The derailments at Amsterdam Central Station on 6 and 10 June 2005

The Hague, 30 November (project numbers M2005RV0606-04 en M2005RV0610-02)

THE DUTCH SAFETY BOARD

The Dutch Safety Board [*Onderzoeksraad voor Veiligheid*] was set up to investigate and ascertain the causes or probable causes of individual or category incidents in all sectors. The aim of the investigation was exclusively to prevent future accidents or incidents and to make binding recommendations if the outcomes give cause to do so. The organisation consists of a Board with five permanent members plus a number of permanent committees. Special supervisory committees are put together to carry out specific investigations. The Dutch Safety Board is supported by a bureau whose members include investigators, secretary-reporters and supportive staff.

The Dutch Safety Board is the legal successor to the Transportation Safety Board [*Raad voor de Transportveiligheid*]. The investigation referred to here was carried out partly by the Transportation Safety Board. However, the Dutch Safety Board is responsible for its publication.

	Dutch Safety Board		**Rail Committee**
Chairman:	P. van Vollenhoven		J.A. Hulsenbek
	J.A. Hulsenbek		J.P. Visser
	A. van den Berg		F. Bauduin
	F.J.H. Mertens		L.H. Haring
	J.P. Visser		R.W.M. van den Heuvel
			J.F.M. Kitzen
			D.P. Rookmaaker
			F.R. Smeding
			W.A. Vriezendorp

General secretary:	M. Visser		
Project manager:	T.J. van den Berg		
Visitors' address:	Anna van Saksenlaan 50 2593 HT The Hague	Postal address:	Postbus 95404 2509 CK The Hague
Telephone:	+31 (0)70 333 7000	Fax:	+31 (0)70 333 7077
Internet:	www.safetyboard.nl		

CONTENTS

GENERAL CONSIDERATION

On 6 June, 10 June and 15 August 2005, trains derailed on the western emplacement of Amsterdam Central Station. Initially, the Board did not intend to carry out a separate investigation into the derailments which occurred on 6 and 10 June but wanted to wait until it had received the relevant reports from the Inspectorate for Transport, Public Works and Water Management [*Inspectie V&W*]. However, after the third derailment on 15 August, the Safety Board decided to start its own investigation into these accidents because it was aware of the degree of anxiety that had been caused due to three derailments taking place in a short space of time on one emplacement. The main issue on which the investigation focused was therefore the extent to which a common cause could be found for the three derailments in the local infrastructure.

I. No common cause

The Safety Board concluded that no common cause for the three derailments could be found which was related to the emplacement at Amsterdam Central Station. The cause of the first derailment was a defective wheel on a goods wagon. The wagon could have derailed at an entirely different location. The second derailment was caused by a set of points which had been damaged as a consequence of deficient repairs to the infrastructure after the first derailment. However, these repair-related deficiencies could also have occurred at a different emplacement. Therefore, a direct link exists between the first and second derailments, but this link has nothing to do with the safety of the railway emplacement concerned. The third incident, the derailment of a shunted passenger train on 15 August, is the most complex of the three, with a great many factors playing a role. However, the idea that deficiencies in the railway emplacement were the common cause of the three derailments can be rejected.

Even so, because structural safety defects were the reason for the separate derailments, the Safety Board did decide to issue reports on the derailments. This report focuses on the first two derailments (6 and 10 June 2005). The report on the third derailment is to follow in due course because the complexity of that incident means more time is needed for the investigation.

II. The derailment on 6 June

On Monday 6 June 2005, a train carrying gravel derailed at 18:34 on the west side of the emplacement at Amsterdam Central Station. As a result of the derailment, several sections of the train came apart. The engine with 20 wagons came to a halt on the rails. The middle section of the train derailed and a number of wagons overturned. Significant damage was caused to the infrastructure and the repair work took several days.

The direct cause
The cause of the derailment, as revealed by the investigation carried out by the Inspectorate for Transport, Public Works and Water Management, was a loose tyre in the rear wheel set of one of the goods wagons in the middle section of the train. Part of the tyre had become detached from the inner wheel. Investigators also discovered that the tyre clip was missing (a tyre clip is an extra fastening device to ensure that a tyre which has become detached from the inner wheel is still kept in place. See paragraph 2.2 for an explanation). Investigators also discovered that the marking on the wheel in question was missing (four stripes on the wheel flanks which are painted every 90º and which help to identify a loose wheel).

The wagon owner, Voestalpine Railpro, commissioned AEA Technology (AEAT) to carry out further investigations into the cause of the loose tyre. AEAT concluded that the tyre had come loose due to a combination of factors with the tyre thickness playing an important role. At the time of the derailment the tyre was 33 mm thick while, according to legal standards applicable to this type of wagon, it should have been at least 35 mm. As the tyre becomes thinner, its resistance to distortion decreases. A high temperature, as a result of braking, and a high wheel load can cause the tyre to become loose. The Safety Board therefore concludes that, in this case, the thickness of the tyre caused it to loosen.

Maintaining the wheel set
During large-scale maintenance in 2003, the wheel set was tested and the right profile was fitted to the tread. Before finishing (grinding to make the wheel round again after one-sided wear and tear) the tyre thickness was 43 mm according to the measurement carried out by NedTrain WBD. After finishing it was 35 mm. Although the 35 mm thick tyre complied with the legal requirements, it did not comply with the quality standard of 38 mm tyre thickness after revision which had been agreed between the railway industry parties. NedTrain has not been able to provide a satisfactory explanation for the fact that the wheel set was fitted despite it not complying with the agreed quality requirement (of 38 mm). Neither did Voestalpine Railpro observe this defect.

The maintenance system is changing. More responsibility is being assigned to the owners of the equipment. As the owner, Voestalpine Railpro was not sufficiently prepared for this responsibility, although improvements are now being implemented. Another change is the privatisation and internationalisation of goods transport by rail which are being accompanied by an intensification in the use of (goods) equipment. However, the maintenance regime and the applicable standards are still based on experiences gained in the past. Although these developments are acknowledged in the railways policy document issued by the Ministry of Transport, Public Works and Water Management, this has not resulted in any concrete improvements in the maintenance system to date.

The technical check before departure
As the rail transport company in charge of the goods train, Railion is required to carry out a technical check prior to departure. The wagon master did not register anything unusual during this check. The investigation by the Inspectorate for Transport, Public Works and Water Management revealed that the train had a number of defects. First of all, the control markings of the banded wheels were missing or were not clearly visible in the case of a number of wagons of the derailed train. These control markings make it easy to detect a displacement of the tyre. Rail transport over the main infrastructure is not permitted without properly visible control markings on the tyres. Secondly, nobody noticed that the tyre was too thin. Lastly, nobody noticed that the tyre clip was missing on the rear of the wheel. Incidentally, the views of the Inspectorate for Transport, Public Works and Water Management and Railion differ as regards the issue of whether the tyre clip always has to be checked or only when other signs (such as control markings) reveal that something is wrong with the tyre. The Safety Board is surprised that this difference in views has so far not caused the Inspectorate to introduce different agreements or guidelines.

Defects were overlooked during the technical check before departure of the derailed train. That this should happen once is understandable because everyone makes mistakes. However, the Safety Board finds it worrying that certain defects repeatedly went unnoticed. An excessively thin tyre and missing marking stripes do not come about just like that and must therefore have been evident during earlier checks, without any action being taken. Apparently, there are structural deficiencies in the system of technical checks and the supervision thereof. In this case the deficiencies were associated with major safety risks (namely derailments). Safeguards have to be put in place to ensure that this does not happen again in the future.

III. The derailment on 10 June

At 03:12 on 10 June, an empty coal train passed over a damaged set of points. The tongue of the set of points (which is supposed to steer the train in the right direction) was bent. As a result, one of the wheels of a particular wagon was steered in a different direction causing three wagons to derail, one of which tipped over.

The tongue of the set of points became bent after one or more trains had passed over the set of points while they were in the wrong position. This happened because the signals relating to the position of the set of points which were visible to the train traffic controller did not correspond to the actual position of the set of points outside. This discrepancy was the consequence of a bridging element which had been incorporated into the points operating system. This bridging element was fitted during the work carried out after the derailment of 6 June. Due to the fact that safety system cables had been broken during that incident, the set of points continued to cause malfunctions in the train traffic controller's operating system. In order to make railway traffic possible between Amsterdam Central Station and Amsterdam Sloterdijk, the set of points was jammed in one position so that it could still be used, at least in that position.

