is provided.

7.79. **Cabin equipment** :—All cabins shall be equipped with—

(a) A Cabin Diagram showing the location and normal position of all points, Facing point locks' Signals and Level Crossings, with their respective cabin lever numbers ;

(b) A lever pull chart suitably exhibited ;

(c) Lever collars ;

(d) A suitable staging with ladder for attending to interlocking frame ;

(e) Telephones, as necessary ;

(f) All equipments as required to be provided by concerned Departments including a clock, and

(g) A name board of sufficient size.

Note.—The lever pull chart, referred to in sub-Para (b) above, need not be provided in Cabins where the number of release evers concerned are indicated on the lever name plates to guide the Cabinman in following the correct sequence for pulling the levers.

7.80. **Numbering of levers.**—All levers, including spares, shall be numbered consecutively through the frame from left to right. Each lever shall be provided with a number plate. This will show the function in the order of operation which must precede to release when no lever description board is provided.

7.81. **Signal and Interlocking apparatus—Installation.**—Signal and interlocking apparatus shall be, as far as possible, so installed and the connections and circuits so arranged, that the relevant fixed signal shall remain at or return to its most restrictive aspect in the event of failure of any part of its connection and circuits.

7.82. **Essentials of Interlocking.**—Lever frames and other apparatus provided for the operation and control of signals, points, etc., shall be so interlocked and arranged as to comply with the following essentials :—

(i) It shall not be possible to take 'OFF' a running signal, unless all points including isolation are correctly set, all facing points are locked and all interlocked level crossing are closed and locked against public road for the line on which the train will travel including the overlap.

(ii) After the signal has been taken 'OFF' it shall not be possible to move any points or lock on the route, including overlap and isloation, nor to release any interlocked gates until the signal is replaced to the 'ON' position.

(iii) It shall not be possible to take 'OFF' at the same time, any two fixed signals which can lead to any conflicting movements.

(iv) Where feasible, points shall be so interlocked as to avoid any conflicting movement.

7.83. **Holding Route** :—

7.83.1. Signals governing movements over Points shall be placed as close as possible to the Points. Where a signal is more than 180 metres from the Facing points it controls, arrangments snall be made to keep the Points locked until the train has passed them. Similar arrangments shall also be made to hold consecutive Points should the distance between them be more han 180 metres.

7.83.2. At a station where trains run through at speeds more than 50 kilometres per hour, such arrangements to hold the route are also required in case of trailing points situated more than 180 metre from the signal controlling them. However, such arrangements are not required if the Points are locked in either position by the signal in advance as stipulated in paragraph 7.84.

7.83.3. Route holding arrangements for facing or trailing points are, however, not necessary, if due to the manipulations required in the system of control, it is impossible under normal working conditions for the Points to be operated before the train has passed.

7.83.4. It is desirable to provide continuous track circuit for holding the route.

7.84. **Locking trailing points by Signals in advance** :—Levers operating Stop Signals which are next in advance of trailing points operated from the same cabin, shall when reversed, lock such point levers in either position unless route locking is provided or the distance between the Points and the signal is such that the locking interferes with traffic movement.

7.85. **Clearance at Junction Point** :—

7.85.1. Where it is difficult under normal conditions of visbility for a Cabinman to estimate clearance, bars or other approved devices shall be provided in order to define the fouling points of junctions, loops, siding connections, crossings etc.

Note.—It is desirable to provide such protection by track circuiting the Point Zone.

7.85.2. Where the movement of trains over the Points is not visible to the Cabinman operating the Points—

(a) Occupation of the track between Stop Signal reading over the Points upto the fouling mark ahead of such Points shall be electrically indicated at the place of operation ;

(b) In order to prevent the movement of Points while a train is passing over them, facing Points may be provided with track circuit locking of the Point lock lever or ground track lock.

7.86. **Track Circuit Control of Signals.**—Where continuous track circuiting is provided, the occupation by a vehicle of any track circuited section shall control the running siganl or signals leading to the same line and shall also lock in either position, the Points on the section.

7.87. **Slot Circuits.**—Slot circuits for Home Signals leading to non-track circuited reception lines shall be so arranged that a slot once given is effective for the reception of only one train and a fresh slot has to be given for a subsequent train.

7.88. **Station Master's Control—**

7.88.1. The Station Master shall be provided with intrelocked mechanical or electrical control over the Home and Last Stop Signals. Separate control on Warner and Calling-on Signal may be provided where required.

7.88.2. The Station Master's control over Home Signals can be dispensed with only if all the following conditions are satisfied :—

(a) All reception lines are fully track-circuited from Home Signal to corresponding Last Stop Signal in double line and Home Signal to Home Signal in Single line ;

or

All reception lines are track-circuited from the fouling mark to fouling mark and the non-track circuited portion of the line from the fouling mark to the Home Signal is within the range of visibility of the Cabin Assistant Station Master/Leverman/Switchman.

(b) Station Master does not allot the line ; and

(c) Cabin Assistant Station Master/Switchman posted in the Cabins operates the block instruments and controls receptions/despatch signals.

7.89. **Interlocking of Last Stop Signal and First Stop Signal with Block Instrument.**—Where block instruments are in use

(a) The Last Stop Signal shall not be capable of being taken off until Line Clear has been obtained from the block station in advance ;

(b) It shall not be possible to close the line and grant or receive 'Line Clear' unless the 'ON' aspect of the relevant approach signals are proved.

7.90. **Automatic replacement of Signals :**

7.90.1. On Double Line Sections where Double Line Block Instruments have been provided and on Single Line sections where tokenless block instruments have been provided, the Advanced Starter Signal as well as the Starter Signal shall be automatically replaced to 'ON' position by the entry of a train into the block section.

7.90.2. On Single Line Sections where Token instruments are in use, it is desireable to provide such automatic replacement arrangement for the Last Stop Signal.

7.90.3. On Double Line Sections where Double Line Block Instruments have been provided and on Single Line sections where tokenless Block Instruments have been provided, the Home Signal shall be automatically replaced to 'ON' position by the passage of a train in advance of the Home Signal.

SECTION 'I'

Interlocking of Catch Sidings and Slip Sidings

7.91. At stations where Catch and Slip Sidings are provided in accordance with the Rules for opening of a Railway, interlocking arrangements and other safeguards in accordance with Paragraphs 7.92 to 7.97 shall be provided.

