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Level 2

Signalling Design: Module X02 – Level Crossings: Common Design Requirements

Endorsement and Authorisation

For endorsement and authorisation, please refer to
NR/L2/SIG/11201

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1 COMMON DESIGN REQUIREMENTS.

1.1.1 This section gives details of items common to several different types of crossing to avoid repetition in the individual sections.

2 ROAD TRAFFIC LIGHTS

2.1.1 Road traffic light signals (RTL's), are described in the Traffic Signs Regulations and General Directions 2002, Diagram 3014, including arrangement, dimensions and mounting height range. The arrangement, size or height may vary outside these requirements with the agreement of the ORR on a site specific basis.

2.1.2 All the RTL's at a level crossing shall be of a similar type producing similar light outputs.

2.1.3 Where two or more level crossings are closely sited such that approaching road users may see both sets of lights at the same time, the same type of RTL's shall be provided at all. This is to avoid confusion and possible misinterpretation

NOTE Where a Network Rail crossing is having RTL's renewed and it is sited close to crossings belonging to another infrastructure owner that are affected by this clause, then the requirements shall be fulfilled by giving notice of our intentions to the other infrastructure owner. If they wish to change to similar RTL's at or around the same time, then reasonable steps shall be taken to work with them. If they do not wish to carry out any alterations at this time, no further action is required.

2.1.4 Separate light signals for pedestrians may be provided in certain circumstances. The signal is known as a "Standing Red Man". It is described in the Traffic Signs Regulations and General Directions 2002, Diagram 4006, including arrangement and dimensions. No height range is specified, but it shall be sited to be clearly visible to pedestrians approaching the crossing, but not where it would cause an obstruction or possible injury.

2.1.5 Standing Red Man may be provided in the following circumstances:-

- At automatic crossings with a significant obtuse skew (say above 30 degree skew), then because the RTL's are sited parallel across the road. The offside RTL's in each direction are at a significant distance from the line. Standing red men may be placed on those corners beyond the RTL's with an associated pedestrian stop line. There is no requirement to light prove these units.
- At MCB's and similar with high pedestrian usage. Standing red men may be provided in addition to the RTL's to reinforce the message to pedestrians. There is no requirement to light prove these units, although it may be done at local discretion to provide an indication that a failure has occurred.
- At MCB's and similar on one direction roads. Standing Red men may be provided instead of RTL's on the exit sides of the road. In this position they shall be light proved in lieu of providing RTL's. A failure of the unit shall be considered as equivalent to both red lights in a RTL failing.

3 AUDIBLE WARNINGS.

3.1.1 The function of the audible warning is to provide an alert to pedestrian users that a train is approaching the crossing.

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3.1.2 The audible warning devices shall each be capable of producing a basic sound level of greater than 80dB measured at 3 metres radius directly in front of the unit. The basic sound level of the units shall be capable of being adjusted down by some external means to suit the local requirements.

3.1.3 Provision shall be made in the level crossing design to set independent day and night volume settings. This is usually done via a time-switch reducing the sound output at night, but other methods are not excluded. No minimum or maximum sound levels for night are specified.

3.1.4 Default sound levels are 80dB day and 70dB night, but can be varied as necessary to set to suit local circumstances.

3.1.5 Default times for “night” are 2300 to 0700, but they may be varied to suit local circumstances and method of operation.

NOTE Default setting of YO3 units is “high” during day and “medium” during night, which equate to 80dB and 70dB sound levels. These may be adjusted as required by testing or maintenance staff in the light of any complaints received from local householders or similar. Where complaints are received, it shall be explained to the complainant we have a duty to warn pedestrians at night. As a result our strong preference is to turn down to a level that becomes acceptable to the complainant while remaining audible by pedestrians on a quiet night, rather than the alternative of completely switching off the warnings at night. The complainants may be present when any adjustments are carried out to help reach agreement. However it is possible to completely switch off at night if it is known that no (or extremely few), pedestrians use the crossing at night.

