AWS

TPWS

N.D.Turkar/PL/IRIEEN

AUXILIARY WARNING SYSTEM

Introduction:- AWS is an aids to Motorman

a)It gives Alarm

b)It indicates

c)It decelerates

d)It stops

- It is a microprocessor based control system, which continuously monitors the speed, direction of traveling, distance traveled aspect of the signal passed and the alertness of the Motorman.
- And thus increase the reliability of railway system.

- AWS type ZUB-100 designed and developed by M/s. Siemens Ltd, it was introduced in WR suburban section of Mumbai Division on 24.02.87.

- It is a high-grade safety device preventing the accident due to the negligence of human failure of Motorman.

- It compels the Motorman to obey the aspect of the signal and maintain the correct speed.

- If it is not well acknowledge with in time, AWS decelerate the train and stop the train.

Advantage of AWS:-

It prevents accidents.

i) It upgrades the safety of passengers and working of train.
ii)It prevents the damages of railway system.
iii)Only on aid.
iv)Does not relives driver from his duties.

Track Equipment:-

1. Track Magnet
2. Up to Coupler

Cab equipment:-

1. Engine or train magnet
2. Tacho generator
3. Coupler
4. Isolating switch unit (ISU)
5. Brake application unit (BAU) Brake actuating unit.
6. Control processing unit (CPU)
7. Hooter
8. Drivers indication panel

a) Taget speed indicator
b) Signal failure by pass button
c) Signal by pass counter
d) Reset push button (Blue) of EBC
e) Emergency brake counter
f) Vigilance button
g) Indication lamp (i) Blue (ii) White (iii) Yellow (iv) Red

1) Track Magnet: -

It is placed at track near the signal. It is connected to the signal through Opto coupler card.

Track magnet transmit the information of aspect of signal to CPU track magnet has three chamber.

a) First chamber – Consist of a tuned circuit and 50 HZ coil.
b) Second chamber – Certain oscillators tuned frequency to different frequency. The frequency are as under: -

F1- 2800Hz

F2- 2800 HZ + 800 Hz = 3600 Hz

F3- 3600 Hz + 800 Hz = 4400 Hz

F4- 4400 Hz + 800 Hz = 5200 Hz

F4 – F3 + 800 = 5200 Hz

F5 – F4 + 800 = 6000 Hz

F6 – F5 + 800 = 6800 Hz

F7 – F6 + 800 = 7600 Hz

a) The third chamber – consists of power coil modulator card and 100 MHz coil with tuned circuit – 100 KHz frequency is amplitude (Modulated) with a dia frequency in Modulator cords.

Power coil Generate about 12V (AC) received from engine magnet power coil (cord). Power coil Generate about 12V (AC) received from engine magnet power coil (cord)

Type of Track magnet: -

A.Type Magnet – A type magnet is used with normal signal and given frequency F1 to F5 in pair of 2.

B.Type magnet. B type magnet is used for getting fixed frequency like F4 and F5 frequency or F5, F6.

Track magnet are water tight and are tested by feeding 0.5 kg/cm2 air pressure for 1 minute.

By dipping in water no pressure dropped is allowed.

Opto Coupler Card: -

It is placed on the signal post in a metallic box and work as link between signal aspect and track magnet. It lake the input from the signal transformer output and connected it to the track magnet.

2. Cab equipment:-

1. Engine magnet or train magnet :- it is fitted under frame below guard seat when it passes over track magnet it collects the information from track magnet and send to it to CPU through coupler.
2. Engine magnet passes parallel to the track magnet at a distance (175 mm ± 0-5mm) in Jessop block and (183.5mm + 0-5mm) in ICF stock.

1) It acts as a power source for track magnet
2) It dictates the presence of track magnet by clip in current of 50 KHz coil.
3) It received modulated frequency and transmit it to CPU.

Tacho Generator: -

It is fitted on the axle of the front wheel of the train and gives following information to the CPU. Speed, zero speed distance traveled, direction of travels.