7.92. **Reception of trains :**

7.92.1. Either a minimum of two Stop Signals shall be provided in rear of the Catch Siding points or the First Stop Signal shall be at an adequate distance equal to Block overlap from the catch siding points.

7.92.2. A train shall first be brought to a stop at the First Stop Signal, before the Catch Siding points are set for the main line and the reception signals taken 'OFF' unless the following conditions are satisfied :—

(ii) The line on which the train is to be received is clear and the train is to be received on the main line.

(ii) The points leading to the Catch Siding as well as all the Points required for a run through train are set for the main line immediately after granting Line Clear to the Block station in rear.

(iii) Line clear has been obtained from the Block section in advance.

(iv) The gradients in the block section ahead are such that the train can be brought under control easily.

7.93. **Setting of Catch Siding/Slip Siding :**—The take off points of a Catch/Slip siding shall normally be set and locked for the siding and interlocking between the points and block intruments shall be provided as in para 7.94 and other safegaurds as in paragraph 7.95 to 7.97.

7.94. **Interlocking of Catch/Slip Siding points with Block Instruments.**—The interlocking shall be such that the key required to set the siding points is released from the instruments in the " Train Going to "/ " Train Coiming from " position and once the key is removed from the block instruments, the instrument gets locked in the relevant position. The instrument can be normalised only after the points are set for the the Slip Siding/Catch siding and the " Train Going To "/" Train Coming from " key is released from the Points and brought back to release the instrument. Where a Slip Siding is located at the departure end of a Double Line Station, the interlocking shall be such that the Points can be set towards the Block section only when the block instrument is set to " Line Clear ".

7.95. **Audible Indication.**—An audible indication shall be provided at the place of operation of Points as an aid to the Operating staff, indicating that the train has been received or despatched and that the points shall now be reset for the Catch Siding/Slip Siding. This indication would continue till the points are reset for the Catch Siding/Slip Siding.

7.96. **Safegaurds in working.**—In all cases where interlocking arrangements stipulated in para 7.94 are provided between the Slip/Catch Siding and the block instrument, the following safegaurds shall also, *inter-allia* be provided in the Station working Rules :—

(i) Shunting on non-isolated lines shall cease once Line Clear has been granted ;

(ii) Points shall remain set and locked for the Catch Siding until Home Signal has to be taken 'OFF'.

(iii) Before normalising the block instrument the Asistant Station Master/Cabinman shall verify the Complete arrival or despatch of the train, even if he is getting an audible warning, which can arise due to reception or despatch of a complete train or part thereof.

7.97. **Emergency Key.**—An Emergency Key of the Catch/Slip Siding shall be kept in a sealed box under the custody of the Station Master. This is used for operating the Slip Siding/Catch Siding points when either the block insturments have failed, or when the train is still in the Block section and a train is required to be despatched into the Block section.

SECTION 'J'

Operation of Points and Signals by Electrical Means

7.98. The points and Signals may be operated individually from a—

(i) Lever frame ; or minature power frame ; or

(ii) Control panel ; or

(iii) Station Master's Slide Control.

7.99. **Locking and sealing arrangements.**—Locking and sealing arrangements shall be provided for the covers of locking tray of lever frame/power frame, etc., to secure against unauthorised opening.

7.100. **Lever frame/Power frames.**—

7.100.1. Lever Frame locking tray and power frame mechanism shall be completeely enclosed with removable covers giving free acess to all parts.

7.100.2. All electric locks shall be be forcibly replaced to the locking position.

7.100.3. The interlocking frame shall be properly earthed and earth resistance shall not be more than 10 ohms. Safeguards shall be provided to prevent injury to the operator in the event of a short circuit or other similar circumstances.

7.101. **Operation of Signals by Electrical means.**—Where levers are used to operate signals by electrical means, they shall be provided with "normal" indication locks adapted directly to prevent the full return movement of the lever to the normal position unless the signal has returned to the 'ON' position. This rule does not apply to a mechanical interlocking frame if

(a) the signal is easily visible, or

(b) the position of the signal is repeated.

7.102. **Operation of points by Electrical means.**—Except where alternative electric locking is provided, the lever operating electrically worked points shall be provided with "normal" and "reverse" indication locks adapted directly to prevent the full movement of the lever, unless the point mechanism has made the required movement and the points are set and locked in a position corresponding to that of the lever and in the case of facing points, they are securely locked.

7.103. Visual indicators shall be provided to show the "normal" and "reverse" positions of all points, the condition of all track circuited sections, route setting and to repeat the indications of Colour Light Signals.

7.104. **Track circuits as a means for detecting obstructed lines.**—Adequate arrangements shall be made, where necessary for reminding the Operator of vehicles which are standing within his control. In case of passenger lines or where light engine crossing and shunt movements are frequent or where stop Signals are at a considerable distance from the Cabin, or where the view of the Operator is likely to be obstructed, the provision of track circuits or other automatic device is desirable.

Note.—Whenever the use of normally closed type of track circuit is specified in this Chapter, it shall automatically cover the use of axle counter in lieu of track circuit.

7.105. **Track Circuiting.**—At Stations where points and signals are operated from an Assistant Station Master's Office at a central place, track circuiting of the entire station section including all lines where direct reception is provided shall be done.

7.106. **Circuits.**—

7.106.1. The circuits controlling the operation and indication of Points shall be so arranged that, as far as practicable, a cross connection or a short circuit cannot operate the switch or give a false indication of the position of the points.

7.106.2. Circuits controlling the operation and indication of Signals shall be so arranged that, as far as practicable, a cross connection or a short circuit on any of the wires cannot give a false clear indication.

7.106.3. The battery or power supply for line circuits, as far as practicable, shall be arranged at the end of the circuit farthest from the operated unit.

7.106.4. Where the line supply voltage normally exceeds 125 volts protection arrangements as laid down in the Indian Electricity Rules, 1956, shall be provided.

7.107. **Crank Handle interlocking.**—

7.107.1. At installations with motor operated points, crank handles shall be kept electrically locked and released for every operation requiring a crank handle. The interlocking systems shall be such that the crank handle cannot be released when relevant signals are taken 'OFF' and once the crank handles is released the relevant signals cannot be taken 'OFF' until the crank handle is restored to its electric lock and gets locked therein.