However, the train traffiac controller was still unable to route over the jammed set of points because a malfunction was still being reported in the operating system due to the broken cables. In order to get rid of this malfunction signal, the contractor decided to 'bridge' the malfunction signals and thereby create an artificial signal on the position of the set of points while blocking the signal on the actual position of the set of points. As long as the artificial signal ('the set of points is right-hand in control') corresponded with the position in which the set of points was jammed, no dangerous situation could arise. The danger arose at the moment that the points jamming equipment was removed, without removing the bridging element. From that moment onwards, the set of points could be moved to a different position while the (still artificial) signal in the operating system continued to report the same position. The train traffic controller was no longer receiving the correct information on the position of the set of points.

Underlying cause: Faulty decision-making
The fitting of a bridging element into the safety system of a 'live' track can be regarded as a risky measure. In 'normal' situations, this measure is not used very often. However, it was opted for in this exceptional situation. The Safety Board understands that exceptional situations sometimes require exceptional measures. However, an exceptional measure must be accompanied by sufficient safeguards and the decision must be taken at a sufficiently high level. This was not so in this case.

The Railways Calamities Team [*Calamiteitenstaf Rail*] (RCT: the highest decision-making body involved, under the supervision of ProRail) took the decision to make the tracks concerned serviceable as quickly as possible despite it being known that there were technical problems relating to the signs due to the broken cabling. The (possible) safety consequences of this decision were not taken into account sufficiently during the decision-making by the RCT. As far as the representative of ProRail Inframanagement was concerned, this decision did not, in any case, constitute a reason for staying in contact with the contractor while the decision was being implemented. The decision to install a bridging element was taken at operational level by the contractor. There are only very brief records of it having been taken and it was insufficiently communicated to those responsible on behalf of the contractor and ProRail at the scene. In any event, the RCT and, as a result, the responsible parties from ProRail were not aware of the bridging element. As a result, when the track was put back into service, not everyone knew that a bridging element had been fitted and it was unintentionally left in place. Both at the level of control by ProRail and at the operational level by the contractor, the parties involved did not act as might be expected in a scaling up situation.

Underlying cause: No check before the track was put into service
The manager of the track is responsible for it being fit and safe for use. One would therefore expect ProRail, the manager, to carry out sufficient checks after completion of the repair work in order to guarantee that the track could be safely put into service again. This appears not to have happened in this case. In contravention of the applicable procedures, the set of points in question was not tested and no comprehensive final check was carried out after completion of the work and before the tracks were cleared for use again. As a result, the above-mentioned fault was not noticed and this eventually led to the derailment. Track safety succeeds or fails according to how safe it is for trains to use the railway infrastructure. That is why deficiencies in the monitoring of serviceability are regarded as serious. Partly as a result of the derailment in question, ProRail is developing an entirely new procedure to govern the putting into service of infrastructure. That procedure is intended to eradicate the safety deficiency observed. However, because the decision-making and implementation still have to take place, the Safety Board cannot form a definitive judgement of the effectiveness thereof. The Board expects the Inspectorate for Transport, Public Works and Water Management to monitor ProRail critically on this issue.

Structural lack of safety: Weak spots in the calamity procedures
Weak spots in the calamity procedures can be designated as a second underlying cause of the derailment. The above-mentioned deficiencies are due partly to a lack of clarity regarding who is responsible for what during repair work on such a scale. Partly as a result of this, decisions were not taken at the right level and were not communicated to the right people. Procedures relating to authorities and responsibilities when dealing with calamities were insufficiently coordinated with all the parties involved.

The lack of clarity referred to is partly a consequence of the fact that authorities and responsibilities change when controls are scaled up in the event of large-scale calamities. Scaling up does not occur in the vast majority of calamities. This means, however, that the operating procedure, and the expectations of the contractor in particular, are governed by routine in such situations. If no scaling up takes place, the contractor has considerable decision-making power and carries out the final check itself without any representative of the manager being present on site. If scaling up does occur, ProRail plays a more direct controlling role via the 'sub-aspect manager for infrastructure repairs'. However, insufficient responsibility was taken in the run-up to the second derailment. Those responsible at ProRail did not have a sufficient overview of the safety-critical work that the contractor carried out.

Structural lack of safety: Insufficient regulations
It has transpired that both deficiencies (faulty decision-making regarding the bridging and the lack of a check before releasing the track for use) were partly able to occur because of a lack of clear regulations. The quality of (safety) regulations and their implementation are a crucial part of a safety management system (SMS). ProRail acknowledges this and has defined it as a 'safety-critical process'. Nevertheless, it transpires from the above-mentioned observations that the system of regulations within ProRail is still quite inadequate. In practice, the effect of the SMS is still insufficient. In the report on the level crossing collision in Veenendaal (31 October 2002), the Safety Board also referred to procedures applied in the event of unplanned work in general and the fitting of bridging elements in level crossing installations in particular. In a response, ProRail indicated that it was drawing up policy and rules relating to the fitting of bridging elements. However, to date, the Safety Board has not seen any evidence of concrete results. This is an example which shows that the SMS (still) does not link up with, or has not been properly implemented in, processes at operational level. ProRail should be expected to do more as regards the linking up of the SMS with the daily work processes.

The Inspectorate for Transport, Public Works and Water Management inspected the SMS used by ProRail Inframanagament, and discovered six serious deficiencies in the SMS and its execution at management level. However, the Inspectorate did not investigate the operation of the SMS in daily practice. In the report entitled '*Door rood op Amsterdam Centraal'* [Through red at Amsterdam Central Station], the Safety Board had already advised the Inspectorate to 'base supervision explicitly on the assessment of the quality of the application in daily practice of the safety management system'. In her response, the minister only refers to the supervision of transport companies and not to ProRail. Although the Safety Board realises that this is the first inspection of the SMS used by ProRail, the advice still applies. As long as the SMS has not been sufficiently implemented in daily practice, it will not fulfil its aim. The Inspectorate for Transport, Public Works and Water Management should have included this in the assessment.

IV. Recommendations

The derailment on 6 June

1. Voestalpine Railpro is advised to develop the maintenance system for its railway equipment in such a way as to guarantee that the equipment continues to fulfil the applicable requirements. This includes a complete and clear registration of the state of repair of each vehicle.

2. The Inspectorate for Transport, Public Works and Water Management is advised to implement, as a priority, the plan described in the Second Framework Policy Document on Rail Safety in the Netherlands to maintain strict supervision of the maintenance and maintenance processes for goods equipment. In particular, the Safety Board recommends an improvement in the system of technical checks and regular maintenance which ensures that deficiencies such as the lack of wheel markings can no longer occur.

The derailment on 10 June

3. ProRail is advised to ensure that the safety management system is implemented in a way that guarantees the safety of the daily work processes used by ProRail and the contractors.
   On the basis of the investigation at hand, the Safety Board particularly recommends that:
   - rail safety is demonstrably included in the decision-making process in the aftermath of calamities;
   - the safety of the track is explicitly assessed, communicated and recorded whenever responsibility for the infrastructure is transferred;
   - the SMS aspect of 'quality, control, communication and implementation of technical and general safety regulations' is adapted and executed in such a way that unclear and outdated regulations (can) no longer apply;

- the Railways Emergency Plan is implemented and communicated in such a way that it is clear to all the parties involved in calamities which responsibilities and authorities the situation that has arisen entails (depending on the level of scaling up).

4. The Inspectorate for Transport, Public Works and Water Management is advised to assess the operation of ProRail's safety management system in practice.

P. van Vollenhoven	M. Visser
Chairman of the Dutch Safety Board	General Secretary

LIST OF ABBREVIATIONS

AEAT	AEA Technology Rail B.V.
GM	General Manager (a member of ProRail's traffic management)
RCT	Railways Calamities Team
SI	Serviceability Inspector
OIR	Sub-aspect manager for infrastructure repairs (a member of ProRail Inframanagement)
IM	ProRail Inframanagement
Inspectie VenW	Inspectorate for Transport, Public Works and Water Management
VenW	Ministry of Transport, Public Works and Water Management
WSM	Workplace Safety Manager
PC	Process contractor
RPT	Railways Policy Team
SRC	Switching and Reporting Centre
PTC	ProRail Traffic Control
SMS	Safety Management System
VR	Voestalpine Railpro
WOCO	Work contract

1 INTRODUCTION

1.1 THE DERAILMENTS

On Monday 6 June 2005, a train carrying gravel derailed at 18:34 on the west side of the emplacement at Amsterdam Central Station. The train consisted of an electrical engine type 1600 with, behind it, 50 loaded dual axle goods wagons. As a result of the derailment, several sections of the train came apart. The engine with 20 wagons came to a halt on the rails. The middle section of the train derailed and a number of wagons overturned. The contents of two wagons, consisting in total of around 50 tonnes of crushed gravel, ended up in between the tracks. The last part of the train, wagons 27 to 50 inclusive, remained on the tracks and did not derail.