3.1.6 The audible warning unit shall produce two alternating tones with frequencies of nominally 800Hz and 1000Hz. The tones shall be of equal duration and repeat at 0.5 second intervals. (This can be alternatively expressed as 0.25 secs of 800Hz followed by 0.25 seconds of 1000Hz.) The unit shall also be capable being switched to double the repetition rate to 0.125 seconds of 800Hz followed by 0.125 seconds of 1000Hz, which is required for the “another train coming” situation at automatic crossings.

3.1.7 An alternate audible warning unit is available that incorporates a voice message warning. At automatic crossings, this replaces the continuous “another train” coming two tone sound with a sequence of 4 seconds of two tone followed by around four seconds of voice message like or similar to “WARNING DO NOT CROSS ANOTHER TRAIN IS COMING”. This sequence continually repeats.

3.1.8 The voice message audible warning unit requires different wiring compared to the YO3 unit to change between day and night levels. For this reason all audible warning units used at the crossing shall be the same type and cannot be mixed.

3.1.9 The voice message audible alarm may also be retrofitted to MSL sites without the benefit of ATC circuitry. In this case it can be arranged to give a voice message on the 1st train tone, “WARNING – MORE THAN ONE TRAIN MAY BE APPROACHING”.

3.1.10 A minimum of two audible warning devices shall be provided. They shall normally be sited on the reverse side of the primary road traffic signals in diagonally opposite corners. However if only one side of the road has a recognised footpath, then they shall be both sited on the RTL’s at the footpath side of the road.

3.1.11 For crossings other than MSL, and where the distance between YN & ZO road traffic light units is greater than 17m, extra devices shall be provided as follows:

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- Devices shall normally be provided at each corner of the crossing;
- Where there are four or more rail tracks and a sufficient 10' gap exists, then additional devices shall be sited on posts in the 10'. One on each side of the road that a recognised footpath exists.

3.1.12 For dual-carriageway roads, a minimum of four devices sited on the outside corners of the arrangement shall be provided.

3.1.13 Due account shall be taken of local site conditions, and the potential for noise nuisance.

3.1.14 The audible warning mounting bracket shall provide adjustment in the vertical and horizontal axes. The default pointing arrangement when mounted on an RTL shall be to point at the diagonally opposite RTL and to angle down to point at the centre of the crossing surface. This may be varied as required to suit local conditions.

3.1.15 On AHB, ABCL & AOCL crossings, the audible warnings shall commence at the normal repetition rate when the amber lights start. They shall cease when the red road lights extinguish after the train has passed over the crossing.

3.1.16 Where there is more than one track, if a second train reaches the strike-in point before the first train passes the crossing, the audible warnings shall change to the increased repetition rate when the first train arrives at the crossing. They shall continue to sound at the increased rate until the second train passes the crossing and the red lights extinguish.

3.1.17 If the second train reaches the strike-in point while the first train is traversing the crossing, the audible warnings shall change to the increased repetition rate immediately and continue until the second train passes the crossing and the red lights extinguish.

3.1.18 If a third train strikes-in before the second train has cleared the crossing, the audible warnings shall continue at the increased repetition rate until that train, or any subsequent train that strikes in, has passed the crossing and the red lights extinguish.

3.1.19 At MSL crossings where audible warnings are provided, they shall sound whenever the red light is displayed.

3.1.20 Where there is more than one track, then on a new crossing, the standard arrangements of ATC tone applicable for AHB, ABCL & AOCL shall be provided. Where the crossing is an existing MSL crossing that is being retrofitted with audible warnings as an improvement, - then ATC arrangements shall not be provided where they would require significant changes to the crossing circuitry rendering the installation non-cost effective. In this case the audible warnings shall continue to sound at the normal warble rate while the red light is illuminated.

3.1.21 At MCB, TOB and user worked barrier crossings the audible warnings shall commence at the normal repetition rate when the amber lights start. They shall cease when the barriers become fully lowered. The increased repetition rate is not used.

3.1.22 The position of the audible warnings shall be shown on the ground plan.

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3.1.23 During local control (where provided), the audible warnings shall function normally, but are inhibited for hand operation .

