Knorr-Bremse Group

Presentation of EDT101

Working Group on Derailment Detection

Rome , October 13th – 15th, 2014

Motivation for the Development of Derailment Detectors

In the 1990s there were a couple of severe accidents caused by derailment of tank cars in Switzerland

Stein-Säckingen, 1991:	8 tank cars derailed
Zürich-Affoltern, March 1994:	5 tank cars derailed
Lausanne, June 1994:	14 tank cars derailed

The derailments were not immediately detected and caused damages resulting in millions of Swiss Francs

Knorr-Bremse's Oerlikon-Knorr Eisenbahntechnik AG (OKE) became part of a project team with SBB to develop countermeasures.

The intended solution was oriented towards a very simple pneumatic system able to react to the oscillating forces induced on a wagon frame by a derailment.

Our Motivation for the Design of the specific Derailment Detector EDT100/EDT101 (1)

- Freight cars must be robust, interoperable and should not require any specific maintenance (at least not more than they already have)
- Rail freight is very cost sensitive and the financial burden of additional equipment must be very reasonable
- A derailment does normally not lead to an immediate disaster as the car continues to run until an “obstacle” like a switch comes in the way
- As a derailment does not cause a significant drag the loco driver has hardly a chance to realize it
- There is no electricity available in freight cars (and even worse: electricity is often forbidden is certain highly explosive areas). ***But even if so:***
- Communication with the loco driver of an electronic derailment device by cable would require that **all existing freight cars** must be retrofitted with electric lines causing a high investment burden and additional work in the marshalling yards
- If the communication is done wireless then the devices have to be assigned to the train consist, resulting in additional work in the marshalling yards
- Anyhow still today electronic devices would cause a significantly higher investment than pneumatic devices

Our Motivation for the Design of the specific Derailment Detector EDT100/EDT101 (2)

- Other than in case of a fire – especially in passenger trains – where an immediate stop might be critical (e. g. in tunnels) quickly taking out kinetic energy is a good idea in case of derailments and is even demanded by the TSI SRT (2008, page 28):

4.4.2. Emergency rule

The IM's operation rules shall adopt and develop in more detail, if necessary, the principle that in case of an incident
(except a derailment, that requires an immediate stop)

→ The selected design was therefore a pure pneumatic device that needs no maintenance at all and uses the same safety feature (stop the train automatically) that has been proven for more than 100 years in case of train separations and other incidents when the main brake pipe was opened

Functional Principle of Knorr-Bremse Derailment Detector EDT101 (1/3)

The purpose of a derailment detector is to stop the train by activating automatic application of the brake when its triggering threshold has been reached after the occurrence of a wagon derailment.

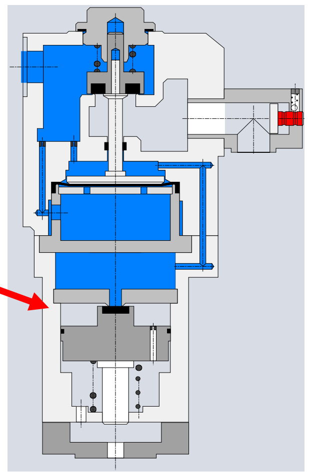
The derailment detector cannot prevent derailments.

Its presence on a vehicle should never be used as an excuse for cutting back or compromising on preventive vehicle maintenance.

Driving and Pipe Filling

- Brake pipe connected to the blue reservoirs
- Spring coupled mass
  reacts on vertical accelerations
- As long as the vertical accelerations
  are below the trigger level nothing happens
- The upper valve portion which vent the Brake Pipe is derived from the well known NV3/NV4/NV5011 emergency valve family by Knorr Bremse.

