

INTERLOCKING

Definition: - Interlocking means an arrangement of signals, points and other appliances, operated from a panel or lever frame, so inter-connected by Mechanical locking or Electrical locking or both that their operation must take place in proper sequence to ensure safety.

1. Basic Principles: - **The basic principles of interlocking are as follows:** -

- i) It shall not be possible to take “off” conflicting signals.
- ii) It shall be possible to take “off” signal for a running line only when:-
 - (a) All points on the running line are correctly set and facing points locked
 - (b) All points, giving access to the running line from the sidings and goods lines, are set against the running line.
 - (c) Level crossing gates if included or controlled by interlocking are closed and locked against the road traffic.
 - (d) A signal lever when operated must lock or back lock as necessary the levers operating the points and gate locks referred to above.

Once signal is taken off it shall not be possible to alter the points, to unlock the gate lever etc until all signals are taken off have been put back.

- iii) When all signals are in the “On” position, all points which would be locked by taking ‘off’ such signals must be free for shunting purposes/testing etc.
- iv) It must be impossible to take “off” a Warner Signal, until all the relevant stop signals in advance have first been taken “off” and when “off” it must back lock all such signals.

a) Interlocking –

Points, Signals and other units are usually, operated by means of levers and panels. Interlocking between these levers is accomplished either by mechanical or by electrical or electro-mechanical or electronic means. In the former method, some mechanical contrivance variously designed, controls the relation between one lever and the other.

At less important stations the point, signal and other levers are interlocked by means of keys which are used to lock or release the levers, either in the normal or in the reverse position, as required. At other stations the levers are interlocked by means of tappets inside a box of the lever frame, which is normally kept covered and sealed.

2. Types of Interlocking:

- i) Mechanical Interlocking.
- ii) Panel Interlocking (Relay)
- iii) Route Relay Interlocking.
- iv) Solid State Interlocking(SSl)

i) Mechanical Interlocking:

In mechanical signaling, since the functions are operated by levers, the relationship that should exist between the functions can be transferred to exist between the levers. To ensure that the signal can be taken ‘OFF’ only after the point is correctly set, we can arrange the interlocking between the signal lever and point lever to be such that the signal lever can be reversed only after the point lever is in the correct position, viz. ‘Normal’ or ‘Reverse’, as the case may be.

As the size of yards & train movements increased, size of lever frames also increased. These lever frames not only increased in size occupying more space but also required intensive maintenance.

ii) Panel Interlocking:

With the advent of Electro-mechanical relays, lever frames gave way to relay interlocking based installations. This development resulted in relatively faster operation, fail safe operation and reduced size of buildings required for housing of interlocking installations. With further increase in traffic and expansion of railway network, panel Interlocking installations were commissioned.

iii) Route Relay Interlocking:

Route Relay interlocking is same as Panel Interlocking with Electro Mechanical

Relays doing the Interlocking except that it can be employed for big yards. The interlocking is done between one route and another route. Another Important feature in terms of operating point of view is that the SM has to only press two buttons, Signal button & Route Button (entry-exit system). He doesn't have to individually operate the points to the required position.

iv) Solid State Interlocking (SSI):

Computer based interlocking uses thousands of Electro-mechanical relays requiring complex wiring and Inter-connections. The wiring diagrams for such installations run into hundreds of sheets. Individual relays, wiring and interconnections along with thousands of shouldered joints are required to be physically examined and certified. This exercise requires traffic blocks of long durations and large manpower to manage the traffic during blocks.

Even for small yard re-modelling like addition of a loop line, all the above activities are required to be redone. Therefore, the advantages of relay based interlocking installations are being nullified.

The SSI system occupies considerably less space, consumes less power, is more reliable and is easy to install and maintain. Also, initial commissioning & changes due to yard re-modeling can be carried out in negligible time requiring skeleton manpower for traffic management during the blocks.

Unlike PI or RRI, Microprocessors (IC'S) are doing the Interlocking based on pre determined logic circuits.

Advantages of SSI:-

- Increase in section capacity.
- Faster operation.
- User friendly operation.
- Fail safe technique
- Multiple mode operation.

Significance of SSI for operating staff:

- Reduces man power
- Centralised operation
- Multiple mode of operation
- Control cum indication panel
- Video display unit (P.C)
- CTC (Centralised Traffic Control)—permits remote control
- Significant reduction in traffic block time
- Easier & simple operation

Indirect and Direct Interlocking: -

(a) Indirect interlocking means that the points are set and locked from one place and the signals are operated from another place and another lever frame; the interlocking is effected by means of keys carried from one place to the other.