7.107.2. In case of major stations, grouping of Points shall be resorted to and non-interchangable crank handles provided for each group.

SECTION 'K'

Relay Interlocking Installations—Route Setting Type

7.108. Route setting shall be on the basis of "Entrance-Exit" principle. Facility for individual operation of points shall also be provided.

7.109. Route setting, *i. e.*, setting and locking of the route and clearing of main signals include the following processes :—

(i) Prove that the route selected does not conflict with any other route which has already been set and locked;

(ii) Operate the points in the route, overlap and those required for isolation to the required position, lock and detect them ;

(iii) lock the route including overlap and isolation ;

(iv) Prove that the tracks in the route and the overlap are clear ;

(v) Prove that all interlocked level crossing gates in the route including overlap are closed and locked against road traffic ;

(vi) Prove that the signals are controlled by the Block System in force as necessary :

(vii) Prove that the relevant crank handles are electrically locked in ;

(viii) Clear the signals after the above conditions are satisfied.

7.110. The system shall be so designed that the points in a route once set shall remain in the last operated position until they are required to be operated for the setting up of another route or for individual operation except when stipulated otherwise.

7.111. The route shall ordinarily be released by the passage of the train over the route. Sectional Route Release may be provided where necessary. Emergency route release shall also be provided with appropriate time delay.

7.112. Approach locking and back locking shall be provided for all routes governed by main signals. Approach and back locking shall be continuously effective from the approach track which shall commence from an adequate distance in rear of the signal.

7.113. **Point Operation :—**

7.113.1. The points shall be operated by electric or electro-pneumatic or electro-hydraulic point machines. Points leading to unsignalled lines or sidings may be manually operated with suitable electrical control.

7.113.2. Where required, provision may be made for emergency operation of points during track circuit failures. Each such individual operation shall be recorded on a suitable Electric Counter.

7.114. Where required, provision may be made for emergency sub-section route release. Where such release is provided, it shall be possible to release the sub-section only with the co-operation of both the Station Master and the Maintainer.

7.115. All running signals shall be colour light multi-unit type and shunt signals shall be of the Position Light type. Calling-on signals may be provided in accordance with para 7.19.

7.116. A signal in the 'OFF' position shall be replaced to 'ON' position automatically by the passage of a train. It shall also be possible to replace a manually controlled signal in the 'OFF' position to the 'ON' position manually.

7.117. The Calling-on Signals shall lock and detect points in the Route and prove that the level crossing gates in the Route are closed and locked against road traffic.

7.118. Shunt movements shall, as far as possible, be controlled by Shunt Signals. The Shunt Signals shall lock and detect the points in the Route and prove that the tracks in the route excluding the berthing track are clear and that the level crossing gates in the Route are closed and locked against the road traffic.

7.119. Where local control panels are provided over a portion of the yard, the points and signals of that portion of the yard shall be operated as follows :—

(a) directly from the main control panel ; or

(b) from the local control panel after obtaining release from the main control panel ; or

(c) from the local control panel after operation of an emergency switch. This emergency operation shall be suitably counted in a Counter.

7.120. Suitable indications shall be provided on the control panel for points, track sections, routes, signals including Calling-on Signals, 'A' Markers, level crossings, train approach, power supply cancellation, slot and crank handle interlocking, etc., as required.

SECTION 'L'

Requirements of Signalling Circuits using Electronic Equipment

The following fail-safe principles shall be incorporated in the design of the equipment :—

7.121. Component failure shall be self-detecting by way of causing a signal to display a most restrictive aspect as far as practicable.

7.122. Failure of components which are not self-detecting shall not cause any unsafe failure of the equipment. Even simultaneous failures in different components which are not self-detecting shall not cause any unsafe failure of the equipment.

7.123. All fail-safe circuits shall work on continuous energisation principle such that open circuits in wiring, relay contacts, etc., or loss of power supplies shall not cause unsafe conditions.

7.124. Common return shall not be used for vital circuits. In vital circuits, the final stage shall use fail-safe signalling relays. A transformenr isolation shall be provided between the final stage fail-safe signalling relay and the electronic device preceding it. The D. C. power supply shall not have any galvanic connection with the coil of the final stage signalling relay.

7.125. All electronic equipment shall have a long Mean Time Between Failures (M. T. B. F.). Duplication of components and parts of equipment or modules may be resorted to for improvement of the reliability where necessary. Where components/parts modules are duplicated, it is desireable that provision may be made for cross checking the performance of one set by the other set and *vice-versa*

7.126. Due consideration shall be given to the effects of faults in fail-safe electronic equipment to allow open or short circuit or earthing conditions and variation in component values due to ageing, replacement of faulty component with new components of specified tolerance, etc. Safety shall not be impaired as a result of multi-terminal devices failing-either open circuit, short circuit or with partial short circuit between any pair of terminals or earthing.

7.127. Special care shall be taken in the design of amplifier circuit to eliminate the possibility of self-oscillation. It is desirable that loss of safety requirements is not caused should the amplifier go into self-oscillation due to any unforeseen contingency.

7.128. Where specific frequencies are used for safety circuits, particular care shall be taken to ensure that the frequency generating equipment is producing only the desired frequency signal. Verification shall be carried out using passive tuned filters in series with each frequency source.

7.129. The physical construction of fail-safe equipment shall be designed to eliminate the possibility of external objects causing short circuits between combinations of terminals in vital circuits. This may be achieved for example, by adequate separation of terminals, and by the fitting of protective shrouds where necessary.

7.130. For the consideration of the fail-safe feature of an electronic safety signalling device, failure of one component for all the modes of probable faults indicated in paragraph 7.126, one at a time shall be considered. If the failure of the component under examination is not self-detecting, then simultaneous failure of other associated components shall be considered.