The derailment did not cause any casualties or injuries. However, there was considerable damage to both equipment and infrastructure. Wagon 23 collided with a post carrying an overhead wire causing the gantry which extended across six tracks to collapse, as a result of which a large section of the emplacement was no longer usable.

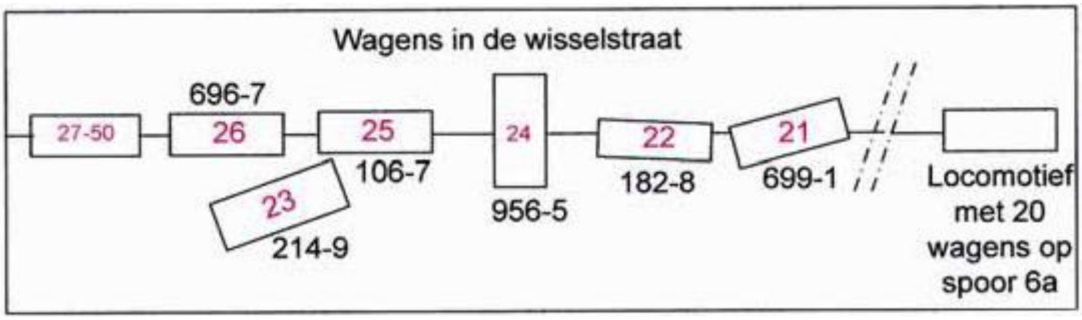


Illustration 1 Illustration showing the position of the wagons after the derailment (source: Inspectorate for Transport, Public Works and Water Management)

Work on 7, 8 and 9 June
The repair work lasted until the afternoon of Thursday 9 June 2005. During this period, train services around Amsterdam were seriously disrupted. Mistakes were made during the work. The track was put back into service with a faulty safety system for points and signs. This eventually resulted in a set of points pointing in a different direction than indicated by the system. As a consequence, trains passed across this set of points and damaged them.

Derailment on 10 June
At twelve minutes past three in the morning of Friday 10 June 2005, an empty coal train derailed on the damaged set of points. The train consisted of an engine and 36 empty coal wagons. The rear three wagons derailed and one tipped over on its side. There were no casualties. However, there was damage to the equipment and the infrastructure. A number of points were also damaged.

Illustration 2 Defective set of points 63, track and final position of the derailed wagons

1.2 The investigation by the Dutch Safety Board

The derailments on 6 and 10 June 2005 turned out well in the sense that there were no casualties. However, any derailment on the main railway network can potentially be disastrous. After these two incidents the Safety Board collected data to see whether there was a possible link between the two. Due to capacity considerations, however, the Safety Board did not carry out two full separate investigations into the derailments. This decision was also influenced by the fact that the Inspectorate for Transport, Public Works and Water Management had already started an investigation into both derailments.

When a third derailment at the same emplacement occurred on 15 August 2005, the Safety Board decided to initiate an investigation into the three derailments. In view, also, of the general public's concern about the three incidents at Amsterdam Central Station, the main focus of the investigation was whether they were based on any common factors. The public concern was evident from, for example, newspaper articles following the derailments and questions posed in the Lower House[1].

No common cause
Each derailment was investigated to establish the extent to which the local infrastructure contributed to the derailment. The conclusion was that deficiencies in the local infrastructure cannot be designated as a common cause for the three derailments.

---

[1] For example, MP Gerkens of the Socialist Party (SP) asked the minister, "Can you appreciate that the succession of derailments are causing concern in Amsterdam and throughout the Netherlands among passengers, staff and people living in the vicinity …. ?"

In addition, separate investigations were carried out into the direct and underlying causes of the derailments. As regards the derailment on 6 June, account was also taken of the fact that derailments as a result of a broken wheel can have very serious consequences depending on the speed of the train and its location at the time of the derailment. A tragic example is the derailment of a high speed train at Eschede (in Germany in 1998), which was the consequence of a broken wheel and which resulted in the loss of 100 lives. Another derailment caused by a broken wheel, happily with less serious consequences, occurred on 20 August 1999 in Baarn. This incident was investigated by the Transportation Safety Board of the time[2].

Relationship to the inspectorate reports
As mentioned above, the Safety Board did not, in the first instance, intend to investigate the derailments which took place on 6 and 10 June. It was the third derailment on 15 August that led to the decision to investigate the three incidents together. In relation to the derailments on 6 and 10 June, it was then decided to carry out an initial study of the reports of the Inspectorate for Transport, Public Works and Water Management on the first two derailments so that they could be used as a basis for assessing the necessity and desirability of an additional investigation by the Safety Board.

After the publication of the Inspectorate reports, the Safety Board verified a number of essential aspects of the circumstances they described. On this basis, the Board concludes that the circumstances and direct causes of the derailments in the Inspectorate reports are portrayed in a sufficiently complete and transparent manner. The description of the circumstances and the direct causes of the derailments in this report have therefore been largely derived from said Inspectorate reports. The only substantive difference in the description of the circumstances concerns the role an excessively thin tyre played in the derailment on 6 June. This aspect had not yet come to light at the time that the Inspectorate's report into this derailment was published. However, it has been included in this report by the Safety Board.

The outcomes of the Inspectorate investigations did raise a number of queries on the part of the Safety Board relating to the underlying causes of both derailments. That is why the Safety Board investigated a number of aspects in more detail, in order to establish whether there are any structural deficiencies in rail safety. This more detailed investigation focused in particular on the second derailment (on 10 June) and also on the underlying causes in the organisation relating to the calamities in general and the repair of the infrastructure in particular. The investigation into the underlying causes of the first derailment (on 6 June) was limited to a brief analysis of the system of technical checks carried out before the departure of the train and the responsibilities relating to the maintenance of goods equipment. A number of deficiencies were detected. Within the framework of this investigation, a decision was taken to limit these analyses and the report does not specify in all cases the extent to which these deficiencies are of a structural nature. However, the Safety Board is going to monitor these aspects and will return to them if there is reason to do so.

The third derailment
In contrast to the investigation into the first two derailments, a more detailed investigation into the direct causes was necessary for the third derailment (on 15 August). Both the investigation by the Inspectorate for Transport, Public Works and Water Management and the investigation by the parties involved failed to provide any clarity as to the circumstances. The causes are so complex that the Safety Board needs extra time for the investigation. A separate report into this derailment is going to be published at a later stage. The report at hand therefore only deals with the derailments of 6 and 10 June.

1.3 THE ORGANISATIONS INVOLVED

Railion (derailments on 6 and 10 June)
Railion Nederland was the rail transport company involved and, as such, is responsible for the transport process used for both goods trains. Railion is the owner of the engines and Railion Germany is the owner of the 36 dual axle goods wagons (Fcp type) that were used to transport coal. The engine driver was employed by Railion. Before a train is allowed to depart, the rail

[2] The report entitled, 'The derailment of the passenger train at Baarn on 20 August 1999' [*Ontsporing reizigerstrein bij Baarn op 20 augustus 1999*], published on 31 August 2000.

transport company carries out a technical check on the train. Rail transport companies may only use the track if the Minister has awarded a so-called safety certificate following an assessment of the safety management system.

Voestalpine Railpro (derailment on 6 June)
Since 2002, Voestalpine Railpro (VR) has been part of Voestalpine Bahnsysteme GmbH based in Austria. VR is the owner and user of the 50 dual axle goods wagons (type Fccpps) used to transport crushed stone. VR owns a total of around 1,700 goods wagons. Some of these are used by the company itself and some are leased out. VR is required to ensure that the technical state of the wagons complies with the applicable rules. VR hired Railion to transport the wagons in question.

ProRail (derailments on 6 and 10 June)
ProRail manages the track infrastructure and the traffic control to ensure safe rail movements. Its management tasks include caring for the quality, reliability and availability of the main railway infrastructure in the Netherlands.