(b) Direct interlocking means that all levers, viz. the point, the point locks and the signal levers are concentrated in one lever frame and worked therefrom; the interlocking is effected by means of rigid connections between levers without the use of keys.

Standards of Signaling and Interlocking: - Interlocking at stations is standardized into four different classes viz. I(R), II(R) and III(III). The regulations prescribing the four standards have been drawn up primarily to meet the needs of crossing stations on the single line but, with such modifications as may be necessary in regard to the equipment of signals; these are also applicable to other stations both on single and double lines. The standards are as follows: -

(a) Standard I.(R)

(i) Isolation - Isolation of the main line is recommended, but is not essential.

(ii) Points - the facing points should be provided with key locks, locking both switches independently and the switches detected independently by relative signals.

(iii) Interlocking - Interlocking between points and signals may be carried out indirectly by means of key locks.

(iv) Signals - Outers and Bracketted Home signals shall be provided. The provision of Starter signals is optional. Working Warners may be provided for metre gauge stations where trains run through, if considered necessary, but are not required for other stations signalled to standard I.

(b) Standard II(R)

(i) Isolation of the main line is essential.

(ii) Points - the facing points should be provided with plunger type locks, locking both switches independently and the switches and the bolt being detected independently by relative signals.

(iii) Interlocking - The interlocking between points and signals may be direct or indirect. Where indirect interlocking is used, signals shall be worked from a position under the control of the Station Master and key must be provided to enable the Station Master to lock up the signal frame.

(iv) Signal - Outers, Warners and bracketed Home signals must be provided, and Starters where considered necessary; (ii) Where Starters are not provided the "off" position of the Warner signal shall be dependent upon the receipt of 'Line Clear' on the block instrument.

(c) Standard III(R).

(i) Isolation - same as for Standard II.

(ii) Interlocking: - the interlocking between points and signals must be direct.

(iii) Signals. - Outers, Warners, Bracketed Home Signals and Starters must be provided and Advanced Starters as may be necessary.

Multiple aspect signalling.

The Standards, their speeds, requirements of isolation equipments of points and requirements of interlocking between points and signals are the same as in the case of two aspect signalling. The Signalling, however, should be as under: -

(i) Standard I - A Distant and a Home Signal in each direction.

- (ii) Standard II - A Distant, a Home and a Starter Signal in each direction.
 (iii) Standard III - A Distant, a Home and a Starter signal in each direction.

SL No.	Item	Std. I (R)	Std. II (R)	Std. III (R)
1	Isolation	Y*	Y	Y
2	2 Aspect (2A) Semaphore/ Multi Aspect(MA) Signalling	2A/MA	2A/MA	MA
3	Double distant	N	Y**	Y
4	Point Operation	Mechanical	Mechanical/Electrical	Mechanical/Electrical
5	Point Locking	Key/FPL/HPL	FPL/Ptm/c	FPL/Ptm/c
6	Point Detection	Mech/Electrical	Mechanical/Electrical	Mechanical/Electrical
7	Lock Detection	N	Y	Y
8	Interlocking	Key/ Mechanical	Mechanical/Electrical/ Electronic	Mechanical/Electrical / Electronic
9	Track Circuiting	N	Mech Interlocking: Run Through Lines (Main), Electrical/Electronic: All Running Lines	All Running Lines
10	Block Working (Min.)	Token	Token/ SGE	# SGE/ TC
11	Preventing signal passing at danger	N	N	N

*Isolation is not compulsory provided that the conditions laid down in the second paragraph of the general rule 4.11 are complied with "Limits of speed while running through stations-

Double distant on sections where goods trains have a braking distance of more than 1 km.

At station provided with CPI or high density routes, Means for verifying complete arrival of train by suitable means.

Note: The provisions of the new revised Para 7.131 will only apply to future Signalling and Interlocking installations. Wherever existing installations do not fulfill these requirements, existing speed of operation may be permitted to continue.

Painting of Levers: - Levers shall be painted in the following colours:-

(a) Warner signals (two-aspect) lever	Green.
(b) Distant signal (multiple-aspect) lever 45° aspect	(a) Yellow.
(c) Distant signal (multiple-aspect) lever 90° aspect	Green.
(d) Other Signal levers	Red.
(e) Slot lever mechanical	Same color as of the lever slotted, with a 6" (150 mm.) wide blue band in the middle.