3.1.24 It is not necessary to prove the integrity of the audible warning devices. Failure to operate need not be indicated to the monitoring control point.

4 DOUBLE CUTTING OF LEVEL CROSSING CIRCUITS.

4.1.1 Double cutting shall be used where practical but some level crossing equipment in use does not allow for it. Examples presently incapable of double cutting include RTL's (But not MSL's), local control units, barrier detection circuits, boom proving etc. This situation is reviewed whenever alterations to typical circuits are under consideration. It is acceptable to continue with single cut tail cable circuits where shown in the published typical circuits.

4.1.2 Factors in this decision that single cut tail cables are acceptable include:

- Difficulty of providing double cut road light flasher units;
- Difficulty of doubling up contacts in barriers for detection and boom proving;
- Complications involved with introducing a double cut Local Control Unit;
- Relative shortness of tail cables;
- All tail cables are fed off one power supply that is checked for earths at regular intervals;
- No failures or issues have occurred in existing single cut circuits significant enough to cause a policy change.

NOTE, this does not in any way preclude further equipment being converted to use double cut circuits in the future, either when new equipment is introduced or circuits revised. If so, typical circuits shall be revised and reissued at that time.

5 CROSSINGS WHERE RETB, NSKT OR TPWS IS PRESENT.

5.1.1 If a crossing that uses a DCI is sited at the start of a block section for Radio Electronic Token Block, (RETB), No Signalman Token (NSTR), or No Signalman Keytoken (NSKT), then there shall be no connection or interlocking between the crossing and the block controls. The crossing and block shall be completely separate. Issue of a token shall not for instance cause the crossing to operate.

5.1.2 There shall either be a minimum distance of 50m between the block section board and the crossing DCI or they shall be combined on one board. If they are combined, the red flashing lamp of the DCI is not required as the stop authority is given by the board itself.

6 BARRIERS.

6.1.1 Barriers used at an AHB shall be drive up/gravity fall types, so that the barriers are intrinsically failsafe and in a total power failure, shall fall and block the road. A BR843 pedestal fitted with a standard "grey pack" is an example. Other types may be approved for use at AHB's in the future.

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NOTE, in the BR843 "Grey pack", the solenoid valves are normally open and require energising from a 24V supply to allow the barriers to raise. For easy identification, the hydraulic packs for these barriers are painted grey.

6.1.2 Barriers used at an ABCL, TOB or user worked crossing shall be designed to remain in the raised position in the event of power failure. A BR843 pedestal fitted with a "blue pack" is an example. A drive-up/drive down design of barrier also fulfils these requirements. (In the "blue pack", the solenoid valves are normally closed and require energising from a 24V supply to allow the barriers to fall. For easy identification, the hydraulic packs for these barriers are painted blue.)

6.1.3 Barriers used at MCB's and variants may be drive up/drive down or drive up/gravity fall as required.

6.1.4 The barriers shall be sited as close as reasonably practicable to the railway while still remaining clear of the fixed structure gauge. The barrier pedestals shall accept barrier booms from 3.6m to 9.1m in length (pivot to tip), in increments of 0.5m.

6.1.5 All new barrier booms shall be in accordance with BR 843, Appendix E or an approved alternative.

6.1.6 Booms up to 6m shall have a minimum of two lamp units. Longer booms shall have three lamp units. The lamp nearest the tip shall be at or within 150mm. The lamp units shall shine in both road directions. They shall be illuminated at all times except when the booms are fully raised. Where the boom light design allows, the lights shall be aligned facing oncoming traffic.

6.1.7 When lowered, the upper edge of the booms shall not be less than 900mm above the road surface at the centre of the carriageway. The clearance between the bottom edge of the lowered boom and the road surface shall not exceed 1000mm across the length of the boom unless a skirt is fitted.

6.1.8 When raised, the boom shall be inclined towards the carriageway at an angle of between 5 and 10 degrees from the vertical. When raised, any part of the boom or barrier equipment which is less than 5m above the level of the carriageway shall not be less than 450mm laterally from the nearside edge of the carriageway.