A management concession has existed since 2004. It states that ProRail has an adequate safety care system and that the main infrastructure can be used safely and efficiently. ProRail used this management concession as a basis for drawing up the management plan which states what ProRail is going to do and what the costs are. This plan, which has been approved by the Minister of Transport, Public Works and Water Management, is used as a basis for the annual budget allocation. The management plan does not include any concrete performance targets as regards safety.

ProRail Inframanagement manages the infrastructure and is therefore responsible for keeping the railway and the emplacement in good condition. Maintenance is carried out by means of contracts issued to process contractors. The manager supervises the work carried out by the process contractors. See Annex 3 for a brief organisation chart of the regional organisation of ProRail Inframanagement.

ProRail Traffic Control (PTC) is responsible for traffic control in Amsterdam and the surrounding areas from the train traffic control centre in Amsterdam. The 'Amsterdam West' train traffic controller is responsible for railway traffic on the Amsterdam West Side emplacement. The train traffic controller has the process management operating system at his disposal.

ProRail Traffic Control is responsible for coordinating procedures in the event of calamities. To this end, ProRail PTC has drawn up a Railways Emergency Plan which divides calamities into 12 calamity scenarios. This plan also distinguishes between three levels at which calamities are dealt with, with operational management at the first level being provided by the general manager (GM). It is possible to scale up to a higher level. This is done according to certain criteria. If these criteria are met, or if the GM takes the decision to scale up, a Railways Calamities Team (RCT) is set up. This is the second level. The third and highest level (not used in this case) is the national policy team. In the event of scaling up to the second level, the substantive responsibility during the repair work is taken by the managers of the so-called sub-aspects:
- general management and coordination
- alarms
- rescue and control
- relief
- restoration of traffic function
- restoration of transport function
- alternative transport
- clearance
- infrastructure repair
- communication.

The responsibility for the infrastructure repair sub-aspect covers, among other things, the making available of repaired infrastructure. The sub-aspect manager for infrastructure repair is the official at ProRail Inframanagement who is on duty at that point in time. This official is responsible for the substantive supervision of the contractor that is repairing the infrastructure.

The GM is responsible for general management and coordination of the sub-aspects. The responsibility of the GM includes the key coordination of sub-aspects and the guaranteeing of the safety of those present. A workplace security manager is appointed to take care of the latter. This is usually an employee of the contractor in question. See also the general organisation chart of the calamity procedures in Annex 3.

Strukton Railinfra (derailment on 10 June)
Strukton Railinfra is the process contractor commissioned by ProRail for, among other things, the emplacement at Amsterdam Central Station. Strukton Railinfra is part of the Strukton Groep NV, an international construction group. It is one of the commercial process contractors commissioned by ProRail to carry out repairs to malfunctions and maintenance. The Dutch railway network is divided into a several dozen contract areas. The conditions and agreements which apply to maintenance and the rectification of malfunctions are laid down in a process contract for each contract area.

NedTrain (derailment on 6 June)
This is a company that carries out maintenance, cleaning and revision work on rolling stock. It is an independent subsidiary of the Netherlands Railways. The last revision of the wheel set was carried out by NedTrain Duisburg and the last overhaul by NedTrain Amersfoort (this branch has since closed as a main workshop).

The Ministry of Transport, Public Works and Water Management (derailments on 6 and 10 June)
The Minister of Transport, Public Works and Water Management has ultimate responsibility for the system in the railway sector and is also responsible for drawing up rail safety policy and the resulting standards. The minister grants concessions for the management of the rail infrastructure, safety certificates and authorisation permits to rail transport companies.

The Inspectorate for Transport, Public Works and Water Management, Rail Supervision Unit (derailments on 6 and 10 June)
The Rail Supervision Unit of the Inspectorate for Transport, Public Works and Water Management is responsible for the supervision of safety within the railway system. This supervision focuses on the issuing of permits to, and inspections of, rail transport companies that transport people and goods, engine drivers and other personnel, railway vehicles, managers of infrastructure and notified bodies that perform inspections on the basis of the Railways Act [*Spoorwegwet*]. The Inspectorate is responsible for the supervision of ProRail within the framework of the management concession which has been granted to ProRail by the minister. This applies only to rail safety. One inspection task concerns the investigation of incidents and accidents on the track.

1.4 Assessment framework of the Dutch Safety Board

An assessment framework forms an essential part of the investigation given that, in the context of an assessment, it is important to specify the standards and criteria being used. The assessment framework constitutes a general description of the desired situation so that an insight can be acquired into the areas where improvements and additional measures are required.

The assessment framework used comprises three parts. The first part provides the relevant elements of the law and regulations. The second part focuses on the standards and guidelines that prevail in the sector. The third part consists of five points for attention drawn up by the Dutch Safety Board in connection with safety management. The Safety Board uses these points as a basis for assessing how organisations interpret their own safety responsibilities.

1.4.1 Dutch legislation
Dutch legislation in the field of rail transport starts with the Railways Act, which came into operation on 1 January 2005 and which lays down the main features of the responsibilities within the rail transport sector. The essence of the Act is that:
- the infrastructure must comply with requirements to be specified in detail.
- the minister grants one or more concessions for the management of the main railway infrastructure.
- a railway company is entitled to access the main railways once it has a company permit and a safety certificate (both to be granted by the minister).
- railway equipment must comply with requirements to be specified in detail.
- the minister appoints one or more supervisors by decree.

Sections 47 and 48 of the Railways Act are particularly important for the derailment on 6 June. According to Section 47, ‘the railway company or the owner of a railway vehicle will ensure that the railway vehicles they use … comply consistently with … the requirements … ’ (which are then specified in more detail). Section 48, paragraph 1 states, 'it is prohibited to have maintenance and repair work carried out on railway vehicles which use the main railways by parties other than the natural persons or legal entities authorised by our minister'. According to paragraph 2, 'an authorisation is granted on request if c. the (additional) requirements specified by a general administrative order are met, or if further requirements are met' which, according to paragraph 3, relate to the available space and equipment used, to people's expertise and to the process used for the maintenance or repair work.

The Railways Act is elaborated in the form of a number of royal decrees and ministerial regulations. The Railway Traffic Decree [*Besluit Spoorverkeer*] is important in connection with the derailment on 6 June. According to Section 2, 'The railway company ensures that a train which, at its behest, is used to participate in traffic on the main railway, is examined by an expert for any defects which may jeopardise the safe and untroubled use of said main railway'. The Rail Traffic Regulation [*Regeling Spoorverkeer*] is also relevant since it lays down additional rules for technical checks. Annex 1 includes an overview of the points that have to be checked along with a specification that the minimum thickness of a tyre for wagons with a maximum speed of 120 km/hour is 35 millimetres. The wagons involved in the derailments could be pulled (in an unloaded state) at a maximum speed of 120 km/hour.

In addition to the management concession, the decisions on the management of the infrastructure are particularly relevant to the derailment of 10 June.

- Management concession. ProRail makes sure that the main railway infrastructure can be used safely and efficiently without excessive wear and tear to railway vehicles. ProRail is also required to analyse the risks of use and management for the safety of the main railway infrastructure and take suitable measures to control these risks satisfactorily.
  (Art. 3).
- ProRail has an adequate safety care system (Art. 7).
- Main railway infrastructure decree. The main railway infrastructure must comply with the requirements laid down in ministerial regulations. If the infrastructure complies with these requirements, an inspection institute must issue a certificate of approval. After serious damage, the minister can determine that the infrastructure in question must be re-inspected.
- Main railway infrastructure regulations. The main railway infrastructure must comply with the requirements relating to, among others, the following aspects:
  - Free space profile
  - Track dimensions
  - Permitted wear and tear to points
  - Radiuses of curvature
  - Safety and protection installations
- Decree governing the appointment of railway supervisors. The officials of the Rail Division (now known as the Supervision Unit) of the Inspectorate van Transport, Public Works and Water Management are designated as being the officials responsible for the supervision of compliance with the Railways Act. The Director-General of Passenger Transport is the supervisor as regards the execution and compliance with the management concession. In so far as the management concession generates regulations aimed at the safety of the infrastructure, the Inspectorate for Transport, Public Works and Water Management is the supervisory body. The focus is, for example, on the obligation of having an adequate safety care system.