Couplers: -

It conveys the information from Tacho generator to CPU through conducts and also gives train coil to CPU.

ISOLATING SWITCH UNIT: -

Isolating switch unit has manually operated isolation switch and a set of MCBs; it consists of 110V supply to AWS system provision also exists for counting No of isolation number. It helps in isolating of AWS in case of Malfunction or due to some other reason, ISU has eight LED.

a) Yellow – LEDs (I) 110V, (2) 24V, (3) 12V – (4) 5V – Power on supply
b) Supply to Master controller - Green LED
c) 2 Supply to Magnet Valve - Green LED
d) Supply to HMV - Red LED
e) Supply to AMV - Red LED

Brake actuating unit (BAU) BAU consists of :-

a)Brake control relay(BCR)
b)Emergency braking reverse relay
c)Emergency braking normal relay
d)Services braking relay (SBR)

CPU: **-**

Control processing unit – It process the information received from track magnet and gives instruction to indication panel., for the action of hooter and brake actuating unit.

Hooter: -

It is an audiser alarm or warning to motorman an passing of signal and will be continued till it is acknowledged or by passed.

Drivers Indication panel: -

It has many buttons and counters and indication.

Signal failures by pass button (SFBB) It is operate only when trains dead stop. It must be pressed while manual signal is to be passed at danger on receiving T88B.

Signal failure by pass counter (SFBB) It is a counter and counter the number of operation of SFBB on pressing SFBP it rotates half and on passing the signal (Track magnet) it complete its rotation.

Emergency Brake counter (EBC) It is a counter and counts the number of penalty or emergency brakes applied the EBC rotates half when emergency brakes are applied and complete when reset push button is pressed.

Reset Push button: -

It is operative only in stand still condition of train. It is pressed to release emergency brakes applied by AWS.

AWS MAGNET VALVE: -

Two magnet valve are used for application of emergency brakes by AWS, these are:

a) Feed cut off magnet valve (FCMV) It is provided on the pipe feeding MR pressure to brake controller. Normally when it is energized it allows the MR pressure to charge BP through ICS. A cock is provided in parallel to this magnet which is opened only when AWS is to be isolated.

b) Exhaust Magnet Valve: - (EMV) It is provided after the EAV and before the pilot valve normally when it is energized, it blocks the BP pressure to exhaust when it is reenergized it opens the path and brakes are applied. A cock is provided in series to these magnet valve, which is closed only when AWS is to be isolated.

COMBINATION OF FREQUENCY:-

Out of 7 frequency two are used at a time to communicate a particular signal aspect thus it information can be feed but all combinations are not used.

Sr.No	Combination	Function
1.	F1 + F2	Absolute Red ®
2.	F1 + F3	Double Yellow (YY)
3.	F1 + F4	Yellow (Y)
4.	F1 + F5	Permissive Red
5.	F3 + F4	Green (Signal Off)
6.	F2 + F4	Signal at caution (Yellow) with Inter signals distance more than 700m
7.	F2 + F6	No Change in earlier information
8.	F5 + F6	Reduced braking distance after next signal
9.	F1 + F6	Release the brake curve

OPERATION INSTRUCTION FOR AWS:-

Switching on of AWS: -

1)Switch ON AWS MCB.

2)Close the feed cut off magnet valve cock (90o to big pipe).

3)Open the exhaust magnet valve cock (Parallel to small pipe).

4)Switch On AWS ISU.

5)Switch On DCS, ICS, Control Key, EP Key.

6)Record ISU EBC and SFBC number in AWS cards, when the AWS is switch ON following indications are displayed on indication panel.

a)Blue and white lamp lit.

b)Blue lamp extinguished and relit after 4 and 5 seconds.

c)White lamp flashed and relit steady.

FUNCTIONAL TEST OF AWS TO BE DONE AT

1) Starting of trip, (2) Carshed or stabling yard,
   Taking overcharge at in between station

Procedure: -

Keep vigilance button pressed for 10 sec. White lamps (LED1) are flashing, blue, Red and yellow lamps (LED) lit and steady.