(f) Slot lever electrical	Same colour as of the lever slotted with a 6" (150 mm.) wide yellow band and in the middle.
(g) Points lever	Black
(h) Facing points lock lever.	Blue.
(i) Economical facing point lock lever	Upper half-black lower half-blue.
(j) Station Master's control lever	Upper half white lower half-black.
(k) Lever-crossing gate control lever	Chocolate.
(l) Release lock lever	Black, with a 6" (150 mm) wide blue band in the middle.
(m) Setting lever, "List and Morse" signalling ...	Blue with a 6" (150 mm) wide black band in the middle.
(n) Detector lever (D.W.)	Red and blue bands 6" (150 mm.) wide alternately.
(o) Route lever.	Upper half red, lower half black.
(p) Siding key control lever	Black.
(q) King lever	Red and white bands 6" (150 mm.) wide alternately.
(r) Spare lever	White

Numbering of levers in frames.

1. All levers, including spares, are numbered consecutively through the frame from left to right. Each lever is provided with a name plate showing its function and the number of the other levers in the order of operation which must precede to release it.

2. The levers are broadly classified into three groups :-

- (i) Up signal levers/slotting levers.
- (ii) Down signal levers/slotting levers.
- (iii) Point, lock, shunt signal and other levers.

3. The group to which the lever connected to the first approach signal, or Warner signal, situated to the left, or the person working the levers, belongs is allotted the first set of consecutive levers, lying to the left of the frame. The second set of consecutive levers is allotted to group (iii), and the third set of levers lying to the right is allotted to the remaining group. All levers, including spares/spaces, of each group are, then numbered consecutively, starting from the first lever on the left. The relative position of the levers of each group, the first lever on the left. The relative position of the levers of each group, generally, corresponds to the relative position of the units they operate.

Isolation: - A line is said to be isolated from the adjacent line or lines when no movement on the adjoining lines can foul it. Isolation can be achieved by any of the following methods.

(a) Snag dead end, (b) sand hump, (c) trap points, (d) setting of points (e) permanently locked points, (f) Scotch Block and (g) Hay's Derail. (h) Derailing Switch.

Note:-For the purpose of definition of Isolation (f) scotch block and (g) Hay's derail are not means of Isolation. Otherwise Definition of Isolation may be changed as 'isolated from the adjacent line or lines as well as any movement on same line.'

(a) Snag Dead End

- (i) This is an extended portion of track with an erected obstruction with buffers at the end.
- (ii) The length is at least 180 metres.

- (iii) This is used to isolate main line from loop line.
- (iv) This is an efficient substitute for signal overlap.

(b) Sand Hump

Sand hump is an extended portion of rail embedded in sand. It is total 60 m in length, with increasing gradient of 1 in 60, of which the first 30 m is laid with normal track embedded in sand and remaining 30 m is an earthen lump of uniform 4 m width.

(c) Trap Points

- (i) This is a single rail cut.
- (ii) This rail cut will be away from the adjacent line.
- (iii) To provide isolation, the trap point will be open.
- (iv) When it is open and if a vehicle moves the vehicle will derail.
- (v) This is provided to isolate running line from non-running line and main line from loop line.

(d) By setting of points:

At interlocked stations, isolation can also be obtained by setting of points.

(e) Permanently locked points Certain points, including traps are kept permanently locked and

- (i) The keys for these points are kept in on duty station Master custody.
- (ii) These points have to remain set and locked in normal position.
- (iii) These keys are handed over, when these points are required to be worked.

(f) Scotch Block

- (i) A lump of log covered with iron sheets and coloured red.
- (ii) This will be connected with a chain tied up on the earth.
- (iii) This is a place across the rail and locked to prevent vehicles moving away.
- (v) If the vehicle moves the vehicle will derail.
- (vi) This is used normally to isolate running line from non-running line.

(g) Hayes Derail

It is a device designed to limit the movement of free rolling, uncontrolled wagons/ vehicles. This is accomplished by grinding the flange of a wheel up and over the railhead, dropping the wheel clear of the rail on outside of the rails. The wheels lodging in the tie cribbing and ballast halt movement of wagons /vehicles.

(h) Derailing Switch

This is an extended portion of track ending with some sand.