1.4.2 Standards and guidelines

The railway sector is characterised by a large number of specific guidelines which have been drawn up within the sector (before 1995 within the Netherlands Railways, thereafter by various parties). These internal sector rules have no status under public law and are not interfered with by the Ministry of Transport, Public Works and Water Management. The regulations do not include any standards which apply to the thickness of the tyres required after an overhaul. The norm agreed between the railway companies and the maintenance companies is that this thickness has to be at least 38 mm after an overhaul (six-yearly overhaul routine).

Standards and guidelines relating to working on, and the safe use of, the infrastructure are relevant to this derailment. It would be going too far to include a complete overview here and the following is a summary of a number of relevant procedures and guidelines implemented by ProRail:

- *If 6106 Operating test on technical sign installations and C5524/l Test and setting regulations on signs (TIV).* These regulations provide rules for the testing of, for example, points. They state that a test has to be carried out after a function has been restored.
- *Handbook for Inspector's of Safe Serviceability.* At the time of the derailment, this was the applicable procedure for use by an 'inspector of safe serviceability' after completion of new or

repaired infrastructure. According to this procedure, a safe serviceability check has to be carried out if work or calamities have had an effect, or could have had an effect, on the safe serviceability of the track.

- *Regulations IF6102: temporary provisions in technical sign safety installations with a view to operations and testing*. These regulations refer to the fitting of bridging elements. Links (bridging elements) may, in principle, only be fitted to (parts of) technical sign installations which are not in service or which have been put out of service. Exceptions are possible in certain circumstances.
- *Railways Emergency Plan.* This plan provides the framework within which the calamity procedures of ProRail Traffic Control are set up. For example, it lays down the division of tasks between the parties involved, the coordinating responsibility of the general manager, etc.

1.4.3 Safety management assessment framework
In principle, the way in which an organisation interprets its safety responsibility can be tested and assessed from a number of different perspectives. There is, therefore, no universal handbook that applies in all situations. That is why the Safety Board itself selected five points for attention as regards safety which give an idea as to which aspects can play a role (to varying degrees). The Safety Board believes that this choice is justified given that these safety issues are included in numerous (inter)national laws and regulations and in a large number of widely accepted and implemented standards. A safety management system specifically for the rail sector is included in Annex 3 of European Directive 04/49/EC.

The following points for attention apply (for a more detailed discussion see Annex 2):
1. Insight into the risks as a basis for the approach to safety
2. Demonstrable and realistic approach to safety
3. Execution and enforcement of the approach to safety
4. Continual tightening of the approach to safety
5. Management control, involvement and communication (internal and external)

The Safety Board acknowledges that the assessment of the way in which organisations interpret their own responsibility for safety depends on the nature of the organisations involved. Aspects such as the sort of work or the scope of the work may also be important and should therefore be incorporated into the assessment. Although judgements are made on a case by case basis, the underlying philosophy is identical each time.

1.5 OVERVIEW OF THE DOCUMENT

The rest of this report consists of two parts. The first part examines the derailment on 6 June and the second part the derailment on 10 June. Both parts have the same structure of three chapters with the headings 'circumstances', 'analysis' and 'conclusions'. For the derailment on 6 June, these are chapters 2 to 4 and for the derailment on 10 June these are chapters 5 to 7. Both parts can be read individually. Chapter 8 includes the recommendations on both derailments.

PART I : DERAILMENT OF TRAIN CARRYING GRAVEL ON 6 JUNE 2005

2 THE CIRCUMSTANCES

2.1 THE DERAILMENT

The train was loaded on 6 June 2005 with pieces of gravel (ballast used for rail construction) in the Coenhaven harbour in Amsterdam and then travelled to the goods emplacement at Amsterdam Westhaven. After a technical check, the loaded train (number 53682) departed at 18:23 in the direction of Amsterdam Central Station a few kilometres further on. At around 18:30 the train arrived at the emplacement at Amsterdam Central Station. It proceeded via the set of points towards track 6a. While travelling along this track, the train derailed and the air pipe broke. The engine driver noticed that the train had started to jolt and that it was losing air pressure. The engine came to a halt halfway along track 6a while a large section of the train (which had a total length of 482 metres) was still on the set of points. The incident registration shows that the goods train was stationary at 18:34. The engine driver then saw that some of the gravel wagons had derailed and immediately contacted the train traffic controller to report the derailment.

Illustration 3 Photo of the debris

The Inspectorate for Transport, Public Works and Water Management concludes in its report that the derailment was the direct consequence of the loose and displaced tyre of the left wheel of the rear wheel set of wagon 22. The Inspectorate did not determine the underlying cause of the sudden loosening of the tyre. The other damage observed to the equipment and the infrastructure can be designated as consequential damage. According to the Inspectorate, a check of the data from measurements taken shortly after the derailment and data from the maintenance database show that no evidence has been found in the infrastructure which could have been the cause of the derailment.

Illustration 4 The rear axle of wagon 22 (Source: Inspectorate for Transport, Public Works and Water Management)

2.2 THE CONSTRUCTION OF THE WHEEL

A small percentage of wheels used in goods transport are 'tyred' wheels, meaning that a tyre is fitted around the inner wheel. However, the majority of wheels are solid wheels, made from a single piece of metal[3]. The advantage of using tyres is that, in the event of extensive wear and tear, only the tyre has to be replaced and not the entire wheel.
The loosening of the tyre is prevented first and foremost by the strength of the connection between the tyre and the inner wheel. The tyre is heated and then pressed around the inner wheel while hot. When it cools, the tyre shrinks and therefore fits very tightly around the inner wheel. This connection prevents the tyre from coming off.
A second safeguard against the tyre coming loose, and which specifically prevents the tyre sliding sideways, is the tyre clip. The tyre clip is rolled onto the inside of the wheel, after which the lip of the tyre (which partially hangs over the inner wheel) is pressed against the tyre clip. The tyre clip cannot prevent the tyre from coming loose from a wheel but does provide an extra safeguard should the clamping tension no longer be sufficient to prevent the tyre from coming loose from the inner wheel. In other words, the tyre clip ensures that the tyre does not slide sideways.

[3] According to information provided by the Inspectorate for Transport, Public Works and Water Management, around 50,000 goods wagons are used for train movements each week. Of these, around 1% are fitted with tyred wheels.

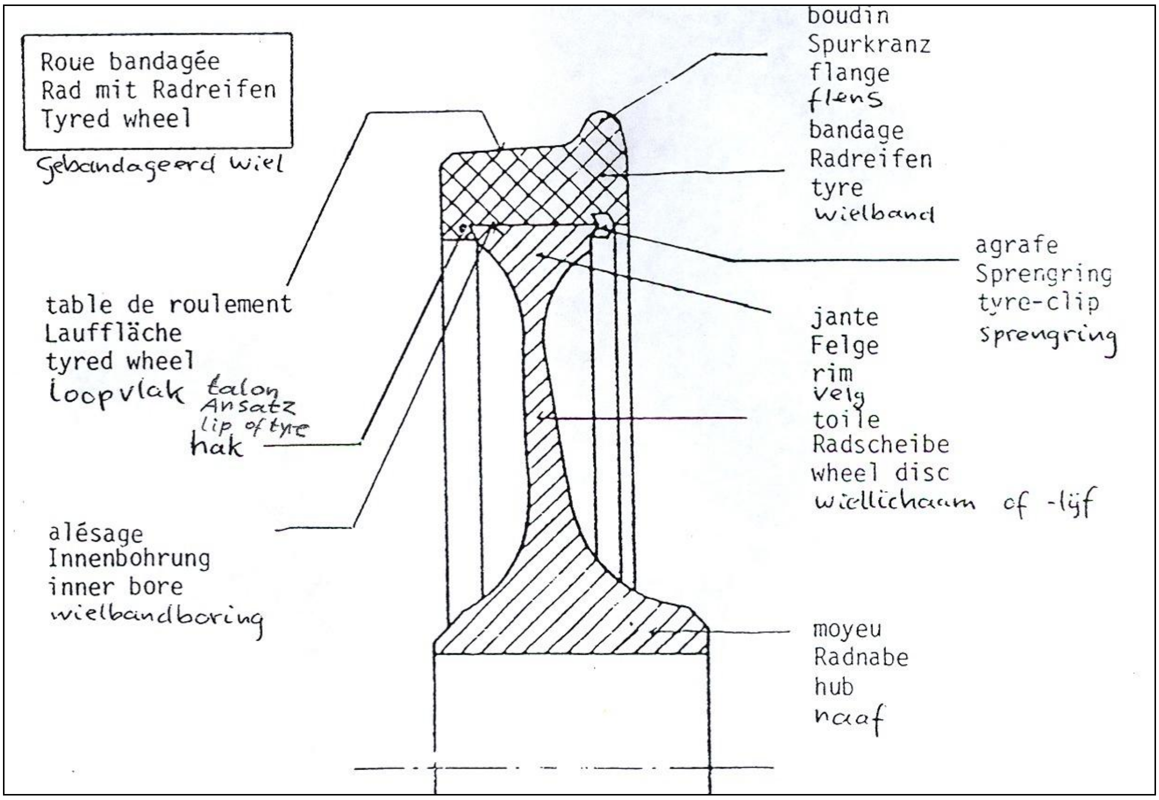


Illustration 5 Structure of the tyre - inner wheel and tyre clip system (source photo: Inspectorate for Transport, Public Works and Water Management)

In general terms, a tyre can start to come loose as a result of a combination of factors, namely the wheel load, a thin tyre and a considerable increase in temperature caused by the contact between the brakes and the tyre.

