BOMBARDIER

General Installation Specification

Transponder JGA 29001/6

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1 General

1.1 About the document

This document describes the installation requirements for the Transponder.

It should be used during the initialising phase of an installation application. Information from this document may be used for preparing an application specific "Installation instruction".

When preparing such a document by using information from this document, remove all unessential parts, and leave only information that is important for the installation team to know.

All new documents that are based on this document must contain a reference to this document, so it is possible to see what revision that was used.

When defining the installation requirements for the wayside equipment, consideration must be taken to the requirements for the onboard equipment. The tolerances for the transmission system are dependent both on wayside and onboard equipment.

This document is *not* meant to be used as an installation instruction for the installation team during the serial installation.

1.2 Information to user

This Device complies with Code of Federal Regulations 47 Part 15 (FCC Rules). Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by Bombardier could void the user's authority to operate the equipment.

No special accessories to meet the emission limits requirements are needed.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

1.3 Definition of terms

Abbreviation	Description
ATP	ATP is the abbreviation for Automatic Train Protection system, which is a speed supervision system.
Transponder	Device that transmits information to a passing ATP-equipped vehicle.
FCC	Federal Communications Commission
PCB	Printed Circuit Board
Crosstie	Sleeper

2 Transponder

2.1 General

The transponder is the device acting as a transponder, which transfer the wayside data up to a passing vehicle via a high frequency radiation signal.

The transponder is placed in the track, between the two rails.

The default telegram will be individually programmed for each transponder.

The transponder is passive, and powers up via a 27 MHz signal from the vehicle antenna. Then the default telegram of the transponder is transmitted to the vehicle antenna.

The transponder-to-vehicle carrier frequency is 4.5 MHz.

2.2 Mechanical design

The transponder mainly consists of:

- A plate containing antenna loops
- A receive and transmit PCB
- A PCB protection hood, including a wall mounted mail connector
- An input plug connector protection hood.

The weight of the transponder is 6 kg.

Operating temperature range is between –40° and +70° C.

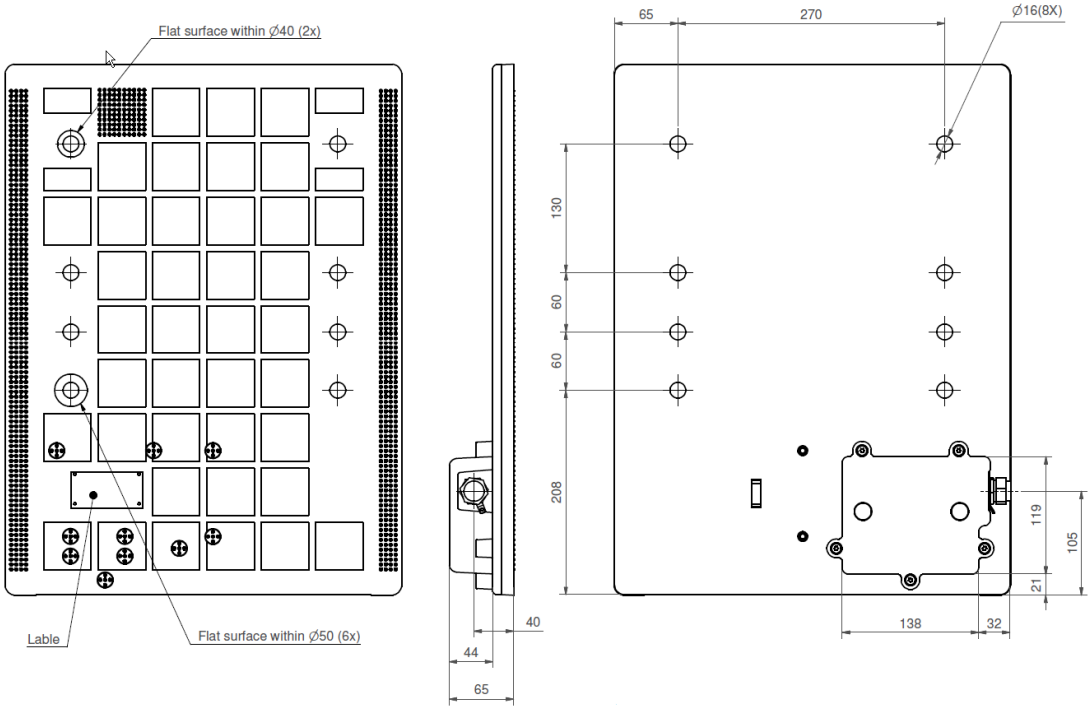
The figure below gives the main dimensions of the transponder.