1) Release vigilance button – Hooter sounds for 2 sec.
   White lamps lit steady, red and yellow lamp extinguished.

Note: - 1) steady white lamp indicate AWS Eqpt in working order.

1) On releasing vigilance button – If white lamps are still flashing means AWS is faulty, then isolate the AWS completely

ISOLATION OF AWS: -

AWS is to be isolated when

a) Non availability of 110V supply.
b) Malfunctioning of AWS.
c) Whenever there is some faults in electrical sides or leakage in pneumatic side.

Procedure:-

1) Switch OFF ISU.
2) Open the feed cut off Magnet valve cock (Parellel to big pipe).
3) Close the Exhaust magnet valve cock (90 to small pipe).
4) Switch OFF AWS (MCB).
5) Record ISU EBC, SFBC number in AWS Card.
6) Entry in the Failure in unit defect chart Maintained by MUI.

CONTROL EXERACISED BY AWS.

Speed > = Speed limit + 1 km -- Audible Warning.

Speed > = Speed limit + 5 km -- EP Brake + Warning.

Speed > = Speed limit + 10km – Emergency Brake.

TPWS

The Railway Safety Regulations 1999 mandated fitment, by 1 January 2004, of a train protection system on all Britain's passenger railways.

- On the mainline network, the chosen system was the Train Protection & Warning System (TPWS).
- Fitment was completed in 2004. Whilst not possessing all the benefits of a full Automatic Train Protection (ATP) system, TPWS addresses some of the shortcomings of the Automatic Warning System (AWS), which it supplements.
- TPWS equipment is only fitted at selected stop signals. The criteria for TPWS fitment primarily involve the prevention of head-on or side-on collisions between trains but not rear-end collisions.
- Where fitted, TPWS will initiate an emergency brake application when a signal is passed at 'danger' and in most cases when a train approaches a 'danger' aspect at too high a speed.
- TPWS aims to stop the train before it reaches the first point beyond the signal where a conflict (that falls within the scope of TPWS protection) could occur.
- This is called the 'clearance point' and the distance from the signal to the clearance point is known as the 'Safe Overrun Distance' (SOD).

Standard TPWS

- TPWS track equipment is configured to either function as a 'Train Stop System' (TSS) or an 'Over speed System' (OSS).
- Every TPWS fitted signal has a TSS and most also have an OSS installed some distance (between 25 and 450 metres) in rear.
- The TSS and OSS each consist of a pair of transmitter loops mounted in the centre of the 'four-foot'.
- The first loop in any pair, in the direction of travel to which it applies, is termed the 'arming loop' and the second loop is the 'trigger loop'.
- The general arrangement is depicted in figure 1.
- Each loop is capable of transmitting one of the six available frequencies, referred to as 'f1' to 'f6'.
- The loops are only energised while the signal is displaying a 'danger' aspect. A loop consists of a wire running around the perimeter of a rectangular plastic grid, 1000 mm in length and 440 mm wide.