Driving and Pipe Filling

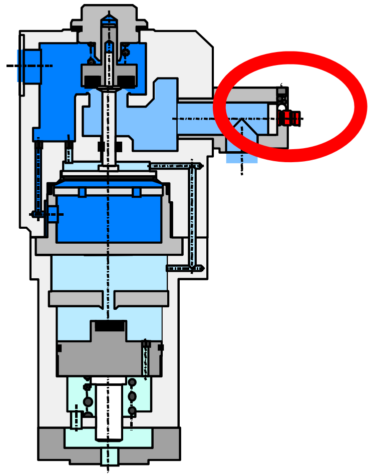


Functional Principle of Knorr-Bremse Derailment Detector EDT101 (2/3)

Derailment Detection

- As soon as the vertical accelerations are above the trigger level the emergency brake valve is activated
- The ventilation of the brake pipe causes the train to stop automatically
- Identification of the activated device by a red marked indicator

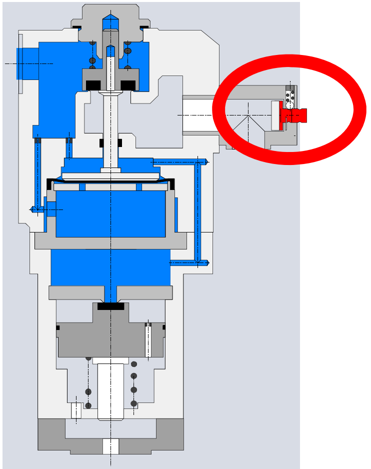
Derailment Detection



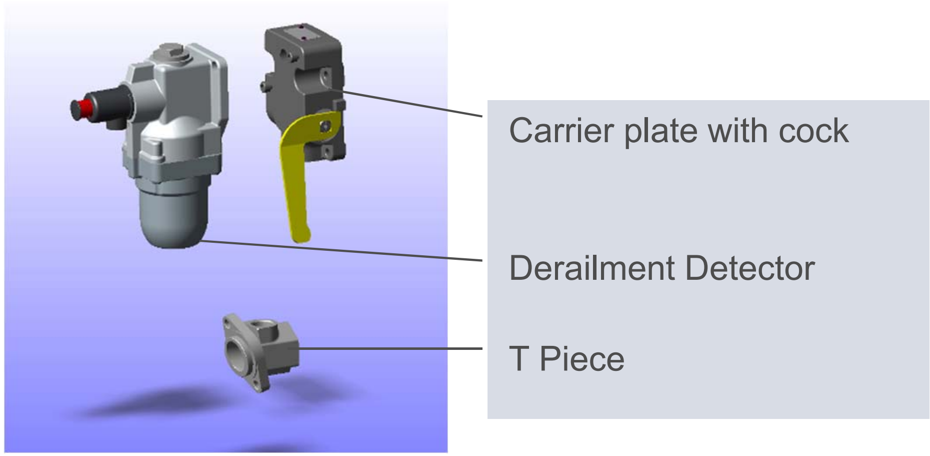
Functional Principle of Knorr-Bremse Derailment Detector EDT101 (3/3)

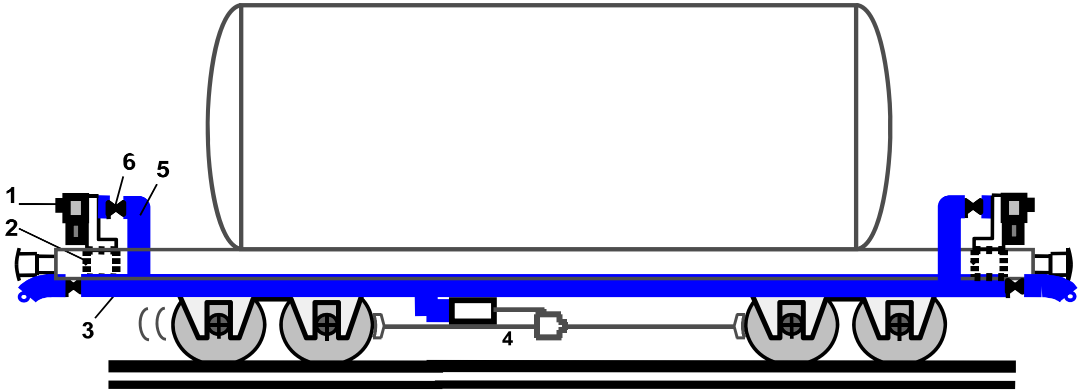
Automatic reset after detected derailment