6.1.9 Where the barrier protects a footway, barrier equipment below 2000mm above the footway shall not be less than 150mm laterally from the edge of the footway furthest from the carriageway.

6.1.10 On a full barrier crossing, when lowered the barriers shall cover the whole width of the carriageway and footpaths. There shall be no space unfenced greater than 150mm width through which a pedestrian might gain entry to the crossing. On four barrier crossings, opposing boom tips shall be aligned within 50mm, and the gap between the tips when lowered shall be less than 65mm.

6.1.11 The gap of 65mm may be increased where the fulcrum of the barrier is above the line of the barrier boom as necessary to avoid the barriers tips touching during the early part of the rise, but where skirts are fitted, the gap between the two skirts shall not be more than 150mm.

6.1.12 The boom finish shall alternate between red and white bands 600mm long for the full length, starting at the tip with a section of red. It shall preferably be retro-reflective over its full area and length to no worse than BS EN12899-1, Class R2.

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Alternatively the main boom finish may not be retro-reflective, but in this case a retro-reflective strip no worse than BS EN12899-1, Class R2 at least 50mm deep, matching the red and white sections, shall be applied over the full length of the boom.

6.1.13 Moving parts of the barrier mechanism, excluding the boom and skirt shall be fenced off from the public.

6.1.14 The barrier shall be fitted to a (concrete) base slightly raised above the surrounding ground to give drainage and prevent water pooling in the bottom of the pedestal.

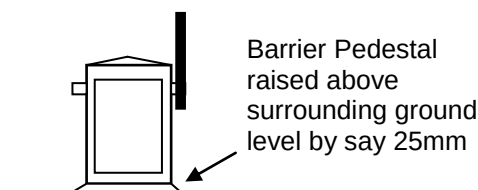


Figure 1 – Raising the barrier machine.

6.1.15 Skirts shall be fitted at manned or full barriers where it is known there is a significant risk of children deliberately passing under the booms, or where it is known herded animals are regularly taken over the crossing on the hoof. Skirts shall not be provided at an AHB or ABCL.

6.1.16 The skirt shall fence in the space between the lowered boom and the surface of the carriageway. The gap between the bottom of the skirt and the road surface measured at the crown of the road shall be nominally 127mm, - but may be altered as a result of kerb height or camber on the road.

6.1.17 Each barrier pedestal shall be fitted with voltage free contacts for detecting the following positions from the horizontal. The contacts shall have some adjustment round these positions as in (table 3).

Table 1 – Pedestal contacts.

Function	Angle From Horizontal	Comments
Up detection.	81° - 90°	Undesirable for the maximum vertical displacement to extend beyond 87° so that wind does not prevent the fall of the barriers (Gravity fall types).
Down detection.	0° - 4°	-
Motor cut of lowering.	2° - 90	For drive down type barriers.
Motor cut Off.	0° - 83°	It is important that there is a sufficient overlap between Up detection and the motor cut off. This overlap shall be a minimum of 2° in all cases.
Lights cut Off.	40° - 90°	Used to switch off the flashing red road lights when the barriers are rising. May be adjusted lower than 40° at some sites if the requirement is to switch off the lights before the barriers reach 45°

6.1.18 All barrier booms shall be fitted with a fracture segment (or equivalent), near their base that shall be the normal point of breakage should the boom be physically displaced to the point of failure.

6.1.19 At any manned crossing where the operator is not immediately adjacent, the

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fracture segments shall be provided with proving contacts that shall give an alarm when a barrier boom is broken. They may also replace protecting signals to danger.

6.1.20 At automatic crossings there shall be a method of indicating to the signaller when a boom is broken.

NOTE On gravity fall barrier types this is normally done indirectly by barrier operation and circuitry. The remainder of a damaged boom can be expected to either raise immediately, or fail to lower when it is next called to do so. The lack of down detection can be seen by the crossing circuitry and an alarm generated. Where barrier operation will not otherwise provide an indication of a broken boom, the fracture segments can incorporate a proving contact to give an alarm.