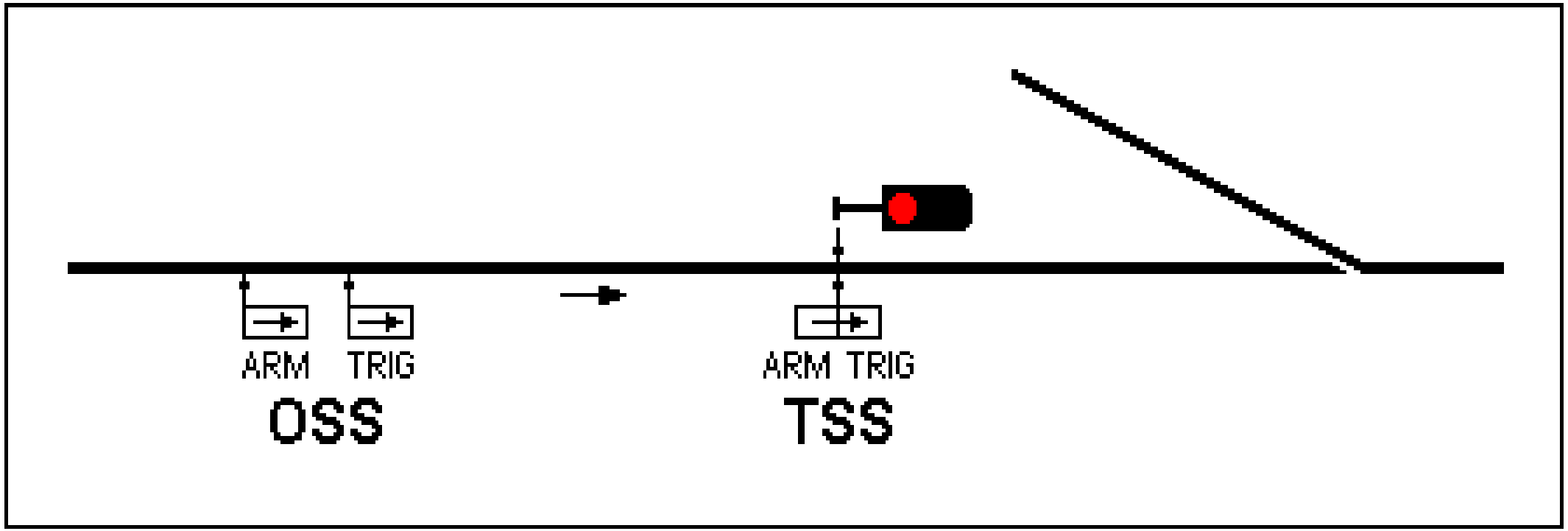


Fig. 1: Standard TPWS Fitment. .

Fig. 2: A TPWS transmitter loop.

- Ideally, the TSS is installed immediately alongside the applicable signal but physical constraints might demand that it be positioned a short distance away.
- Special circumstances can require a signal to be provided with more than one TSS.
- A second TSS may be installed ahead of the signal where a 'standing out' facility exists, or in rear of a platform starting signal so that a train that starts some distance back and accelerates towards a red aspect can be stopped before it reaches the signal.
- The decision as to whether or not an OSS should be provided depends on the effectiveness of the TSS.
- In the majority of cases, the TSS on its own would not be able to stop a train travelling at the maximum attainable speed within the safe overrun distance, thus requiring the addition of one or more OSS.

- The 'set speed' of the OSS is the speed below which a train must pass to avoid a TPWS intervention.
- This is determined by the distance between the 'arming' and 'trigger' loops.
- For example, if the loops are placed 20 metres apart (measured from leading edge to leading edge), the set speed equals 46 m.p.h. for a passenger train, or 36.5 m.p.h. for a freight train.
- Greater separation results in a higher set speed.
- The further away the OSS trigger loop is from the signal, the higher the set speed has to be.
- On detecting an OSS arming loop, a 'trigger delay timer' on board the train starts running for a set duration (974 ms for passenger trains and 1218 ms for freight trains).
- The timer has different settings for freight trains and passenger trains to take account of their different braking characteristics. The timer should have completed its cycle before the trigger loop is detected, otherwise the train is deemed to running at excessive speed and a TPWS brake demand will occur.

- The two loops of a TSS abut so that their magnetic fields overlap.