- Automatic reset of the unit and therefore automatic return of the whole train in the “drive” mode
- Identification of the activated device by a red marked indicator is kept unless the indicator is manually pushed back into the “not activated” position



Installation of Derailment Detector EDT101



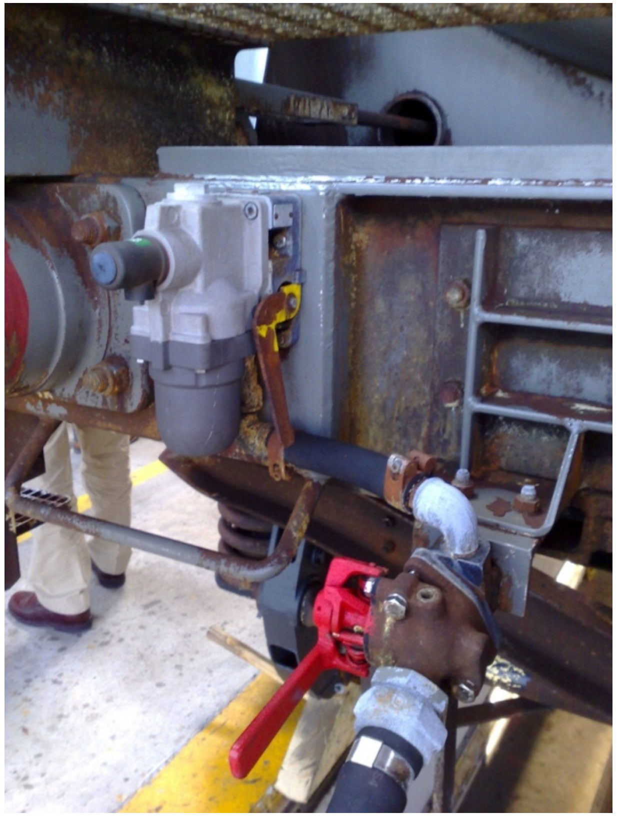


Installation remarks:

- Usable in trains with indirect air brake
- Best detection close to bogies, therefore 2 units per wagon recommended
- The derailment detector shall be installed after a **modal frequencies analysis of the freight car**

1 Derailment detector
2 Buffer plate
3 Main brake pipe
4 Brake system
5 Connection pipe
6 Isolation Cock

Knorr Bremse EDT101 example of installations on freight cars



Installed Units

Until 2008 more than 2,500 EDT100 were delivered, some 700 of them were converted into EDT101 in Switzerland

Below is the list of deliveries of EDT101 according to the countries of delivery:

France	114
Germany	720
Switzerland	713
Russia	4
Slovenia	161
South Africa	2
Total	**1,714**

Other projects are in the pipeline.

Definition of Trigger Level & Resulting False Alarms

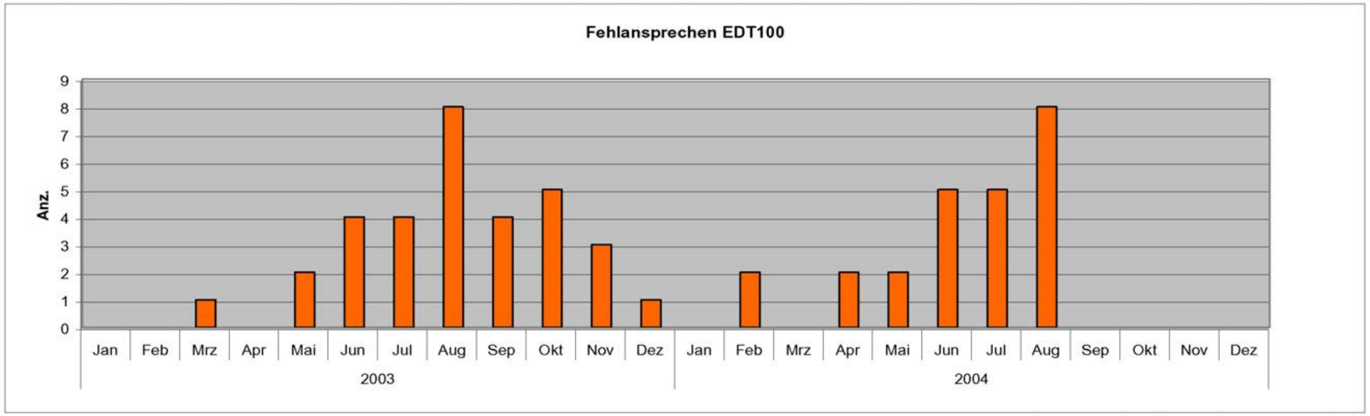
The trigger levels of the original EDT100 were 7.5 ± 2.5 g. From March 2003 to August 2004 false alarms became noticeable in Switzerland: 56 in 18 months on a fleet of 623 wagons (1,246 EDT installed) corresponding to 3% per EDT and per year in average.