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SECTION 'M'

Standards of Signalling and Interlocking

7.131. Broad Gauge lines on Indian Railways have been classified into five categories and Metre Guage lines into four categories in terms of Paragraphs 210 and 211 of the Engineering Code. The complement of signalling equipment to be provided at stations on these routes is indicated in the Tables below :—

Broad Gauge

Details	'A'	'B'	'C'	'D'	'E'
	Above 130 Km. P. H. and upto 160 Km. P. H.	Above 100 Km. P. H. and upto 130 Km. P. H.	Suburban Section	Above 50 Km. P. H. and upto 100 Km. P. H.	@ 50 Km. P. H. and below
Point Fittings	Clamp type Direct Lock.	Approved type of Point Machine Clamp type Direct Lock desirable.	As required *	Plunger type Facing point Lock.	Hand Plunger Lock
Method of operation ...	Electrical operation of Points and Signals.	Electrical operation of Points and Signals.	Electrical operation of Points and Signals.	†† Mechanical Operation of Points and Signals.	Mechanical operation of Points and Signals.
Interlocking	Circuit Interlocking	Circuit Interlocking	Circuit Interlocking ..	Direct Mechanical Interlocking.	Key Interlocking..
Signalling .. .	Multiple Aspect ..	Multiple Aspect ..	Multiple Aspect ..	Multiple Aspect ..	Two Aspect/Multiple Aspect.
Block Working ..	Block Working by track circuit.	† Block Working by track circuit.	Automatic Block ..	††† Single Line : Token working Double Line : Double line Block instrument. ††††	Token working.
Track circuiting ..	All reception lines and from Fouling Mark to Block Section Limit.	All reception lines and from Fouling Mark to Block Section Limit.	All reception lines ..	Run through lines ..	....
No. of Distant Signals ...	Two	Two	....	On sections where Goods trains have a braking distance of more than one kilometre, two distant Signals to be porovided.	One

BROAD GAUGE—concld.

Details	'A'	'B'	'C'	'D'	'E'
	Above 130 Km. P. H. and upto 160 Km. P. H.	Above 100 Km. P. H. and upto 130 Km. P. H.	Suburban Section	Above 50 Km. P. H. and upto 100 Km. P. H.	@ 50 Km. P. H. and below
Auxiliary warning Systen.	To be provided. Continuous Automatic Train protection desirable.	To be provided ..	To be provided ..	....	....
Colour Light Signals ...	To be provided ..	To be provided ..	To be provided ..	....	....
Detection	Electrical Detection with Lock Detection.	Electrical Detection with Lock Detection.	Electrical Detection with Lock Detection.	Mechanical/Electrical Detection with Lock Detection.	Mechanical Switch Detection.
Complement of Signals ..	Distant, Inner Distant, Home, Starters, Advanced Starter.	Distant, Inner Distant, Home, Starters, Advanced Starter.	....	Distant, Home, Starters, Advanced Starter.	Outer and Home in Case of Two Aspect Signalling or Distant and Home in case of Multiple Aspect Signalling.

* When the suburban section falls under Group 'A', 'B', or 'D', as the case may be, the requirements of that Group shall be applicable.

† On Single Line, when density is less than 20 trains each way, Tokenless Block Instruments may be provided. On Double Line, when density is less than 30 trains each way, Double Line Block Instruments may be provided.

†† If the traffic density is likely to exceed 18 trains each way on single line and 20 trains on double line, colour Light Signals may be provided.

††† If the traffic density is likely to exceed 18 trains each way, Tokenless Block Instruments shall be provided and if it exceeds 25 trains each way, Block working shall be by track circuit.

†††† If the traffic density is likely to exceed 30 trains each way, Block working shall be by track circuits.

@ On routes where speed is more than 50 Km. p. h., Signalling requirements as per Group 'D' shall apply.

Metre Gauge

Details	Q, R1	'B'	R2/R3	'S'
	Above 75 Km. P. H.—Trunk Line	Suburban Section	Above 50 Km. P. H. and upto 75 Km P. H. Main Line	50 Km. P. H. and below Branch Line
Point Fittings	Plunger type Facing Point Lock or approved type of Point Machine. Clamp type direct lock desirable.	* As required	Plunger type Facing Point Lock	Hand plunger lock.
Method of operation ..	Electrical operation of Points and Signals.	Electrical Operation of Points and Signals.	Mechanical operation of Points and Signals.	Mechanical operation of Points and Signals.
Interlocking	Circuit Interlocking	Circuit Interlocking ..	Direct mechanical Interlocking ..	Key Interlocking.
Signalling	Multiple Aspect	Multiple Aspect ..	Multiple Aspect	Two Aspect/Multiples Aspect.
Block working	Block working by track circuit ..	Automatic Block ..	Token instruments on Single line Tokenless instruments: Above 16 trains each way. Double line Block Instruments on Double line.	Token working.
Track Circuiting ..	All reception lines and from Fouling Mark to Block Section Limit.	All reception lines ..	Run through line only ..	....
No. of Distant Signals ..	Two	....	One	Nil/One.
Auxiliary Warning System	To be provided	To be provided ..	....	....
Colour Light Signals ..	To be provided	To be provided ..	....	....
Detection	Electerical edet ction with lock detectio	Electrical detection with lock detection.	Mechanical/Electrical detection with lock detection.	Mechanical Switch detection.
Complement of Signals ..	Distant, Inner Distant, Home Starters, Advanced Starter.	....	Distant, Home, Starters Advanced Starter.	Outer, Home in case of Two Aspect Signalling Distant, Home in case of Multiple Aspect Signalling.

* When the Suburban Section falls under Group Q, R1 or R2/R3, as the case may be, the requirements applicable to that Group shall be provided.

SECTION 'N'

BLOCK INSTRUMENTS

General requirements

7.132. **Construction and Type:**

7.132.1. All block instruments shall be of robust construction and of a type approved by the Commissioner of Railway Safety.

7.132.2. On sections where A. C. voltages are induced due to power line parallelism, suitable block instruments with appropriate protecive measures shall be provided. The immunity limits of various types of block instruments are specified in Chapter XVIII.

7.132.3. Block instruments shall normally be worked on physical conductors. Under special instructions, block instruments may be worked on radio relay systems with appropriate secutity features.

7.133. **Lightning Discharger.**—All instruments shall be provided with lightning discharger to approved specification. Where a return line wire is used ,lightning discharger must be installed on both wires.

7.134. **Prevention of irregular operations.**—There shall not be any opening giving access to the interior of the instrument through which it is possible to operate the mechanism by any irregular means.

7.135. **Locking and sealing facilities.**—Facilities shall be provided for locking and sealing the instruments. The doors of the instruments giving access to the internal mechanism shall be provided with a double lock, the key of one of which shall be in the custody of the Station Master on Duty and the key of the other will be with the Elctrical Signal Maintainer in charge of the maintenence of Block Instruments. It shall not be possible to open the door of the Block Instruments without the co-operation of both the agencies.