2.3 INVESTIGATION BY THE INSPECTORATE FOR TRANSPORT, PUBLIC WORKS AND WATER MANAGEMENT

The Inspectorate for Transport, Public Works and Water Management investigated the possible cause of the derailment[4]. This investigation focused on, among other things, the equipment. The investigation into wagon 22 revealed that the tyre of the left wheel of the rear wheel set had moved away from the inner wheel. The tyre had partly come loose from the inner wheel.
Closer inspection of the wheel in question revealed that the tyre clip (see paragraph 2.2 for an explanation of this term) was missing and that part of the tyre on the side of the tyre clip had disappeared. Part of what is known as the lip of the tyre was also missing. The fracture area of the tyre where the lip had disappeared was very rusty which would seem to indicate that the lip material had been missing for some considerable time (although it is not known how long). The tyre clip was not recovered from the scene of the derailment nor from the section of track the train had travelled along. However, part of a tyre clip was found on an entirely different track at the emplacement at Amsterdam Central Station. Investigations by AEA Technology showed that it was probably part of the wheel in question. If this is the case it means the tyre clip had become loose and had broken during an earlier trip.
The Inspectorate for Transport, Public Works and Water Management concluded, on the basis of its investigation, that the cause of the derailment was the loose tyre. According to the Inspectorate, other damage observed to the equipment and the infrastructure is consequential damage.
The goods train was travelling at a speed of around 30 km/h at the time of the derailment according to the statement by the engine driver and the journey registration data. According to the Inspectorate for Transport, Public Works and Water Management, the speed and the braking behaviour of the goods train did not affect the derailment. According to the Inspectorate, a check

[4] Investigation report RV-05U0012 dated 12 September 2005, Inspectorate for Transport, Public Works and Water Management, TE Rail; also 24 hour report RV-05U0012 dated 7 June 2005.

of the data from measurements taken shortly after the derailment and data from the maintenance database shows that no evidence has been found in the infrastructure which could have been the cause of the derailment. The Inspectorate was unable to ascertain during its investigation what had caused the tyre to come loose and why this occurred at the Amsterdam West Side emplacement.

2.4 Further investigation by AEA into the coming loose of the tyre

AEA Technology (AEAT) was commissioned by the owner of the ballast wagon, Voestalpine Railpro, to carry out a further investigation into why the tyre came loose[5]. By way of a reference, the opposite wheel was also investigated as a comparison to the wheel that had come loose. The investigation into the opposite wheel provides clear confirmation of the results of the investigation into the wheel that had come loose.

On the basis of its investigation, AEAT concluded that the tyre had come loose due to a combination of factors. Both tyres of the bogie were found to be slightly concave. The tyre thickness was 33 mm, while the thickness for Fccpps wagons (120 km/h empty and 100 km/h full) has to be at least 35 mm[6].

A concave tyre may be caused by an excessively high wheel load[7], an excessively thin tyre and a substantially increased temperature caused by the brakes on the tyre. Usually, a combination of these factors is involved. The increased temperature decreases the resistance to distortion. According to AEAT, it is plausible that this resulted in the so-called rolling out of the tyre in the hottest part. The rolling out of the steel near the wheel tread caused the tyre to become concave. The shrinking stress would then increase in the middle and decrease at the sides. Incidentally, it is well known that the shrinking stress decreases as the tyre becomes thinner[8].

The movement of the tyre in comparison to the inner wheel (i.e., the inward movement during each turn of the tyre towards the inner wheel) creates a changing load on the tyre clip lip when the wheel is turning. According to AEAT, this fatiguing load led to the tearing of the lip, after which the rest broke off. AEAT also states that the lip became distorted during the wheel production process and that this made the lip more sensitive to tearing. The disappearance of the lip caused the tyre clip to come free from the wheel. As a result, there was no extra safeguard for the tyre. According to AEAT, the rim of the inner wheel must have spontaneously come loose and moved towards the inside edge because the surface between the tyre and the inner wheel is smooth and shiny, without any rust. This would appear to prove that there had been space between both components for quite some time. According to AEAT, the occurrence of tears starting at the tyre clip lip is an important indication as to when the tyre started to come loose.

---

[5] Report by AEA Technology, ref. AEAT/06/50223/003, January 2006

[6] Annex 1 to Article 5 of the Rail Traffic Regulations.

[7] An excessive wheel load is caused by overloading. According to information from both Voestalpine Railpro and the Inspectorate for Transport, Public Works and Water Management this type of goods wagon would never be substantially overloaded when carrying ballast material.

[8] According to AEAT, double centring (marking the position of the tyre in comparison to the inner wheel) on the opposite wheel indicates that the tyre may have shifted once and then been recentred. Based on the appearance, the centre points were fitted a long time ago.

3 ANALYSIS

3.1 INTRODUCTION

In the description of the circumstances (chapter 2) it was concluded that the coming loose and moving inwards of the tyre, as caused by a combination of factors, was the direct cause of the derailment.
This chapter examines in more detail the underlying causes as to why the tyre came loose, with attention being paid specifically to the maintenance carried out on the wheel set and the technical check before departure.

3.2 THE MAINTENANCE ON THE WHEEL SET AND THE TYRE THICKNESS

The new Railways Act, which came into operation on 1 January 2005 and which applied at the time of the derailment, brought with it a change in the responsibilities for the maintenance of railway vehicles. Until 1 January 2005, the maintenance, and in particular the quality of its execution, had been regarded as the primary responsibility of the maintenance company. The Inspectorate for Transport, Public Works and Water Management carried out substantive tests as to whether maintenance companies were also observing the maintenance regulations. As a consequence, the railway company and/or the owner of the equipment were more remotely responsible. In the new Railways Act, the railway company or the owner of a railway vehicle are made more explicitly responsible for the continual compliance of a railway vehicle with the technical specifications and requirements laid down in the regulations[9]. One of the consequences of this is that the owner of a wagon has to make performance agreements with maintenance companies and must ensure compliance with these agreements. Maintenance regulations are no longer part of the statutory framework, so the Inspectorate for Transport, Public Works and Water Management is no longer able to supervise them.
The point of departure used by Voestalpine Railpro for its goods wagons is that they are subjected to small and large overhauls in yearly and six-yearly cycles. The intervals are, incidentally, not prescribed by law. Six-yearly overhauls to the goods wagon at the centre of the derailment incident were carried out on 7 June 1995 at NedTrain in Zwolle and on 1 October 2003[10] at NedTrain WBD in Duisburg. The last annual overhaul was performed on 13 July 2004 at NedTrain in Amersfoort[11]. Until the derailment, Voestalpine Railpro tacitly assumed that the maintenance had been carried out according to the quality standards which the maintenance companies had themselves drawn up. No performance requirements were agreed between VR and NedTrain.
The quality requirement used by maintenance company NedTrain for tyres of this type of wagon is a tyre thickness of at least 38 mm at a small-scale overhaul and a tyre thickness of at least 35 mm at an annual overhaul. If the tyre thickness is less than the statutory requirement of 35 mm, a wagon has to be taken out of service.
At the overhaul in 2003, the wheel set was measured and the tread was re-profiled. According to the measurements carried out by NedTrain WBD, the tyre thickness was 43 mm before this work was carried out and 35 mm[12] thereafter. Although a tyre with a thickness of 35 mm complies with the minimum thickness required for an operational Fccpps wagon, it is less than the thickness agreed within the sector which is required after an overhaul in order to avoid rejection.
NedTrain and Voestalpine have not been able to provide a satisfactory explanation as to why, in this case, a wheel set was fitted after an overhaul which did not fulfil their own quality requirements. Given that NedTrain has since sold the workshop in Duisburg, any data on this matter can no longer be retrieved.[13]
According to the Board it is plausible that during the small-scale overhaul on 13 July 2004, the tyre thickness was already less than 35 mm as a consequence of rolling out. In 2003, the thickness was 35 mm and in 2005 33 mm. It is therefore conceivable that in 2004, at the time of the overhaul,

