Signal Training Bulletin

COMMITTEE G: Education & Training
Communication & Signal Division, AAR

E-2 Highway Grade Crossing Warning Devices; Operating Principles

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Definition: Electrically operated signals used to warn highway traffic of the presence or impending presence of a train at railroad-highway grade crossings.

Symbols: There are several types of warning devices in use. Each type has its own symbol which will be shown in the Signal Training Bulletin covering that type.

General Information: The following are some of the major design and operating criteria (principles) that a properly installed warning system must meet.

1) On the approach of a train, the warning devices must begin to operate a sufficient duration in advance of the train's occupancy of the crossing so that vehicles at the crossing can safely clear the crossing before the arrival of the train. Also vehicles approaching the crossing must have adequate advance warning to permit controlled braking before reaching the crossing.

The conventional flashing-light signal type warning device is most often employed where a single track crosses a highway. In this system, three track circuits are used to detect the presence and location of trains, although type C tracks circuits and motion sensitive devices are becoming increasingly popular.

A train is shown moving towards the crossing in Figure 1. As soon as the train's leading wheels pass the insulated joints it will be occupying the WT(west track circuit) and the WT relay in the instrument case at the crossing will de-energize and start the flashing-light signals to operate, thus alerting the motorists of the approaching train.

To satisfy the criteria that the motorist receives enough advance warning, the speed of the train and the length of the track circuit (WT) must be considered. The minimum advance warning time allowable is 20 seconds. That is to say, that the train in Figure 1 should not arrive at the crossing for at least 20 seconds from the time the WT is first occupied. The person designing the system must know the maximum allowable train speed on this section of track and then calculate the required length for the track circuit.

Example: Maximum train speed = 65 mph. How long must the track circuit be?
At 65 mph, a train travels 95.3 feet per second. Therefore, in 20 seconds the train will travel 20 x 95.3 = 1907 feet.
The WT in this example must be at least 1907 feet. In actual practice, many designers add a 2 second safety factor to allow for relay operation. This would increase WT length by 2 x 95.3 = 191 feet, making the WT circuit 2098 feet long.

The ET circuit in Figure 1 would also be 2098 feet long to provide adequate advance warning of trains approaching from the east.

The XT is a much shorter track circuit, the length being determined by the width of the highway. The insulated joints would be installed a few feet beyond the crossing planks on each side of the road, but at least far enough so a car or an engine cannot span XT circuit.

2. When a train has passed over the crossing and the

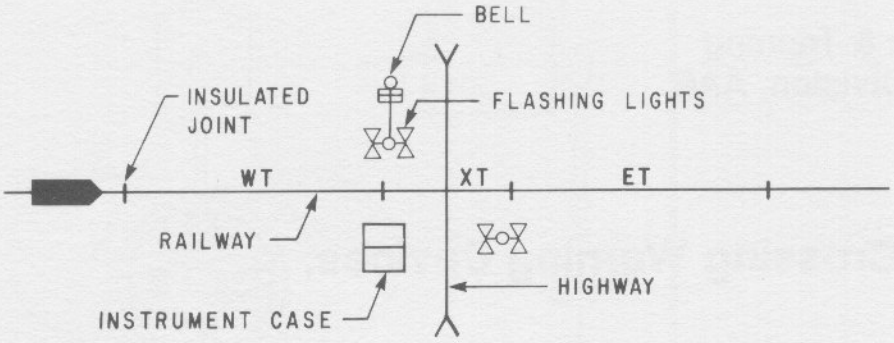

Figure 1 General schematic of rail-highway grade crossing with train approaching from the west (left).

complete train is clear of the driven portion of the highway, the warning device must cease to operate to allow free flow of highway vehicles.

This is accomplished by detecting the train's direction through sequence of track circuit occupancy which operates the controls to turn the lights off when the train moves off the XT circuit.

3. All materials, devices and circuit design must meet or exceed AAR Signal Manual Recommended Practices.

These are but a few of the many requirements which must be followed when designing, installing and maintaining highway grade crossing warning devices.

Note: This Bulletin is for general information only. For specific applications, consult the rules, standards and instructions published by your railroad.

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