The 536 × 400 mm plate is made of glass fibre reinforced polyester, with the antenna loops cast inside. It has 8 holes for different mounting situations:

- Directly on top of a wooden or concrete crosstie
- On to a specific mounting bracket mounted on the crosstie.

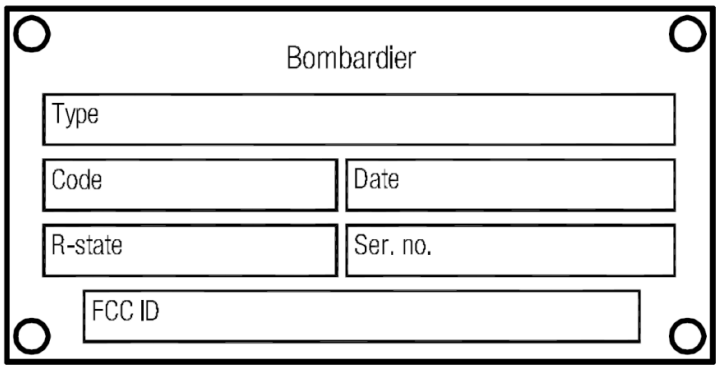
The PCB is located on the underside of the plate. It is covered by the plastic protection hood which is attached to the plate with screws. The entire PCB cavity is then filled with a polyurethane gel to protect against moisture.

The input female connector plug is protected against mechanical damage by a connector protection hood.



Mechanical design of the transponder (balise)

On top of the transponder a marking plate (label) is attached.



2.3 Programming of Transponder

The transponder must be programmed with a default telegram, according to the projecting documentation. The transponder is programmed with an all zero telegram when manufactured.

The default telegram is to be established during the wayside projecting.

Note: Direct after that the transponder is programmed; the protection cup must be properly attached to the transponder connector

2.4 Location of Transponders

2.4.1 Mounting location

2.4.1.1 General

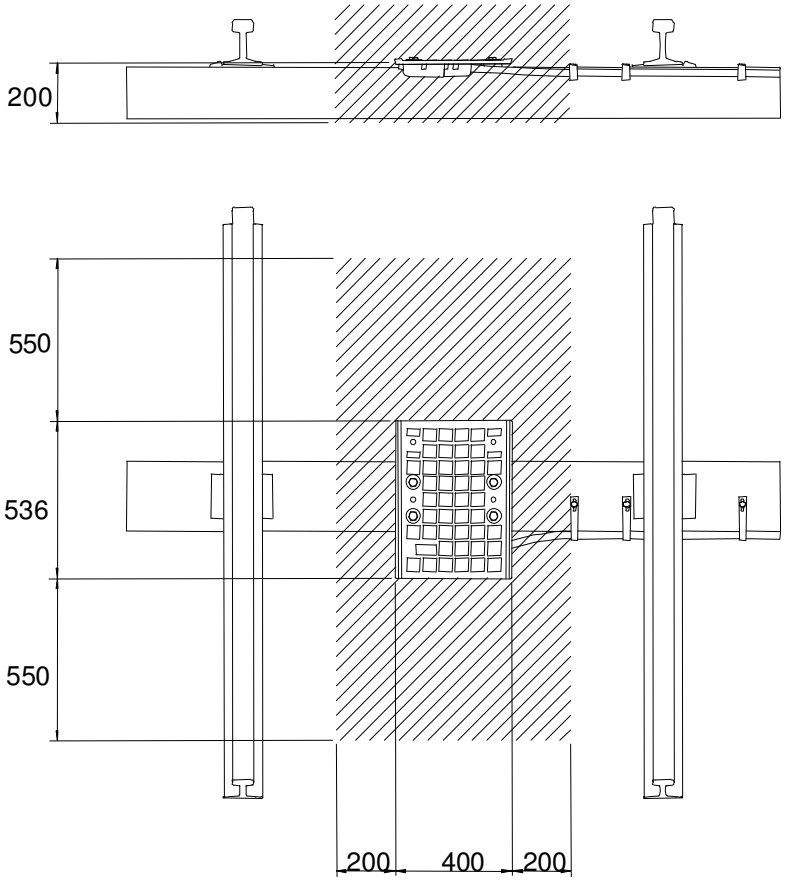
Normally transponders should be located within an attenuation free area.