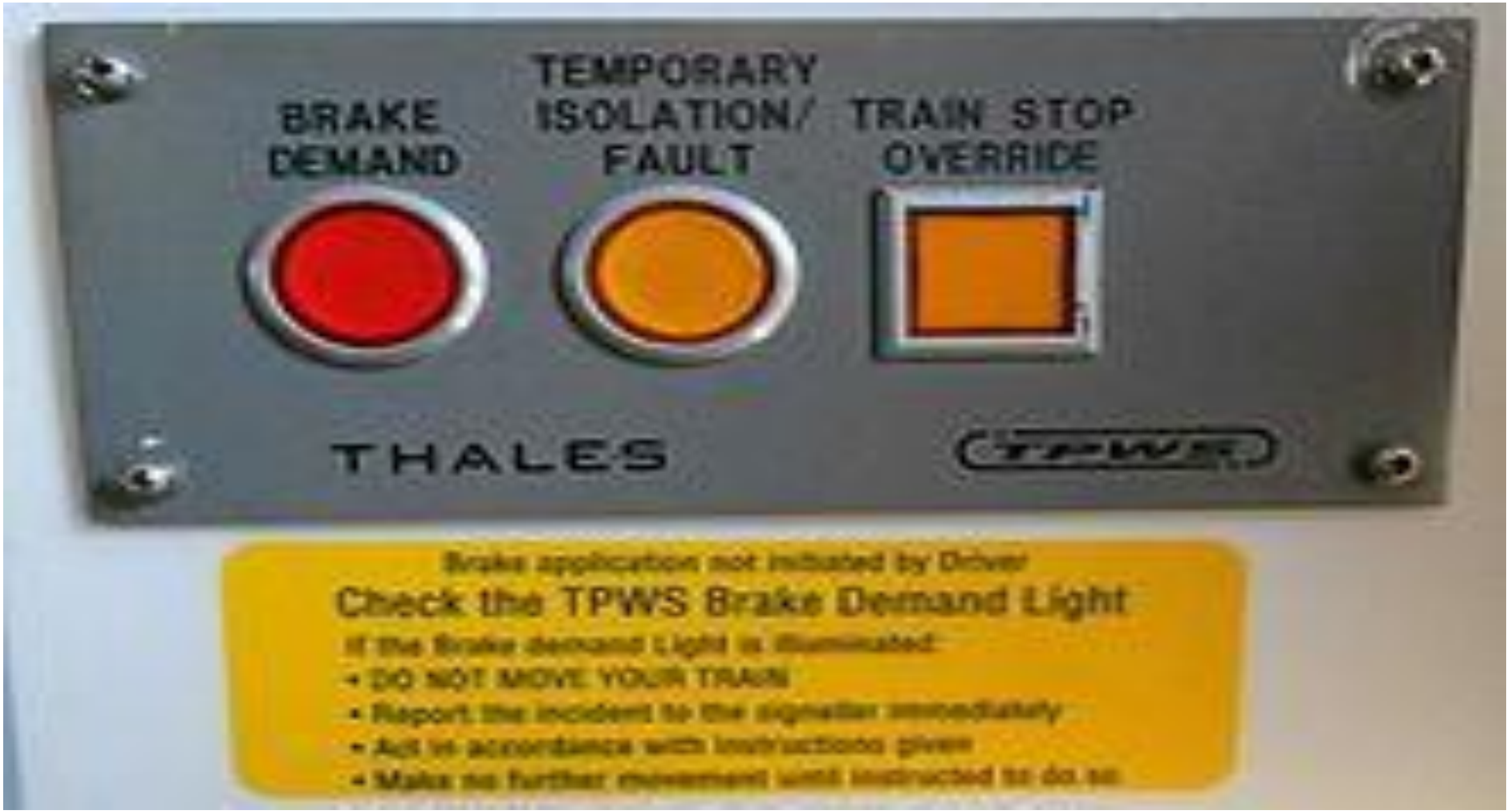
- A brake demand occurs when a train, regardless of its speed, detects a TSS arming loop followed by the corresponding trigger loop frequency (while the arming loop frequency is still being detected).

- The trigger delay timer does not function at a TSS.

- The driver has a facility to override a TSS (because he or she may be instructed by the signalman to pass a signal at 'danger') but an OSS cannot be overridden.

- A "Train Stop Override" button is located inside the driving cab together with TPWS indications marked "Brake Demand" and "Temporary Isolation/Fault".

Fig. 3: TPWS cab equipment.