6.1.21 Barrier motors draw a high current. The minimum external power cable size to a barrier pedestal shall be 35mm². Where cable runs are greater than 50m, a minimum of 70mm² shall be used.

6.1.22 Where cables to barriers cannot be of similar length, then the design may use larger diameter cable to the barrier machine/s furthest away to give a similar volt drop to all barrier machines. This acts to equalise barrier rise times.

6.1.23 The contactors used to switch power to the barrier motors shall be an approved type incorporating a facility to detect overload or overheating. In the event of a fault that prevents the barriers reaching the raised position, this feature shall automatically disconnect the supply to the barrier motors before permanent damage occurs.

6.1.24 Within the associated control apparatus housing, internal wiring carrying power to the barrier motors shall have as large a cross-sectional area as practical, consistent with terminations and connectors to minimise on-load volt drop.

6.1.25 On lines electrified with overhead systems, the boom, if not made of metal itself shall be fitted with a continuous conducting strip along its full length electrically equivalent or better than 35 sq mm of copper. The metal boom or conducting strip shall be bonded to the barrier pedestal main structure by a flexible strap of minimum size 83 mm² by-passing the main boom bearing. The barrier pedestal shall be bonded to the traction return rail with an approved bond.

6.1.26 Provision shall be made in the barrier design and circuitry for hand operation. This shall allow manual operation of the barriers without power being available.

7 EVENT RECORDING.

7.1.1 All new or extensively re-wired level crossings shall be provided with event logging.

7.1.2 For relay based crossings, this shall monitor voltage free contacts of the relays, contactors or switches used to control the crossing. One contact of each function shall be wired to a pair of disconnectable links, from where it shall be taken into the event logger.

7.1.3 For electronic or solid state based level crossing controllers, event logging shall either be an inbuilt feature of the level crossing controller or a separate event logger shall be provided adjacent to the controller.

7.1.4 The functions to be monitored for a relay based crossing are shown in the typical circuits for the crossing type. As a minimum they shall be:

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- The relay used to initiate the operating sequence e.g. (CON)SR, HER etc;
- The relay used to initiate the flashing red road lights (where provided);
- Local control normal (where local control provided);
- Local control unit door (where local control provided);
- Main power supply;
- Amber lights working;
- Each flashing red road light cluster working (where provided);
- Exit treadles (where provided);
- All train detection functions used in the level crossing;
- Second train coming mode (where appropriate);
- Up & Dn detection (where barrier detection provided)
- Any output functions from an Obstacle detector (where provided).

7.1.5 Electronic or solid state crossing controllers shall as a minimum have the equivalent functions logged.

7.1.6 Where specific complications exist, the event logging shall cover the complications adequately, consistent with practicality and site conditions.

7.1.7 In general, any function which may ease later analysis in the event of an incident is worthy of consideration for monitoring. There is usually no requirement to monitor more than one repeat of a function i.e. TPR, T2PR, T3PR, unless each repeat is used to initiate different events.

7.1.8 If sufficient contacts are not available, repeat relays shall be generated. Designed so that where repeat relays are provided, this shall not reduce the overall safety of the level crossing.

8 TRACK CIRCUITS USED AT LEVEL CROSSINGS.

8.1.1 Bi-directional controls shall be provided by default at all new or renewed automatic level crossings and MSL's. This is to minimise the need to provide staff for single line working and engineering work. In exceptional circumstances where the provision of bidirectional controls would be extremely difficult due to other signalling or operations close by, then with agreement of the appropriate operating manager, bidirectional controls need not be provided.

8.1.2 Track circuits used for the initial strike-ins of AHB, AOCL, and ABCL crossings or MSL's shall be supplemented by duplicated treadles at the strike-in end. (Entrance treadles). This shall apply for normal and wrong direction strike-ins. The treadle on the left hand rail in direction of travel is normally named number 1, and the treadle on the right hand rail in direction of travel is normally named number 2.

8.1.3 Where an electronic treadle is internally duplicated, (such as certain GETS models based on axle counter technology), further duplication is not required. One of these treadles satisfies the requirement for duplication.

8.1.4 Axlecounters may be used instead of track circuits providing adequate