7.136. **Prevention of unauthorised operation.**—A lock or other device shall be provided to enable the Station Master on duty to prevent unauthorised manipulation of the instrument during his absence.

7.137. **Isolation of telephone circuit.**—Telephone instrument shall be provided in conjunction with block instruments. It is desirable that the condenser or other means provided for isolating the telephone circuit from the instrument circuit is located within the instrument or in such a way as to be inaccessible for outside interference.

7.138. **Bell push.**—A Bell push button or a bell plunger shall be provided on the instrument for exchange of bell codes.

7.139. A separate battery shall be used for each Block instrument. This battery shall only feed the Block Instruments and not any other circuits. The battery housing shall be locked and sealed.

7.140. Tokenless Block Instruments worked on physical conductors shall be worked on metallic return circuits.

Special requirements of Single Line Block Instruments

7.141. **Fixed Indications.**—The instruments shall be provided with visual indication clearly giving the following indications :—

(i) When the instruments are normal and there is no train in the block section, " Line Closed " at both the stations.

(ii) When Line Clear for a train to leave the Block station in rear has been given, " Train Coming From " at the receiving station.

(iii) When Line Clear for a train to leave a Block station has been received from the Block station ahead, " Train Going To " at the sending station.

7.142. **Current Indicator.**—An indicator, indicating the polarity of current, shall be provided to indicate incoming and outgoing line currents.

7.143. **Operation:**

7.143.1. "Train Going To" and "Train Coming From"—The instruments shall be such that the co-operation of the Station Master at the other end of the section shall be necessary. Even with the co-operation of the Station Master at the other end, the Station Master has to go through one or more definite moving operations on the instrument in addition to working of bell plunger.—

(a) before he can grant Line Clear to the Station Master at the other end of the section to release a token, or

(b) before he can obtain Line Clear and extract a token.

7.143.2. "**Line Closed**"—Both the instruments shall be restored to normal before a further operation of setting the instrument to "Train Going To"/"Train Coming From" can be carried out. It shall not be possible for the instruments at either end of the section to be restored to normal without the co-operative features indicated in para 7.143.1.

7.144. **Operation of "Line Clear" receiving and granting mechanism.**—It shall not be possible for the mechanism which permits a "Line Clear" to be received and that which permits a "Line Clear" to be granted to be in operation at the same time.

7.145. The instruments that is set to "Train Going To" for initiating a train movement shall be the first one to be restored to "Line Closed" on complete arrival of the train at the receiving station.

7.146. **Extraction of token.**—It shall be possible to extract one token only when the instrument has been set to "Train Going To". It shall not be possible to change the "Train Going To" condition until the token has been inserted in one of the instruments of the Block section.

7.147. Token instruments shall be so installed that a token of one block section cannot be placed in the instrument of an adjacent section and preferably such that if the token is over-carried, it cannot be placed in an instrument at the next station.

7.148. The tokens of each section shall be engraved with the code name of the stations at both ends of the block section and with a serial number.

Special requirements of Single Line Tokenless Block Instruments

7.149. **Fixed Indications.**—In addition to the fixed indications specified in paragraph 7.141 the instrument shall be provided with means to indicate "Train On Line" at both the sending and receiving stations when a train has entered the block section.

7.150. **Immunity from extraneous currents.**—Single Line tokenless block instruments shall work on coded impulse/frequency modulated current system so as to be immune from the effects of extraneous currents.

7.151. **Operations—Handle type tokenless Block Instruments:**

7.151.1. "Train Going To" and "Train Coming From"—The instrument shall be such that even with the co-operation of the Station Master at the other end of the section, the Station Master has to go through one or more definite moving operations on the instrument in addition to the working of bell plunger—

(a) before he sets his instrument to "Train Coming From".

(b) before he sets his instrument to "Train Going To".

7.151.2. "Train On Line"—Means shall be provided to ensure that the instruments are set to "Train On Line" automatically by the entry of the train into the block section and maintained in that position until the train has cleared the block section. This indication shall be in addition to the "Train Going To" or "Train Coming From" indications of the handle.

7.151.3. "*Line Closed*".—Both the instruments shall be restored to normal before a further operation of setting the instrument to "Train Going To"/"Train Coming From" can be carried out. It shall not be possible for the instruments at either end of the section to be restored to normal without the co-operative features enumerated in para 7.151.1.

7.152. **Operations—Push Button Tokenless Block Instruments :**

7.152.1. "*Train Going To*" *and* "*Train Coming From*".—The co-operation of the Station Master at the other end of the section may be dispensed with. The instrument shall be such that a button in addition to the bell button shall be operated for "Train Going To" position.

7.152.2. "*Train On Line*"—Means shall be provided to ensure that the instruments are set to "Train On Line" automatically by the entry of the train into the block section and maintained in that position until the train has cleared the block section. This indication shall be in addition to the "Train Going To" or "Train Coming From" indications.

7.152.3 *Line Closed*.—Both the instruments shall be restored to normal before a further operation of setting the instrument to "Train Going To"/"Train Coming From" can be carried out. The instrument shall be such that a button in addition to the bell button shall be operated by the receiving station for setting both the instruments to the "Line Closed" condition. This feature can be dispensed with where an automatic device of closing the Block section is provided.

7.153. **Operation of "Line Clear" receiving and granting mechanism.**—It shall not be possible for the mechanism which permits a "Line Clear" to be received and that which permits a "Line Clear" to be granted to be in operation at the same time.

7.154. Tokenless block instruments shall be provided with—

(i) Audible indicators to warn the receiving station—

(a) when the train enters the block section at the sending station ;

and

(b) when the train has passed the Home Signal at the receiving station.

(ii) Shunting key suitably interlocked with the Block instrument for use as an authority for shunting behind the Last Stop Signal and upto the opposing First Stop Signal.

Special requirements of Double Line Block instruments

7.155. **Indicators for Up and Down Lines.**—The Instruments shall be provided with Visual indicators separately for Up and Down Lines to show the following three conditions :—

(a) Line Closed

(b) Line Clear.

(c) Train On Line.

7.156. **Current Indicator.**—The indicators provided as per paragraph 7.155 may also serve as the current indicators.