No metal objects except for reinforcing iron in the crosstie and mounting bolts may be within the shaded area according to figure below.

Unobstructed space must surround the transponder so that information can be transmitted without disturbances.

If these conditions are not fulfilled a transponder fault can occur as a result of disturbances in the transmission between the vehicle and the transponder.

NOTE:
Deviations from these requirements are absolutely forbidden without written permission from Bombardier.



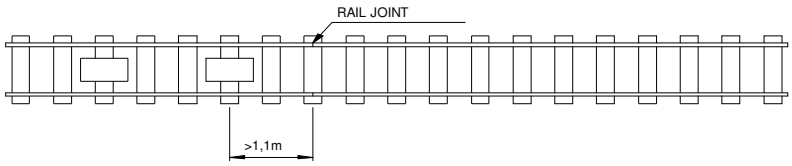
Attenuation free area

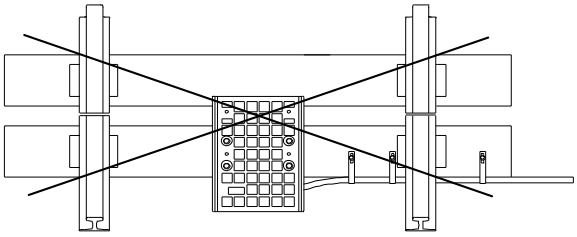
2.4.1.2 In points

Location of transponders in points should be avoided. Metallic parts in the point may cause disturbances to the transmission. Mechanised track maintenance equipment and e.g. snow removal equipment can damage transponders. It is also difficult to fulfil the requirements regarding the maximum deviation of the lateral position. See chapter 2.5.2.2.

2.4.1.3 At rail joints

Strain and movement in the track are greatest at the joints. Here transponders can be damaged by mechanical strain. It is recommended to locate transponders not closer than 1.1 m from the centre of the transponder to a rail joint.

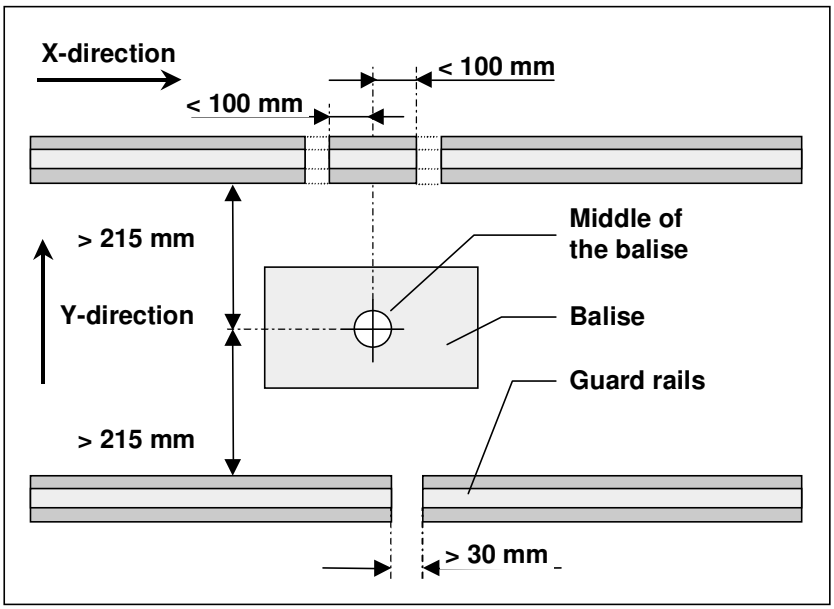




Caution: Installation like this will break the transponder when the first vehicle is passing.

2.4.1.4 At guard rails

For ensuring both cross-talk protection and reliable transmission, guard rails in the vicinity of transponders shall be cut, leaving gaps of at least 30 mm. Such a cut (one in each rail) shall be done within ± 100 mm in the X-direction from the middle of the transponder.