Two reasons were identified:

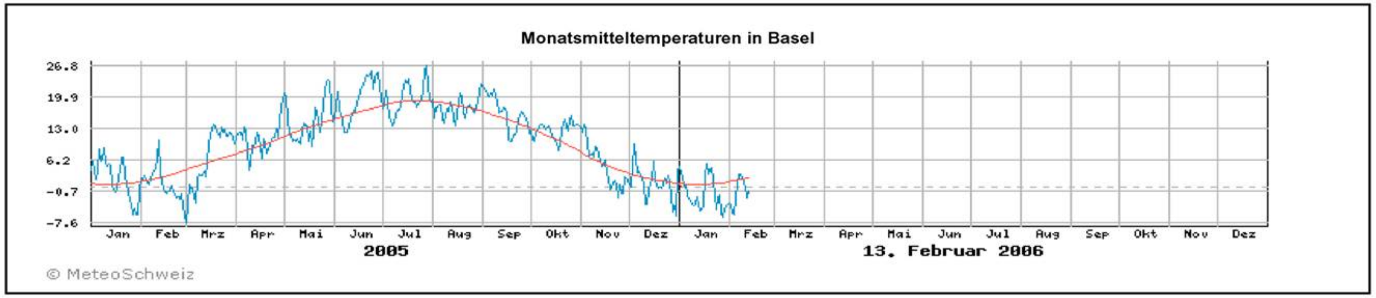
- Vibration levels in normal operation are higher than seen before
- The lubrication in the EDT had a too high temperature dependency

Anzahl Ereignisse - Fehlansprechen EDT100

2003												2004											
Jan	Feb	Mrz	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez	Jan	Feb	Mrz	Apr	Mai	Jun	Jul	Aug	Sep	Okt	Nov	Dez
		1		2	4	4	8	4	5	3	1		2		2	2	5	5	8				