7.157. **Operation before granting or receiving Line Clear.**—The instrument shall be such that the Station Master has to go through one or more definite moving operations on the instrument besides working the bell or plunger before he can grant Line Clear.

7.158. **Audible Indicator.**—Where required, the instruments may be provided with audible indicators—

(a) to warn the receiving station when the train has passed the Home Signal, and

(b) to warn the sending station when the train has passed the Last Stop Signal.

7.159. **Non-Co-operative type instruments.**—Non-Co-operative type double line block instrumants shall work on a system of coded currents.

7.160. The requirements indicated in paragraphs 7.155 and 7.158 will apply to these instruments. In addition, the following shall be provided in these instruments :—

(i) *Automatic "Train On Line".*—Means to ensure the instruments are set to "Train On Line" position automatically by the entry of the train into the block section and maintained in that position until the train has passed the Home Signal at the receiving station and the instrument set to "Train Closed" condition.

(ii) *Audible Indicator.*—Audible Indicator to warn the receiving station when the train enters the block section at the sending station.

(iii) *Shunting Keys.*—Two Shunting keys, one for each line, suitably interlocked with the block instruments for use as an authority for shunting in the block section.

7.161. **Use of track circuits for proving block section to be clear.**—On sections where use of track circuits for proving the block section to be clear is to be introduced, the following equipment shall be provided.—

(a) A track circuit or circuits extending from the Last Stop Signal of the block station at one end of the block section to the other end of the block section.

(b) An indicator in each block station to show whether the block section is occupied or not.

(c) A control to ensure that the Last Stop Signal of the block station in rear is automatically replaced to 'ON' by the passage of a train and maintained in that position until the train has cleared the block section.

(d) A control to ensure that the First Stop Signal is automatically replaced to 'ON' by the passage of the train.

(e) On single line, a control to ensure that the opposing Last Stop Signals of the Block section cannot be taken 'OFF' at one and the same time.

SECTION 'P'

Automatic signalling

7.162. **Automatic Block System on Double line.**—Automatic Block is a system in which the movement of trains is controlled by Stop Signals which are operated automatically by the passage of trains past the Signals. No automatic signal shall assume 'OFF' aspect unless the Line is clear not only upto the Stop Signal ahead but also for an adequate distance beyond it. Except under approved special instructions, this adequate distance of overlap shall not be less than 120 metres.

7.163. **Automatic and Semi-Automatic Stop Signals on Double Line :—**

7.163.1. The automatic Stop Signal which governs entry into an Automatic Signalling section is a multiple aspect colour light signal which is not dependent upon manual operation but is controlled automatically by the passage of a train into, through and out of the Automatic Signalling section which the Signal governs. This Signal shall normally display the 'OFF' aspect but shall automatically assume the 'ON' aspect immediately a train enters the Signalling Section. The 'ON' aspect shall be maintained until the train passes clear of the section and its overlap when the Signal shall assume 'OFF' aspect automatically.

7.163.2. Fixed Signals which require manual control each time they are taken 'OFF' are called Manual Stop Signals. A fixed signal having both manual and track circuit controls and which is capable of being operated either as an Automatic Stop Signal or a Manual Stop Signal, as required, is called a Semi-Automatic Stop Signal. The Semi-Automatic Stop Signal when working as an Automatic Stop Signal shall conform to an Automatic Stop Signal in all matters releating to its functioning including its normal aspect. Similarly, a Semi-Automatic Stop Signal when working as a Manual Stop Signal shall conform to Manual Stop Signals in all matters including its normal aspect. A control may be provided to make a Semi-Automatic Stop Signal to work either as an Automatic Stop Signal or as a Manual Stop Signal as required.

7.163.3. Signals shall be so spaced as to meet the operating requirements of the section. At the same time the distance between signals shall not be so great as to cause serious repercussions during failures or so small as to provide inadequate braking distance. If the distance between the caution and danger aspects in the case of three aspect signalling or attention and danger aspects in the case of four aspect signalling is less than the braking distance of a train, the speed of that train shall be so regulated as to bring the braking distance within the abovementioned signal spacing.

7.164. **Automatic Block System on Single Line :**

7.164.1. Automatic Block System on Single Line is a system in which the movement of trains is controlled by fixed signals which may be Manual Stop Signals or Automatic Stop Signals or Semi-Automatic Stop Signals.

7.164.2. Manual Stop Signals shall be manually operated multiple aspect colour light signals which shall assume 'ON' aspect automatically on the occupation of the section ahead but shall assume 'OFF' aspect only when on clearance of the relevant section they are operated manually.

7.164.3. Automatic Stop Signals which shall be multiple aspect colour light signals operate in the direction of traffic established. Such Automatic Stop Signals as are against the direction of traffic exhibit 'ON' aspect.

7.164.4. Semi-Automatic Stop Signals are capable of being operated either as Automatic Stop Signals or as Manual Stop Signals as required.

7.165. **Manual and Automatic Stop Signals on Single Line :**

7.165.1. The line between two adjacent crossing stations may be divided into a series of Signalling sections and entry into each signalling section shall be controlled by a Manual Stop Signal or an Automatic Stop Signal or a Semi-Automatic Stop Signal which must assume 'ON' aspect on entry of a train into the section and be maintained in that position until the train has passed clear of the next Automatic Stop Signal in advance or, when the next Signal is a Manual Stop Signal, an adequate distance beyond it. The Signal that governs entry into the Block section shall be Manual or Semi-Automatic Stop Signal.

7.165.2. A Control shall be provided to establish direction of traffic and to ensure that conflicting signals cannot be taken off and a suitable indicator provided to indicate the direction established. It shall not be possible to change the direction ulnless the entire line between two crossing stations and the overlap in the direction to be established are at 'ON' at either end. The mechanism of the control shall, in addition, be suitably approach locked. Except under approved special instructions, the overlap shall not be less than 180 metres.

7.165.3. Signals shall be so spaced as to meet the operating requirements of the section. At the same time, the distance between signals shall not be so great as to cause serious repercussions during failures, or so small as to provide inadequate braking distance. If the distance between the caution and danger aspects in the case of three aspect signals or attention and danger aspects in the case of four aspect signals is less than the braking distance of a train, the speed of that train shall be so regulated as to bring the braking distance within the abovementioned signal spacing.