---

[9] See paragraph 1.4.1
[10] The time between these overhauls is not six years (the norm applied internally by Voestalpine Railpro) but eight years. The Safety Board did not investigate this in any greater detail.
[11] The NedTrain workshop in Amersfoort had already ceased to function as the main workplace, but work was still being carried out on equipment.
[12] See Annex 1A to the AEA Technology report, ref. AEAT/06/50223/003, January 2006
[13] Although the Safety Board is of the opinion that data which is relevant for quality management ought to be kept after a workplace has closed, no additional investigation into this matter was carried out.

the tyre thickness was around 34 mm. However, a tyre thickness of less than 35 mm is not referred to in the final protocol drawn up after the overhaul. Incidentally, such final protocols do not refer as standard to the measured tyre thickness, but only when the tyre thickness differs from the norm. It is no longer possible to check whether the tyre thickness has been checked or not during this small-scale overhaul.

Supervision of maintenance by the Inspectorate for Transport, Public Works and Water Management
The Inspectorate for Transport, Public Works and Water Management supervises the quality of maintenance companies. The Second Framework Policy Document on Rail Safety in the Netherlands, published by the Minister of Transport, Public Works and Water Management in 2004, states that the maintenance of goods equipment requires more attention than in the past. The reason was the greater number of kilometres covered by the goods equipment within a certain period of time, the growing number of parties involved in the actual use, leasing and ownership of goods wagons, and the increasing internationalisation of goods transport by rail in general. In a response to this, the Minister of Transport, Public Works and Water Management announced more stringent supervision by the Inspectorate for the period 2004-2010 as regards maintenance, maintenance processes and companies involved in railway equipment, and in particular goods equipment.
According to information from the Inspectorate, this policy intention had not yet been laid down in measurement data at the time of the derailment. The Inspectorate is currently carrying out two inspections into supervision of the maintenance of goods wagons, with a focus on the maintenance, maintenance processes and maintenance companies. These inspections are entitled, 'The inspection of how goods trains are made ready for departure' and 'The inspection of the maintenance and management of railway vehicles'. The inspection of maintenance companies is being planned for sometime in 2006. If the maintenance companies' permits are renewed, the processes will be checked periodically[14].

Conclusion
At the time of the derailment, the maintenance system was in transition as a consequence of the coming into operation of the Railways Act in 2005. The responsibility for maintenance was being shifted from the maintenance company (in this case NedTrain) to the railway company or owner, in this case Voestalpine Railpro (VR). Although VR had taken steps to convert the new responsibility into actions, this process was still in an initial stage at the time of the derailment. The derailment resulted in an acceleration of the process. VR is working on turning its responsibility into actions by setting up a maintenance system for its railway equipment, including monitoring the state of repair of wagons and random checks on the work carried out by maintenance companies. The findings of this investigation (like the observation that the tyre was too thin) indicate the need for a quality system for maintenance to goods wagons (and the supervision thereof). This applies to NedTrain (whose staff fitted a wheel with an excessively thin tyre in contradiction of its own rules) and to VR (which did not notice this fault). If an adequate quality system had been in place, the fact that the thickness of the tyre was less than the minimum would have been noticed sooner and action could have been taken on time. That would have reduced the risk of a derailment. The supervision by the Inspectorate for Transport, Public Works and Water Management of maintenance companies must (according to the Second Framework Policy Document on Rail Safety published by the Minister of Transport, Public Works and Water Management) be tightened in the period up to 2010. However, this had not been done by the time of the investigation.

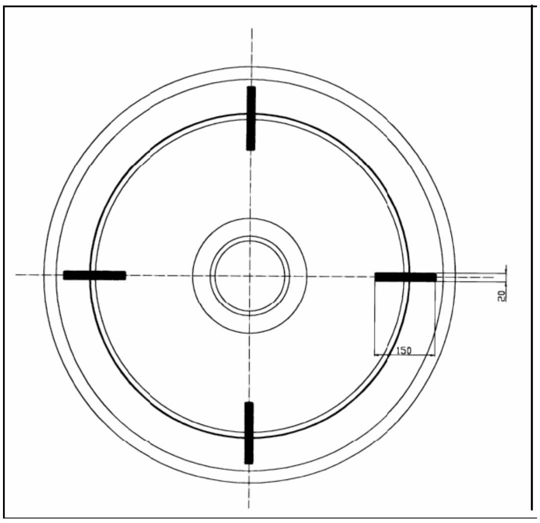
[14] In this context, it can also be stated that the ratification of the COTIF as of 1 July 2006 led to a significant amount of legislation and regulations (primarily RIV/RIC and the UIC card) being included in European legislation and regulations. As a consequence, the Inspectorate for Transport, Public Works and Water Management has acquired better access into the actual train hauliers and into the identity of the parties responsible for maintaining the railway vehicles.

3.3 THE TECHNICAL CHECK BEFORE DEPARTURE

On the grounds of the Rail Traffic Decree and Regulations, Railion, being the rail transport company in charge of the goods train, is required to perform a technical check prior to departure. This check, carried out by a wagon master, has to comply with the provisions of Annex 1 under Article 5 of the Rail Traffic Regulations. According to this annex, tyred wheels must be checked for the thickness of the tyre, tears in the tyre, looseness, distortion of the tyre, the presence of visible control markings and the presence of an undamaged tyre clip[15].

Control markings

The wagon master stated that he walked along the right side of the entire train, while the brakes were on and along the left side of the entire train while the brakes were off. According to the wagon master, his check did not reveal any irregularities[16]. Further investigation by the Inspectorate for Transport, Public Works and Water Management revealed that, in the case of a number of different wagons of the derailed train, the control markings (four stripes on the wheel flanks, painted at 90º) of the tyred wheels were missing or were unclear. These stripes are prescribed as being necessary and serve as a means of checking for movement or loosening of the tyre[17]. The control markings clearly show when the tyre has moved, and when rust has formed between the tyre and the inner wheel (an indication that something is wrong).



Position of the white check marks on tyres, Length 150 mm, width 20 mm.

A railway vehicle may not use the main infrastructure without any proper visible control markings on the tyres. In the past, the sound test (tapping the wheel) was done to ascertain whether a tyred wheel was defective in any way. Due to the increase in the number of solid wheels and the obligatory control markings, the sound test has only limited added value and, according to the Inspectorate for Transport, Public Works and Water Management, it was agreed (in around 1990) that wheel tapping was no longer obligatory.

During the technical check, the wagon master did not notice that the control markings (an obligatory check item) were missing, or this did not give any cause for measures to be taken. If the control markings had been visibly present, it is plausible that any movement of the tyre could have been observed. However, it is no longer possible to say that this would have been the case with complete certainty.

Because control markings do not suddenly disappear from wheels, it must be assumed that the control markings checks (an important aspect of the safety system) are not, or no longer, being carried out in the right way.

Tyre thickness

---

[15] Annex 3 includes the section of Annex 1 to Article 5 of the Rail Traffic Regulations which is relevant to tyres.

[16] See Investigation Report RV-05U0012 dated 12 September 2005, Inspectorate for Transport, Public Works and Water Management, TE Rail.

[17] The requirements for the application and visibility of the control markings are laid down in RIV2000 point 23.7.2 and RIC chapter 6 Technical Requirements: 20.11.

Neither was it observed during the technical check that the tyre was too thin. In principle, it should be possible for a trained eye to check the tyre thickness. If any doubts arise during this visual check as to whether the tyre does have the required tyre thickness, the wagon master can use a measuring instrument that indicates the exact number of millimetres. Because a tyre does not change its thickness from 35 to 33 mm overnight, it must be assumed that the tyre thickness checks are not, or no longer, being carried out in the right way during technical checks.