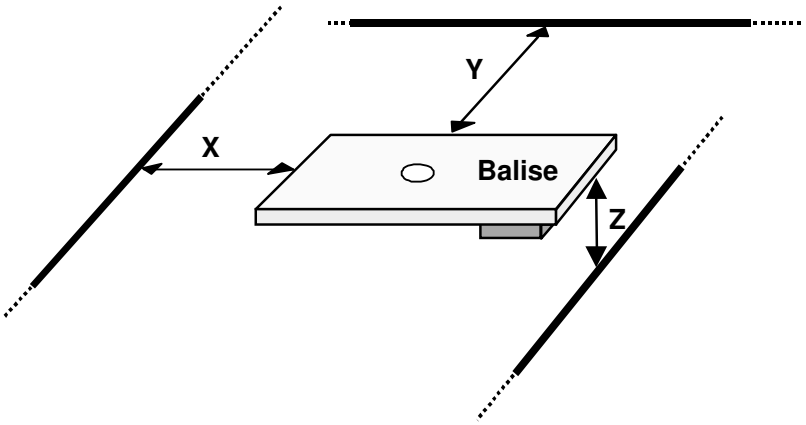


Guard rails in the vicinity of the transponder (balise), only one cut per rail is needed.

2.4.1.5 In the vicinity of cables

The transponder shall be installed in such a way that the interaction with conductors is low. The transponder shall be far enough from a conductor to guarantee that the interaction with the conductor does not cause Safety cross-talk.

If a conductor is more than 1 m from any edge of the transponder in any direction it can be assumed that these requirements are fulfilled.



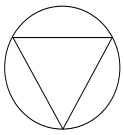
Location of cables/conductors in the proximity of the transponder (balise).

2.5 Mounting of Transponder

2.5.1 General

The transponder shall always be programmed with a default telegram in its memory. The programming can be performed in connection to the installation or be performed in advance.

If the transponder is programmed with the default telegram in advance, it must be checked with the documentation for the current installation that the right individual of transponder is prepared to be mounted on right place. Check also which mounting method should be used.



SAFETY REQUIREMENT:
The installation routines must either ensure that no trains allows to pass an information location that not are approved, or ensure that ATP is not in operation for the actual information location (construction area is set).

Different types of crossties require different types of attachment for transponders. The attachments are designed in a way that metal parts cause insignificant attenuation of the transmission. The design makes the transponders lie at the same height relative to the head of the rail, regardless of which type of attachment that is used for mounting.

It is absolutely forbidden to change an existing attachment or to provide new designs without consulting Bombardier.

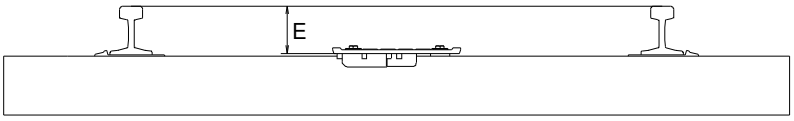
2.5.2 Mounting position

The transponder should be mounted in such a way that it fulfils the specified distances between the antenna and the transponder.

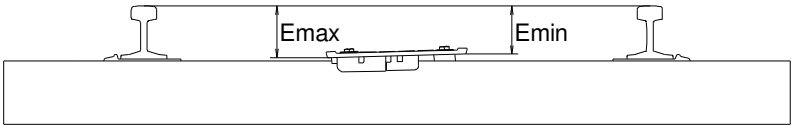
It is not possible to set the mounting distances and tolerances for the transponder without taking any consideration to the mounting distance and tolerance for the antenna on the vehicles. The co-ordination between tolerances for onboard and wayside equipment must be stated in the initialising phase of an ATP-application.

2.5.2.1 Vertical position

The recommended distance from the transponder mounting plane to the top of the rail (E), is *TBD* ± 20 mm. In the tolerance, reduction for the height of the rail according to rail wear must be considered. That means the rail wear must be within the tolerance.



Furthermore, the difference in distance between the four corners of the transponder and the top of the rail should not exceed 11 mm. $E_{max.} - E_{min.} \leq 11$ mm.