- The distance from the points is about 15 feet.
- This is used to isolate main line from loop line.
- This is an efficient substitute for signal overlap under approved special instructions.
- The normal setting of points is for derailing switch.
- If the vehicle moves, the vehicle will derail on the sand at the end of the derailing switch.
- Simultaneous reception is possible with CRS permission.
- This should not be obstructed.

a) Explanation of certain simple terms: -

- (i) **COUPLED POINTS:** - When two or more points are worked by the same lever.
- (ii) **CROSSINGS:** - The appliances provided at the Junctions where two lines cross or join one and other.
- (iii) **COMPENSATOR:** - It is an appliance provided to compensate for difference in length of roddings and wires due to variations in temperature.

- (iv) **CRANK:** - It is an appliance fitted with the rodding to change the direction of the motion given by the lever.
- (v) **DETECTOR:-** It is an electrical or mechanical device which prevents the signals from being taken 'OFF' unless the points are correctly set.
- (vi) **ECONOMICAL POINT LOCK OR S.L.M.** (Switch & Lock Movement):- When the facing points and the facing point lock are worked by the same lever, it is called "Economical Point Lock" or "S.L.M."
- (vii) **FACING POINT LOCK:-** It is a plunger bolt provided at facing points, which ensures that the points are correctly set and locked to prevent them from being moved.
- (viii) **FACING POINT LOCK BAR:** - It is a bar provided at facing points is connected with a facing point lock, which prevents facing point lock being moved while a vehicle is passing or standing over it.
- (ix) **FOULING BAR:-** It is a bar provided at the fouling points between two diverging roads which prevents points being set and locked and signal being taken 'OFF' for one road while a train is standing short of clearance on the other road.
- (x) **LOCKING:** - A lever is said to be locked when in the normal position it cannot be pulled over. A lever is said to be locking another lever when owing to the former's remaining or in the normal or reverse position the latter cannot be pulled over.
- (xi) **RELEASE:** - A lever releases another lever, when due to its operation the latter can be pulled. If lever No. 2 can only be pulled over when lever No. 1 is pulled then lever No. 1 is said to be de-releasing lever No. 2.
- (xii) **SLOT:** - It is an electrical or mechanical arrangement where by a signal can only be lowered only by the joint operation by two or more persons, but can be put back to 'ON' by any one of them.
- (xiii) **TONGUE RAILS:** - These are rails with tapered movable ends which controls the setting of the route.
- (b) **PANEL BUTTONS:**

1. Signal buttons	GN
2. Route buttons	UN
3. Point buttons	WN
4. Calling on signal buttons	COGN
5. Emergency buttons	EGGN, EUYN,EUUYN, EWN, EOVN, RRBUN,
6. Reminder collors	XT RES PB+A/C RES KEY, POWER FAIL, ACK, SYS, HL/SL MECR FAILEDFAIL,ACK
7. Point group buttons	WWN
8. Gate signal buttons	LXN
9. Slot release, slot lock buttons	

Sl. no	Button	Description	Colour	Location
1	SM KEY	SM KEY		Top Centre of the panel.
2	PANEL/ PC SWITCH	Used during the procedure Transferring control PANEL to PC or VICE VERSA Used during the procedure Transferring control PANEL to PC or VICE VERSA		NEAR BY TO SM KEY.
3	GN	(Main) Signal Button	RED	Close to signal and on the first track
4	SH-GN	Shunt signal button	YELLOW	Close to Signal and on the first track

5	UN	Route Button	WHITE	Centre of the berthing or last control track circuit
6	WN	Point Button (used only for point operation)	BLUE	Close to the point demarcation
7	WWN	Point Button (used for point operation and also for route section release)	BLUE or BLUE with WHITE DOT ON TOP	Top to the PANEL
8	LXN	Level crossing control release button.	BROWN OR CHOCOLATE	Close to the level crossing demarcation
9	KLYN	(Point) key lock Release Button	BLACK	Close to the slotted point demarcation
10	COGGN	Calling on Signal control Button (common)	RED	Top of the panel and below COGGN COUNTER
11	EGRN	Common Button to replace a cleared Signal at 'ON'	RED	Top to the panel below EGRN COUNTER
12	GBN	Common Slot Release Button (For Gate, Crank handle)	GREEN	Top of the panel
13	GBRN	Common Slot Return Acknowledgement Button	BLACK	Top of the panel
14	EWN	Common point button for (emergency operation)	BLUE	Top to the panel and below EWN COUNTER
15	AGGN	Common Button to introduce Auto working of a Main Signal.	GREEN	TOP OF THE PANEL
16	AGGRN	Common Button to cancel Auto working of a Main Signal	BLACK	TOP OF THE PANEL.
17	EUYN	Emergency Route Cancellation button	GREY	Top of the panel and below EUYN COUNTER
18	EUUYN	Emergency Route Release button	GREY	Top of the panel and below EUUYN COUNTER
19	OYN/EOVN	Emergency Overlap Release Button	WHITE/GREY	Top of the panel and below OYN/EOVN COUNTER.
20	RRBUN	Super Emergency Route Release button	GREY	Top of the panel and below RRBUN COUNTER
21	E/WHLMEFAIL, WSLMEFAILT	Signal lamp Failure Alarm acknowledge button	WHITE	Top of the panel and below FILAMENT FAIL INDICATIONS
22	E/WHLMEREECT, WSLMEREECT	Signal lamp Failure Rectified Alarm acknowledge button	WHITE	Top of the panel and below FILAMENT fail indications.
23	POWER FAIL ACK	POWER Failure Alarm Acknowledge Button.	RED	Top of left side of the Panel
24	SYSFAIL ACK	SSI system failure acknowledge	WHITE	Top of the panel and system on indications
25	G/U/W/GRN ACK	Button hold alarm acknowledge	WHITE	TOP OF THE PANEL