7.166. **Track Circuits :**

7.166.1. The line shall be provided with track circuits over its entire length and may be divided into a series of Automatic Signalling Sections. The track circuit for the overlap must be separated from the track circuits for the remaining portion of each signalling section.

7.166.2. Track circuits shall also be provided on all passenger running lines as will as other reception lines between passenger lines including their connections to the main lines at all stations on the Automatic Section including stations at either end of the section. There shall be no gap between the track circuits of the station and the track circuits of the Automatic Section.

7.167. **Track indicator for Automatic Signalling on Single Line.**—A track indicator shall be provided at each station to indicate whether the block section is occupied or not.

7.168. **Markers :**

7.168.1. Each Automatic Stop Signal shall be identified by its number and provided with a Marker consisting of a white enamelled disc with letter ' A ' in black.

7.168.2. A Semi-Automatic Stop Signal shall be provided with a Marker which shall show a white illuminated letter ' A ' against a black background when the signal works as an Automatic Stop Signal.

Such a Signal interlocked with a level-crossing shall be provided with an enamelled yellow disc with letters ' G ' in black and an ' A ' marker light. The ' A ' marker shall be lit only when the gates are closed and locked against road traffic.

When a Semi-Automatic Stop signal is required to protect a level crossing gate as also points, the Signal may be provided with an illuminated 'A G ' marker in addition to the illuminated ' A ' marker.

7.168.3. The illuminated markers of a Semi-Automatic Stop Signal shall preferably be repeated at the place of operation of the Signal along side the aspects of the Signal.

7.169. **Provision in Graded Section :**

7.169.1. Automatic Signalling shall not be provided on sections with heavy and continuous falling gradients steeper than 1 in 80 unless the brake power of trains on the section is adequate to enable the trains being stopped at each of the Automatic Stop Signals.

7.169.2. The suitability of Automatic Signalling on heavy and continuous rising gradients shall be decided in consultation with the concerned Departments duly taking into account the ability of a train to start after it has been stopped at an Automatic Stop Signal.

7.170. **Points and Crossings in Automatic Block Sections.**—Emergency Cross-overs and Siding Points in trailing direction shall be secured and locked in the normal position and the switches detected by Signals reading over the Points. In addition, the Points shall preferably be approach locked. Cross-overs or Points in he facing direction shall be provided with the equipment stipulated in para 7.131 and shall be interlocked with signals which shall be approach locked.

SECTION ' Q '

Centralised Traffic Control

7.171. On sections where Centralised Traffic Control (C. T. C.) is to be installed, the following equipment shall be provided :—

(a) Centralised Traffic Control machine.

(b) Relay Interlocking at wayside stations which are provided with Points.

(c) Code generation, transmission and receiving system and medium for transmission of controls and indications.

(d) Block Signalling.

(e) Communication facilities between C. T. C. Centre and wayside stations and between adjacent stations and preferably between way stations and signals in the block section.

(f) Communication between C. T. C. maintenance room and various locations and relay room on maintenance circuit.

7.172. **Centralised Traffic Control machine**—

7.172.1. This may be of any of the following types, depending upon the requirements of the Section :—

(a) Machine with separate indication panel and operating panel.

(b) Console-type machine having indication and operating panels.

(c) Machine with operating switches/buttons located in the track layout of the indication panel.

7.172.2. The machine shall be provided with track diagram on the indication panel to show the complete track layout under Centralised Traffic Control and shall indicate the following :—

(i) The position of points and aspects of Signals, condition of routes, as required ; Whenever the actual position of Points or the aspect displayed by the controlled signal or the condition of route is out of correspondence with the position of relevant relays in the Control Office, the corresponding point, signal or route indication on the indication panel shall, preferably, be flashing.

(ii) *Points lock indications where necessary.*—This indication shall be lit whenever the relevant Point is not free to be operated.

(iii) *Red Track indication lights to indicate the occupancy of various track circuited sections* :— These lights shall normally not be lit and shall be lit when the track is occupied. When the track is occupied, the route light shall not be lit.

(iv) White indication to indicate that the route has been set and locked. The route indication shall be normally not lit and shall be lit when route has been set and locked. When the route is occupied by a train, the relevant route indication on the track circuit concerned shall cease to be lit.

(v) An indication whenever local control is transferred to or emergency control is taken over by any particular station. The indication shall be flashing when there is ' out of correspondence, with the position of the relevant relays in the control office.

(vi) Where necessary, an indication when mains power at any controlled wayside station or ocation fails.

(vii) Indications shall be available to indicate whether regular or standby equipment is in operation.

(viii) Where necessary, an indication whether standby generator is working at any location.

(ix) Station selection lights for each station so that the controller may have visual indications of the station where operations are carried out by him. It shall preferably be possible to call all stations simultaneously.

(x) Indication cycle lights to indicate when indication cycle is being received and point of origin of the indication cycle.

(xi) Lights to indicate ' Blocked ' conditions of points, running lines and block sections, if required.

(xii) Lights to indicate the station or location called by the C. T. C. Operator or telephone where required.

(xiii) It shall preferably be possible to call the maintainers of all stations simultaneously. The indication shall be flashing when there is out of correspondence between the command and the corresponding relays.

(xiv) General check facilities shall preferably be provided to enable the indication of all the signalling functions at site like Points, Signals and Routes to be indicated one after another in sequence for updating the status. This shall be possible through a single command. It shall preferably be possible to send such commands to all stations simultaneously.

7.172.3. If necessary a supplementary track diagram may also be provided to show non-controlled Points. Outlying Sidings, distance between Stations and any other information that may be necessary for efficient operation.

7.172.4. Facilities shall be provided for blocking various Points, running lines in station yards and block sections. Arrangements shall be such that it is not possible to operate a blocked point or to clear a Signal leading to a blocked section from the control office. Jacks and blocking plugs may be used for this purpose and jacks may be provided in the supplementary track diagram.

7.172.5. Following controls, as necessary, shall be provided on the C. T. C. machine through switches/buttons :—

(i) For selection of the required station.

(ii) For setting up a route and clearing of signals or putting back of signals and cancelling a route

(iii) For operation of Points.

(iv) For clearing and putting back of signals.

(v) For bringing into operation standby or regular coding equipment at the control office and at way stations or locations.