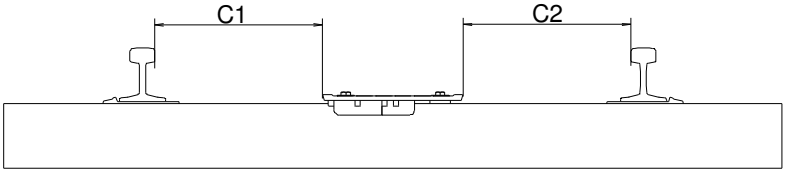


Note: If the transponder shall co-operate with other type of antenna, investigation on mounting height is needed.

2.5.2.2 Lateral position

The transponder shall be mounted in the middle of the track, with a tolerance of ± 20 mm.

The transponder position shall be checked by measuring the distances from the rails to the middle of the sides of the transponder. See the figure below and the figure in chapter 2.5.2.3.



The difference between C1 and C2 should not exceed 40 mm

$| C1 - C2 | \leq 40$ mm·

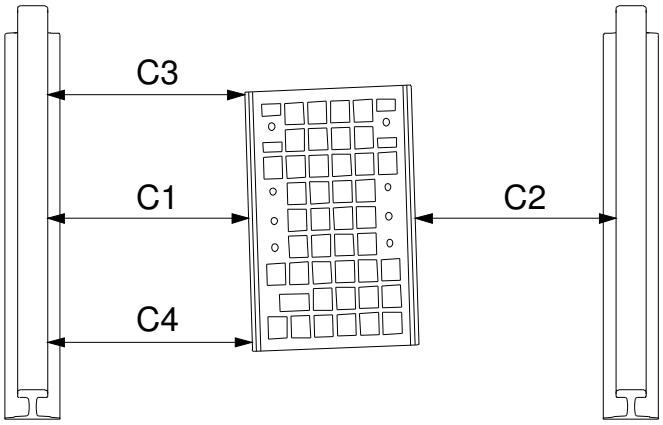
2.5.2.3 Yawing

The transponder must be mounted correctly rotated in its horizontal plane.

The transponder shall be mounted with its longest sides in parallel with the rails.

The function of the transponder is independent of the travelling direction of a passing vehicle.

The transponder position shall be checked by measuring the distance from the rail to two of the corners of the transponder (C3 and C4). See figure below and chapter 2.5.2.2.



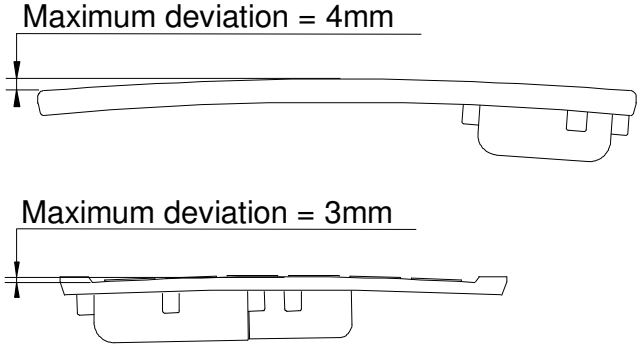
The difference between C3 and C4 should not exceed 18 mm

$| C3 - C4 | \leq 18$ mm.

2.5.2.4 Plane tolerance

The mounting surface of the crosstie must be plane.

It is not allowed to bend or crack the transponder. Lengthways the maximum deviation from its original shape is 4 mm if the transponder is bent in a smooth curve. Straight across the maximum deviation is 3 mm.



2.5.3 Attachment of transponder to crossties

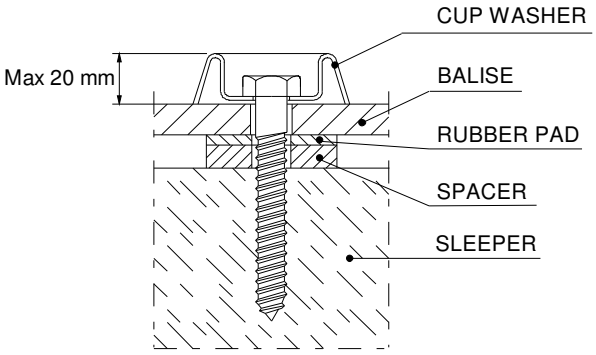
There are 8 attachment holes in the transponder to be chosen and used depending of the mounting method. Usually 4 holes are used.

Dimensions and type of the fastening screws are chosen according to local requirements. The recommended dimension is between 10 and 14 mm in diameter. The screws shall as an anti-rust protection at least have a hot zinc-coating.