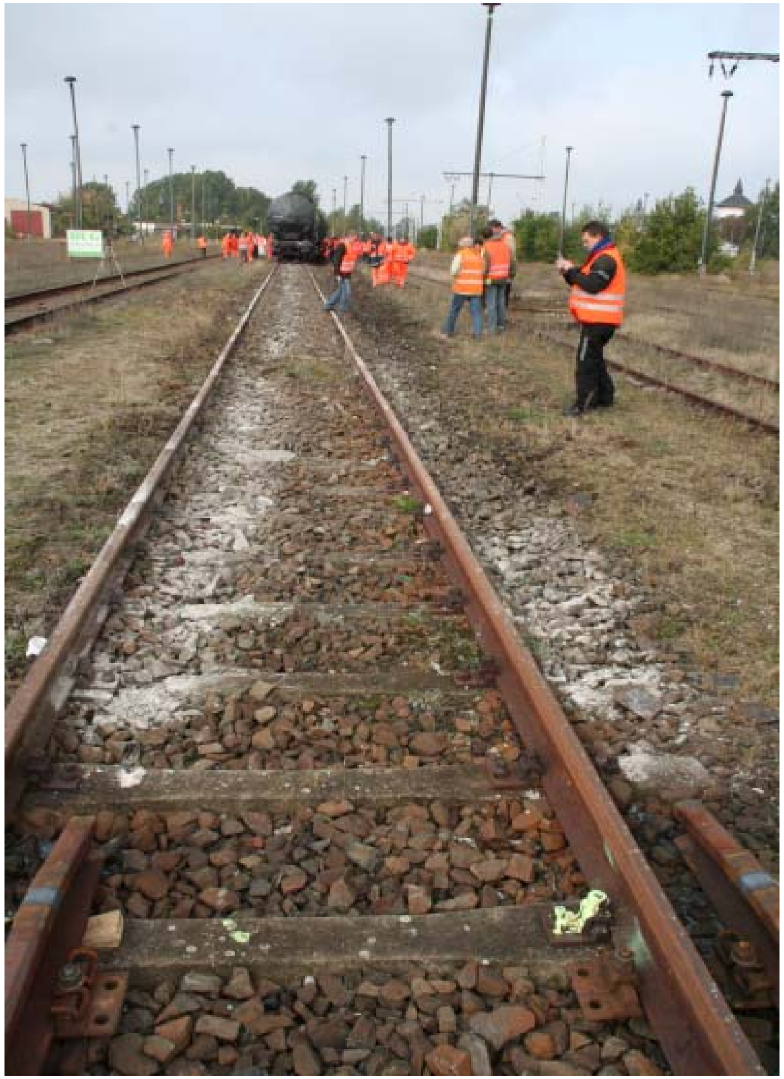


Quelle: SBB, Fehlalarme EDT vom 18.08.2004



Derailment tests according to prove sensitivity of EDT 101
Berlin, October 11th & 12th, 2007

Derailment tests according to prove sensitivity of EDT 101
Berlin, October 11th & 12th, 2007



Definition of Trigger Level & Resulting False Alarms

As far as KB is aware of, none of the false alarms of the old design has led to unsafe conditions or accidents by the automatic brake application along the train.

Additionally to the change of the trigger levels and the mitigation of the temperature dependency the dramatic decline of the false alarms has been achieved also through a dedicated installation process based on a wagon specific mechanical test for avoiding the triggering by oscillations not originated by an actual derailment.

Since the introduction of EDT101 in 2007, (1,714 pieces installed) the number of actual false alarms **reported to Knorr-Bremse is 0**.

Assuming, that 1 error would occur soon, the maximum resulting failure rate can be calculated as follows:

*< (1 activation * 12 months)/(96 months * 1,714 EDT) = < 0.0073 % per EDT and year*

maximum of false alarms	per year	8 years period	installed base

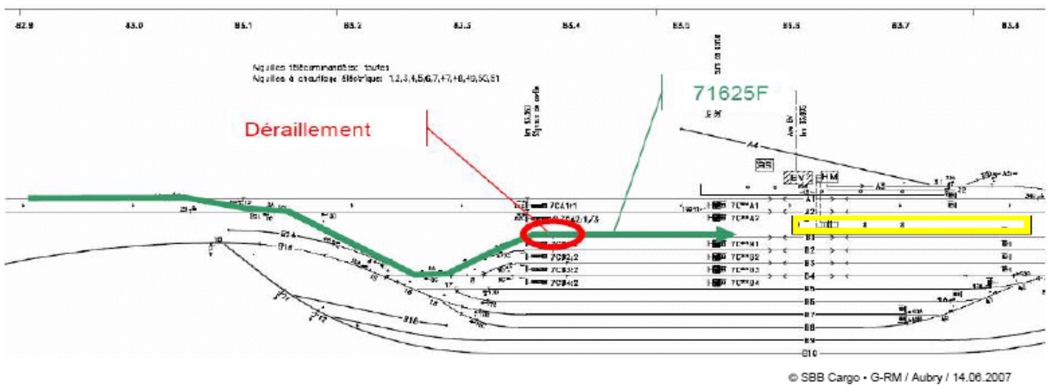
ERA had concluded in 2009 that a maximum false alarm rate of less than 2…3 % per EDT and year would lead to a positive financial impact (benefit – cost result) for derailment detectors.