(vi) For handing over local control to stations and for taking back the control.

(vii) For re-checking the indications from various stations unless continuous scanning is provided for indications.

(viii) For enabling the C. T. C. Operator to call the attention of staff at field locations and wa side stations.

(ix) Indication Suppressors for each station where required.

(x) For initiating the transmission of code, if required separately.

(xi) For cancellation of stored code, if required separately.

7.172.6. Necessary indications may be provided on the C. T. C. machine to indicate whether code system is functioning properly or not. Facility shall be provided for cutting out faulty stations/sections. If a separate monitoring maintenance panel is provided, these indications and facilities may be provided on it.

7.172.7. An automatic train graph recorder may be provided where necessary to record the movement of trains through the section. It should preferably also record the time when a controlled running signal is cleared and the time a train arrives and leaves a station in a C. T. C. Section including the terminal stations.

7.172.8. Train describer facilities for indicating the description of the trains in the C. T. C. section on the C. T. C. machine may be provided, where necessary.

7.173. **Relay Interlocking at way stations** :—

7.173.1. Stations operated from C. T. C. machine shall be provided with an approved type of relay interlocking.

7.173.2. Station Master's panel shall be provided at each station for—

(i) Operation of Points and Signals during failure of C. T. C. system or in an emergency which shall be possible without the co operation of C. T. C. Operator.

(ii) Operation of Points during shunting or maintenance which shall be possible only with the co-operation of C. T. C. Operator.

(iii) Taking over of the local control for doing shunting at wayside stations which shall be possible only with the co-operation of C. T. C. Operator and shall ensure safety of train movements. For taking over of emergency control operation, co-operation of C. T. C. Operator shall not be necessary. Every case of taking over emergency control shall be counted.

7.173.3. Siding Points taking off the running lines at wayside stations or in the block section shall be provided with approved type of electric control and detection.

7.173.4. Station Master's lock up key shall be provided on the local control panel to prevent unauthorised operation of the panel.

7.173.5. *General.*—(i) Provision may be made in the remote control circuits so that controls cannot be sent out for clearing conflicting signals.

(ii) Approach lighting of signals may be provided wherever necessary.

7.174. **Block Working.**—System of block working shall be Automatic Block for Single Line or Double Line, as the case may be. Where electric switch locks are provided on manually operated Points in the block section, arrangement shall be such that the electric lock can be unlocked only after an adequate time interval after the relevant signals have been restored to ' ON '.

7.175. **Code system and medium for transmission of control and indications ;**

7.175.1. The capacity and design of the Code System shall be such that it will be capable of transmitting codes without excessive delay not only at the time of installation but also with the increase in traffic which can reasonably be expected during the period the system is likely to be in service.

Additional space may be provided in the C. T. C. equipment racks in the control office to take care of any possible future additions.

7.175.2. It shall be ensured that the delay in transmission does not affect the train operation and where necessary, section may be divided into two or more sub-sections for the purpose of remote control

7.175.3. Cycle counters may be provided in case of relay type code systems for counting the number of cycles.

7.175.4. Relays used in various circuits and coding equipment shall be of a type approved for the purpose.

7.175.5. Electronic equipment used in the Code System shall be designed for greatest possible reliability in service. Electronic circuit ancillaries such as carrier repeaters, transmitters and receivers and other circuits which are common for several stations shall be provided in duplicate. Facility shall be provided for testing each unit whenever required.

7.175.6. Electronic equipment shall be of solid state type.

7.175.7. Stable power supply shall be arranged for the circuits which are sensitive to fluctuatoins in supply voltage. Design of circuits in electronic units shall be such that drift in component values shall not cause failuresas far as possible and the components shall be worked well within their rated limits.

7.175.8. Appropriate error detection features, where necessary, shall be incorporated in the design of high speed code system.

7.175.9. Code transmission lines may be either cables or line wires. In both cases, the attenuation shall be such as to ensure fully satisfactory operation of the code system. The overhead line wire system shall be designed so as to ensure satisfactory operation under all weather conditions. Carrier circuits may also be transmitted on V. H. F., U. H. F. or Microwave radio links.

7.176. **Communication facilities:—**

7.176.1. If the voice communication system is superimposed on the code line itself, the design of the system shall be such that speech communication and code system will not interfere with each other.

7.176.2. Where necessary, repeaters shall be provided to ensure satisfactory communication between the C. T. C. Operator and various telephone locations on the section.

7.176.3 In the control office, a suitable loudspeaker, microphone and amplifier shall be provided for C. T. C. Operator. In addition, conventional type of head sets with plugs and jacks shall also be provided.

7.176.4. In addition to the telephone at Station Master's Office, the telephones or jacks shall if reqiured, be provided at the Signal posts and in the relay rooms at the stations and in the instrument cases in the section.

SECTION 'R'

Additional Requirements in 25 kv. 50 cycles A. C. Electrified Sections

7.177. The Signalling and Telecommunication equipment in A. C. electrified areas is affected by the Electric Traction System in the following manner:—

(a) Physical obstructions to the visbility of Signals and to the Signal and Point transmission underground cables, etc., by overhead electrical masts and fittings.

(b) Induced voltages in Signalling equipment and circuits from high voltages and current in the catenary.

(c) Voltage developed in the rail by the flow of traction return current affecting equipment connected to the rails.

7.178. Detailed requirements in 25 kV. 50 cycles A. C. electrified areas are enumerated in part II.

Special requirements for Block Instruments

7.179. Block Instruments shall not be worked on overhead lines. They shall be connected to underground cables as per approved drawings.

7.180. A block filter of an approved design shall be installed between the Single or Double Line Block Instrument and the Cable Conductors.

7.181. When a block section originates at a station in electrified area and terminates at a station in non-electrified area, Block instruments at both ends of such block section shall be provided with block filter in accordance with approved instructions.

7.182. The block telephone of Single or Double Line Block instruments shall not be worked on the same cable conductor as the block instrument. It shall be worked on a separate pair of cable conductors.

7.183. Over single line sections, approved type of Token and Tokenless Block Instruments shall be used . If the length of parallelism does not exceed 1.5 kilometres, Push Button Tokenless Block Instruments may be used.

7.184. Over Double Line Sections, only approved type of Block Instruments with block filters shall be used. Details of the type of instruments to be used are enumerated in Part II.