The mounting surface on the crosstie must be plane. If it is not plane it is a big risk for bending the transponder when mounting it. This will sooner or later lead to a failure in the transponder. If the mounting surface not is plane it is necessary to smooth it before mounting the transponder, see also chapter 2.5.2.4 about plane tolerances for the transponder.

Between the transponder and the crosstie there must be rubber pads. These relieve strain when the screws are tightened, and compensate for movements in the crosstie. The rubber pad should be about 4 mm thick; the degree of hardness should be about 70° Shore.

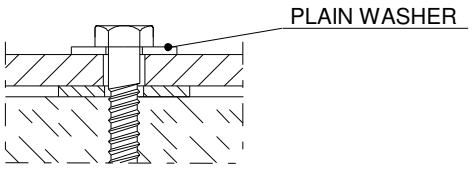
If it is necessary to adjust the mounting height of the transponder, attach a compensating spacer between the rubber pad and the crosstie. Such spacers must be made of non-metallic material.



The maximum allowed height above the top surface of the transponder (balise) for the mounting articles are 20 mm. See figure above (Sleeper = Crosstie).

On top of the transponder there must be a washer between the transponder and the head of the screw. The washer must have a minimum outside diameter of 40 mm. There are two types that may be used:

1. To make it more difficult for unauthorised persons to dismount the transponder, a cup washer that makes access only for a socket screw wrench to unscrew the fastening screw can be used. See figure above.
2. A plain washer. See figure below.



The maximum downward mounting force from the mounting screws are given by a maximum torque of 80 Nm for a nut screwed on a M12 thread. The minimum mounting force must be big enough to ensure a correct fastening of the transponder.

The mounting force is very difficult to estimate when mounting on wooden crossties. However the force must be big enough to ensure a correct fastening of the transponder, but not so big that it cracks or bends the transponder.

When the transponder is mounted check that the transponder is not bent more than allowed, see chapter 2.5.2.4.

2.5.4 Example of attachment to wooden crossties

The mounting procedure below presumes that this attachment screw is used:

Screw: T6S 12×120 fzv or similar

It is advisable to bring spare parts of the screws for the connector protection hood, “DIN84 MCS M5×16 RFST A4” the Bombardier art. no of the screws is SBA133050/0160

Mounting procedure

1. Check with the transponder tester that the transponder is programmed with the correct default telegram, according to the installation documentation.
2. Centre the transponder in the middle of the track.
3. Check that the mounting holes are symmetrical relative to the edges of the rails.
4. Mark the mounting holes with chalk or equivalent. Then drill the holes.

   For beech or other similar hardwood crossties, use an 11 mm drill bit and drill the holes 100 mm deep.
   For pine crossties use a 9 mm drill bit and drill the holes 60 mm deep.
5. Attach the protection cap on the transponder connector.
6. Put carefully the transponder to its right position and perform a test of the transponder, where the default telegram is checked with the transponder test equipment
10. Carefully check that the transponder lies free from ballast so it will not be bent. Take in consideration that the crosstie is pressed down through the ballast when a train is passing.
11. Insert some soft material, e.g. rubber pads, beneath the transponder. These relieve strain when the transponder is tightened and compensate for strains that build up as the wood expands and contracts in wet and dry weather.
12. Provide the screws with washers and screw them into the drilled holes. Use a nut runner with a 19 mm socket or a ratchet type spanner.
    Tighten the screws firmly enough to secure the washer.
13. Check that the transponder is correctly mounted by measuring the mounting position, and plane deviation according to chapter 2.5.2 "Mounting position".
14. Smooth out the ballast around the transponder.

18. Perform a function test according to the "Approval test instruction" documentation.

2.5.5 Example of attachment to concrete crossties

There are a lot of different methods for attaching a transponder to a concrete crosstie, and there is up to local requirements which one to use:

One method is to use bolts or insert fastened directly in the crossties for mounting of the transponder. In this case the manufacturer of the crosstie has to approve the fastening method. The mounting procedure is similar as for attachment in wooden crossties.

It is also possible to use some kind of mounting brackets. There are a lot of different models of concrete crossties, so no detailed instruction will be stated in this document. It has to be defined for each application. Contact Bombardier for advice and approval.

3 Test of installation

Before the installation can be approved for traffic, the inspection and test procedures must be performed.