(Source: European Railway Agency: Impact Assessment on the use of Derailment Detection Devices in the EU Railway System, Final report, May 2009, page 74)

Positive interventions

Knorr Bremse got knowledge of 2 interesting cases where the EDT101 intervened positively

Swiss freight train in Cornaux (March 2006). 4 out of 20 tank cars derailed due to rotten sleepers.
One of the four wagons was equipped with an EDT which stopped the train.



Case study for a typical derailment

The majority of freight wagon derailments do not – luckily – occur on high-speed sections of track but during shunting at low speeds.

The latest example in practice: a group of tank wagons were parked in a tank farm after unloading and secured with stop blocks. A shunter forgot to remove the stop block before the wagons continued their journey, leading to the derailment of four wagons.

Thanks to the derailment detector, the train quickly came to a stop so that the wagon did not topple over, which would have meant damage to the wagon, infrastructure and environment as well as associated disruptions to operations, down times and costs. ■

© V. Umgshardt

Summary

The use of derailment detectors increases safety and reduces costs.

Latest news

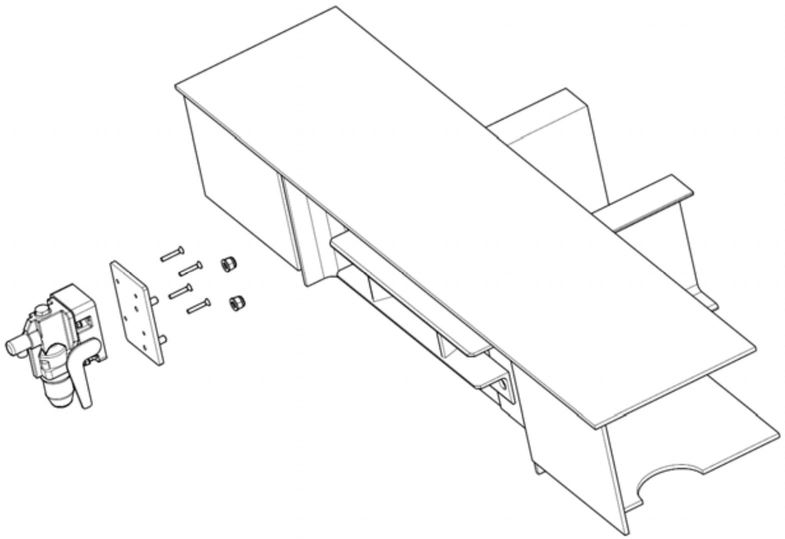
In the 53rd meeting of the RID Technical Committee of OTIF, Switzerland was able to put the topic of derailment detectors back on the agenda. The focus this time will deliberately be on the topic of «railway technology». Together with representatives of ERA, a RID study group chaired by Holland will evaluate today's derailment detectors as well as possible alternatives. The first meeting of the study group will take place in October in Italy.

Field Tests with Trenitalia

50 freight wagons will be equipped with EDT101. 25 out of them are 4 axles (boogie) wagons, the other 25 are 2 axles wagons.

Trenitalia will monitor the behavior of the equipped fleet during normal service conditions with a special focus on determining the reliability of the device and possible events of false alarm.

Trenitalia will monitor the behavior of the equipped fleet during normal service conditions with a special focus on determining the reliability of the device and possible events of false alarm.



Thank you very much for your attention!

Knorr-Bremse Rail Systems Italia
Paolo Mattera
Via San Quirico 199/i
50013 Campi Bisenzio, Florence
Italy

Phone: +39 055 30201
Fax: +39 055 3020333
E-Mail: paolo.mattera@knorr-bremse.com

Knorr-Bremse SfS GmbH
Manfred Walter
Moosacher Str. 80
D-80809 Munich
Germany

Phone : +49 89 3547-1580
Mob: +49 160 90439437
E-Mail: manfred.walter@knorr-bremse.com

www.knorr-bremse.com