BRAKE DEMAND
TEMPORARY ISOLATION/ FAULT
TRAIN STOP OVERRIDE
THALES
TPWS
Brake application not initiated by Driver
Check the TPWS Brake Demand Light
If the Brake demand Light is illuminated:
• DO NOT MOVE YOUR TRAIN
• Report the incident to the signaller immediately
• Act in accordance with instructions given
• Make no further movement until instructed to do so

- TPWS equipment only intervenes if the energised loops are encountered in the correct order (arming loop followed by trigger loop); therefore, the loops need not be suppressed for a move over them in the opposite direction.
- Two sets of frequencies exist to cater for the interleaving or nesting of loops on lines signalled in both directions.
- If just one frequency set was used, unwarranted interventions would result from an arming loop being wrongly paired with a nearby trigger loop that applied in the other direction.
- The frequencies are allocated as follows:

Frequency Set	System	Arming Loop	Trigger Loop
Frequency Set A, for Normal Direction (ND) Loops	OSS	64.25 kHz (f1)	65.25 kHz (f2)
	TSS	66.25 kHz (f3)	65.25 kHz (f2)
Frequency Set B, for Opposite Direction (OD) Loops	OSS	64.75 kHz (f4)	65.75 kHz (f5)
	TSS	66.75 kHz (f6)	65.75 kHz (f5)

Table 1: Allocation of Transmitter Loop Frequencies.

Higher Speed Applications

- Standard TPWS, with OSS loops placed no more than 450 metres from the signal as described earlier, is generally capable of stopping a train travelling at up to 75 m.p.h. inside the safe overrun distance.
- By installing an extra OSS (termed the OSS+) at a greater distance from the signal, the effectiveness of TPWS for higher speed applications can be increased. This type of fitment is called 'TPWS+'.
- The OSS+ trigger loop is normally placed 750 metres from the signal, with the arming loop a further 29.5 metres in rear, resulting in a set speed of 68 m.p.h. for passenger trains.
- The OSS+ can stop a train approaching at the maximum permissible speed, leaving the standard OSS only having to deal with trains approaching at a speed below the set speed of the OSS+.

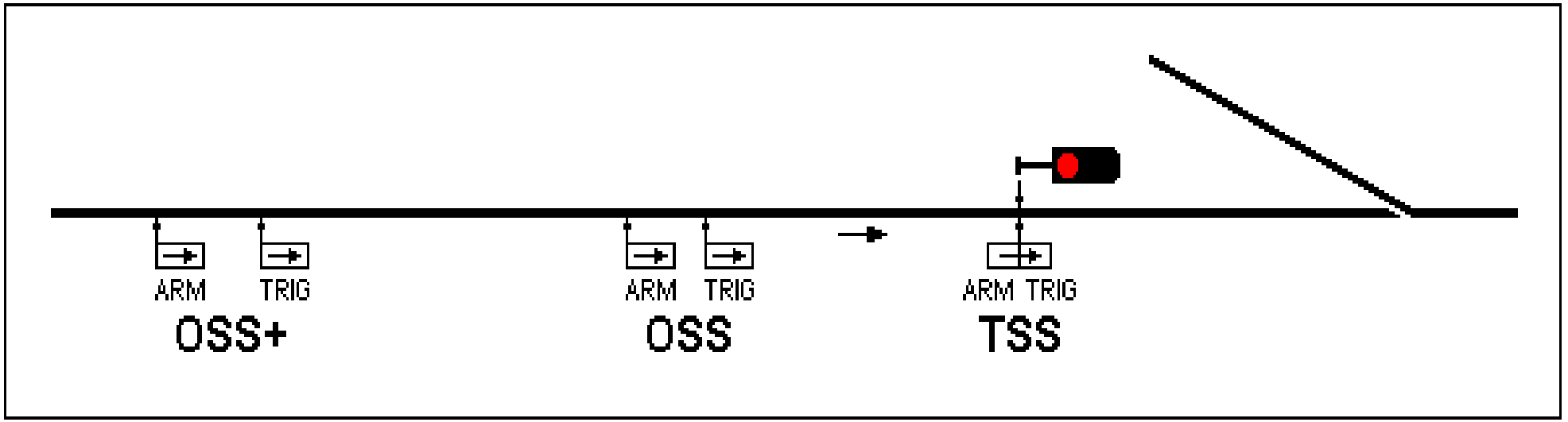


Fig. 4: TPWS+.