26	FCORPB	False feed alarm Acknowledge	RED	Top of the Panel
27	XY RESPB	loop line axle counter reset button	GREY	Below axle counter Reset counter
28	TRAIN ENTRY ACK	Train entering next station block section alarm acknowledge button	BLACK	Top of the Advance Starter Signal Domino

c) PANEL BUZZERS:

1. Button hold buzzer
2. Signal filament failure buzzer
3. Power fail buzzer
4. System fail buzzer
5. Block release buzzer, train entry buzzer
6. False feed buzzer

d) PANEL COUNTERS:

1. Emergency signal replacement counter (EGRN)
2. Emergency route release counter (EUUYN)
3. Calling on signal counter (COGGN)
4. Emergency route cancellation counter (EUYN)
5. Emergency point operation counter (EWN)
8. Emergency overlap release counter (EOVN/OYN)
9. Super Emergency Release counter (RRBUN)

Panel Button Description

Panel Operation Chart

Sl. No.	Gear Type	Buttons operate to	Required Conditions	For Route Release		
				Signal Cancel	Emerg. Route Release	Emerg-ency. Route Cancel
1	Home Signal	GN+UN	Control Tracks overlap tracks up, required point detection including overlap/ isolation point detections, gate is locked and concerned CH locked plus concerned MCB's switched on	GN+ EGGRN	GN+ EUUYN	GN+ EUYN
2	Calling-On Signal	GN+COGGN Release only COGGN keeping GN pressed and press UN	Calling-On Track in front of Signal must be occupied and rear/ replacement track must be high [clear]	GN+ EGRN	GN+ EUUYN	GN+ EUYN
3	Main Line Starters	GN+Ad.St. UN GN+St.UN	Control Tracks up, point required	GN+ EGRN	GN+ EUUYN	GN+ EUYN

			detections including isolation point(s) and concerned CH locked plus concerned MCB's switched on.			
4	Loop Line Starters	GN+AdSt-UN GN+St.UN	Control Tracks up, required point detections including isolation point(s) and concerned CH locked plus concerned MCB's switched on. Approach clear, Clars after berthing track is occupied for 48 seconds.	GN+ EGRYN	GN+ EUUYN	GN+ EUYN
5	Shunt Signal	SHGN+UN	Control Tracks up, required point detections including isolation point(s) and concerned CH locked plus concerned MCB's switched on.	SHGN+ EGRN	GN+ EUUYN	GN+ EUYN
6	Auto Signal Set	GN+AGGN	The Signal should be lowered first	'A' Marker will lit		
7	Auto Signal Cancel	GN+AGGRN		'A' Marker will not lit.		
8	Loop Line Axle Counter Reset	XT RES PB+A/C RES KEY	Loop line Axle Counter Track failed	Station Master will ensure personally for clearance of line		
9	Power Fail ACK	POWER FAIL ACK		Buzzer will stop on pressing the BUTTON,the RED indication remains till the problem is rectified.		
10	System Fail ACK	SYS. FAIL, ACK	System Fail Buzzer should give sound	Buzzer will stop immediately		
11	HL/SL MECR Failed	HL/SL MECR FAILED	On hearing a Buzzer for MECR(Signal filament failure) along with the indication.	Buzzer will stop immediately		
12	HL/SL MECR Rectified	RECTIFIED	Signal filament rectified.	Buzzer will stop immediately		