- Where TPWS+ would not give the desired protection, 'TPWS OS' (Outer Signal) may be fitted.
- With TPWS OS, no OSS+ is provided but the next signal in rear is fitted with TPWS.
- When the junction protecting signal is at 'danger' and no forward route is set, the signal in rear will be held at red until the train has passed its OSS.
- This control is called 'conditional double red'.
- The outer signal's OSS will usually be positioned at the maximum distance that is possible with standard TPWS (450 metres), to minimise delay to trains.
- The arming loop will be 23 metres from the trigger loop, giving a set speed of 53 m.p.h. for passenger trains.
- A train travelling below that speed can be stopped inside the safe overrun distance by the TPWS fitted at the signal ahead.

Buffer Stops and Speed Restrictions

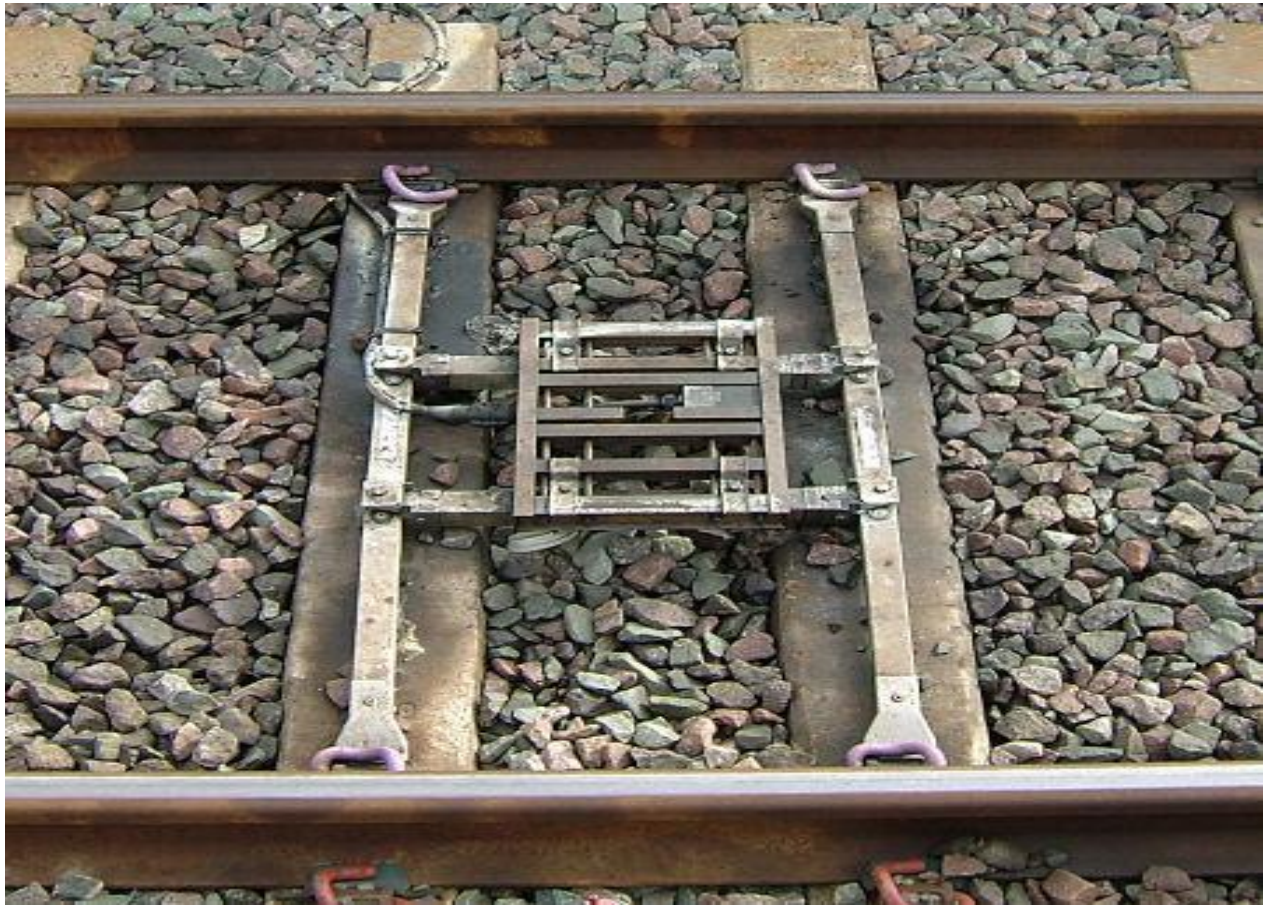


Fig. 5: A TPWS buffer stop mini-loop.

- To help prevent buffer stop collisions on terminal platform lines, OSS loops are installed on the approach to the buffer stops.
- These loops are permanently energised.
- Normally, the trigger loop is positioned 55 metres from the buffer stop and, to give a set speed of 12.5 m.p.h., the arming loop is placed a further 5.5 metres in rear.
- The close spacing of these loops together with the behaviour of the trainborne equipment at very low speeds had initially resulted in trains often receiving false TPWS interventions, despite their speed being below the set speed.
- The problem arose when a train passed over the arming loop so slowly that its magnetic field was still being detected when the trigger delay timer completed its cycle. In this event, the timer resets and starts timing again.
- If, during this second timing cycle, the trigger loop is detected, an intervention will occur.
- The solution was to fit smaller loops measuring 323 mm by 440 mm, so increasing the space between the arming and trigger loops in which neither loop's field is detected by a train.
- These 'buffer stop mini-loops' were installed from 2002, replacing the standard size loops at buffer stops where these were already fitted.

- OSS loops are also fitted on the approach to some permanent speed restrictions (P.S.R.s).
- The set speed for a P.S.R. OSS is typically much higher than the maximum for a signal OSS; therefore, the arming and trigger loops can be spaced further apart than usual.
- Most P.S.R. OSS loops are permanently energised.\
- Self-powered OSS (SPOSS) loops, powered by batteries, were developed for use in connection with P.S.R.s at places where no power supply is available.
- A treadle installed on the approach activates an economiser contact to conserve battery power.
- Some temporary speed restrictions (T.S.R.s) may be fitted with TPWS if they are expected to remain in place for a long period of time.

Equipment Failure

- Any TSS or OSS becomes totally ineffective if either the arming or trigger loop should fail to energise.
- TPWS equipment cannot therefore be considered as 'failsafe'.
- For this reason, a TPWS failure is protected by the previous signal being maintained at 'danger'.
- In addition, TPWS failures will usually be indicated in the signal box.
- The simplified infrastructure of the No-Signalman Token Remote (NSTR) and Radio Electronic Token Block (RETB) systems has stop boards provided in place of worked stop signals.
- These stop boards may be fitted with TPWS, which is controlled by the issuing of tokens.
- The signalman receives no indication in the event of a TPWS failure but TPWS status indicators are provided locally so that the train driver can confirm that the TPWS is working correctly.

- Normally a steady blue light is shown, indicating that the associated TPWS loops are energised.
- When a token is issued, the relevant blue light(s) will start to flash, meaning that the TPWS loops are de-energised.
- The loops remain de-energised for a set period of time, normally five minutes.
- The absence of a light indicates that there is a fault either with the TPWS equipment or with the indicator itself.
- The driver will advise the signalman of the fault.\
- On NSTR lines, the indicators (one for each section) are located inside the cabinets housing the key token instruments.
- In RETB areas, the indicators (known as 'Lineside Status Indicators') are mounted below each TPWS-fitted stop board.
- Similar lineside indicators are also provided at NSTR crossing loops that have power-operated points.

THANKS