Tyre clip
The lack of the tyre clip was also not observed during the technical check. The tyre clip is also an obligatory part of the check. A missing tyre clip in the case of Fccpps wagons can in principle – albeit with difficulty – be detected during a visual check. However, according to Railion, the regular technical check does not cover this point. A check for the presence of an undamaged tyre clip is only carried out if other defects (displaced control markings, sound test, traces of rust) give reason to do so. Given that, in this case, no other defects were observed, the tyre clip was not checked. The Safety Board has understood that Railion and the Inspectorate for Transport, Public Works and Water Management are discussing how the tyre clip check must be performed in practice. Two interpretations are possible. Either the tyre clip must always be checked or the tyre clip must only be checked if the control markings have moved or if rust is visible. To date, the Inspectorate has not made any statement about how the rules in question are to be interpreted.

Supervision of the technical check
The Inspectorate carries out random checks of the technical checks, and checks whether technical defects are recorded and dealt with adequately[18]. These checks focus on whether the technical check has been carried out by a wagon master. The general view of the Inspectorate is that the technical checks carried out by wagon masters are performed well and conscientiously. On the odd occasions that problems occur with, for example, a displaced tyre, adequate measures are taken during the technical check itself. Sometimes, however, the limited time available for a technical check can be detrimental to its thoroughness. However, this has as yet not caused the Inspectorate to take any specific measures. During the period before the derailment, no particular emphasis was placed on the presence or otherwise of visible tyre markings during the checks carried out by the Inspectorate.
However, the lack of the control markings on the wheel and the role that this may have played in the derailment were grounds for the Inspectorate to check the control markings on wagons fitted with tyres. During these checks it was ascertained that the control markings were not present or were not clearly visible in the case of a number of other railway vehicles. Following on from this, the Inspectorate sent a letter dated 17 October 2005 to the rail companies and the equipment owners to point out that the application of control markings and keeping these visible is a requirement which must be fulfilled. In addition, Voestalpine Railpro wrote to its maintenance companies in the second half of 2005. Both initiatives resulted in corrective action being taken as regards the markings. According to the Inspectorate, almost all railway vehicles that needed it have been re-equipped with clearly visible control markings[19]. VR has let it be known that its equipment now also bears the required control markings, apart from perhaps a couple of individual wagons. Following the derailment, Railion has pointed out to the wagon masters the importance of checking control markings on wheels fitted with tyres.
VR has ordered maintenance companies to pay extra attention to tyre thickness and to explicitly report the tyre thickness in the maintenance report. According to the reports received by the VR since then (pertaining to approx. 85 % of the Fccpps wagons) no other excessively thin tyres have come to light.

Conclusion
Both the missing control markings and the excessively thin tyre are items which have gone structurally unnoticed. The system of technical checks (by rail transport companies) and the supervision thereof (by the Inspectorate for Transport, Public Works and Water Management) is evidently arranged in such a way that such aspects may also continue to go unnoticed.

---

[18] In the Inspectorate for Transport, Public Works and Water Management Annual Work Plan 2005 (p. 37), the technical check of goods trains is referred to as an area that requires special attention.
[19] According to information from the Inspectorate, in 2005 wheel marking defects were found in 10 of the 1090 wagons inspected (which were being transported by rail). In 2006, up until the time of writing, one wagon with defective marking has been found. This wagon was not owned by VR.

4 CONCLUSIONS

4.1 DIRECT CAUSE

The direct cause of the derailment was a loose tyre which had slipped inwards on the wheel of one of the goods wagons (wagon 22) in the middle section of the train. The tyre had slipped off the inner wheel. The tyre was able to slide off the wheel because the tyre clip on the inside of the wheel (which secures the tyre) was missing. This was able to happen because the so-called lip of the tyre was partially missing due to having crumbled away. If the tyre clip had remained intact, it may have reduced the chance of the tyre slipping and the risk of the derailment. A factor which increased the chance of the tyre coming loose was the insufficient thickness of the tyre. At the time of the accident the tyre was 33 millimetres thick while it should have been at least 35 millimetres thick.

4.2 UNDERLYING CAUSES

Maintenance to the wheel set
At the time of the derailment, the maintenance system was in transition as a consequence of the coming into operation of the Railways Act in 2005. The responsibility for maintenance was being shifted from the maintenance company to the wagon owner, in this case Voestalpine Railpro (VR). Although VR had taken steps to convert the new responsibility into actions, this process was still in an initial stage at the time of the derailment. The derailment resulted in an acceleration of the process. VR is working on turning its responsibility into actions by setting up a maintenance system for its railway equipment, including monitoring the state of repair of wagons and random checks on the work carried out by maintenance companies. The findings of VR to date indicate that a quality system for maintenance to goods wagons (and the supervision thereof) is essential.

The technical check before departure
It has been established that the control markings on the wheels were missing. These markings (four white painted stripes on the tyre and wheel) allow a loose tyre to be detected. The missing control markings, the excessively thin tyre and the missing tyre clip must have gone unnoticed during technical checks before departure and during earlier checks because the defects in question do not occur overnight. The system of technical checks before departure and the supervision thereof is evidently arranged in such a way that such aspects may structurally go unnoticed.

PART II: DERAILMENT OF THE COAL TRAIN ON 10 JUNE 2005

5 CIRCUMSTANCES

This chapter describes the circumstances surrounding the derailment of the empty coal train. Because it has transpired that the cause of the derailment on 10 June was the repair work carried out after the derailment on 6 June, a short factual description of this work is provided, focusing primarily on set of points 63 which was the set of points on which the coal train derailed.

5.1 Repair work after the derailment on 6 June

The derailment of the gravel train on 6 June caused serious damage to the infrastructure of the western part of the emplacement at Amsterdam Central Station. Among other things, a post carrying an overhead wire was knocked down (causing part of the overhead wire to fall down) and a bundle of cables (including cables required to control set of points 63) was broken. A number of tracks were also severely damaged. As a result, railway traffic between Amsterdam Central Station and Amsterdam Sloterdijk was restricted for several days.

The repair work following the derailment on 6 June took several days to complete. In the night of 7 to 8 June, tracks 2, 3 and 4 were put into operation because tracks 11 to 15 had to shut down for work on the overhead wire. The fact that tracks 2, 3 and 4 were again operational meant that railway traffic could continue on the west side of Amsterdam Central Station. Set of points 63 plays an important role as regards the use of these tracks. However, this set of points continued to generate a malfunction in the train traffic controller's system due to the broken cables. With a view to enabling the tracks in question to be made available for use, set of points 63 was physically jammed in one position (namely: right-hand) and bridged in the safety installation so that the train traffic controller could allow trains to pass across the jammed set of points in question.

5.2 Bridging element

In normal circumstances, the train traffic controller's operating system indicates whether the set of points is in control and in which position. Cables pass these signals from the set of points outside via a relay unit (the safety installation's 'exchange') to the train traffic controller's operating system. If a set of points is in control (for example as a consequence of damage to the set of points itself) or if the cable which passes on the signals is defective, the train traffic controller will be notified that the set of points is malfunctioning. If that is the case, the train traffic controller cannot allow movements over this set of points and the signs in question will stay on red.

Nonetheless, in order to allow a set of points to be used in such a situation, it can be physically jammed in a position that allows them to be used safely. However, because the signs for the track in question cannot be turned to green as a consequence of the broken cable, either the train traffic controller must order each individual train to pass through a red light (which is a time-consuming process), or the warning signal in the operating system must be 'artificially' removed. The latter is done by installing a bridging element. The safety installation is then adapted in such a way (by attaching wires between the relay) that the system signals that the set of points are controlled to a certain side. However, this signal is no longer linked to the actual position of the set of points outside, but is an 'artificially' generated signal. If, for example, the set of points is manually placed in a different position, the system will continue to indicate the position chosen when fitting the bridging element. The train traffic controller only sees the signal that the set of points is in control (the signal that s/he would also see normally), and does not see that the signal is a result of a bridging element.

Illustration 2 The temporary connections are fitted in the relay housing using long black wires (Source of photo: Inspectorate for Transport, Public Works and Water Management).

Putting into operation of a set of points with bridging element
In the night of 7 to 8 June, set of points 63 was physically jammed in one position (right-hand) and then bridged in the manner referred to above so that the train traffic controller could allow traffic to pass over this set of points. As was usual, the train traffic controller also installed a blocking function in his system so that the set of points could only be used in the jammed position.

After the track with the jammed and 'bridged' set of points 63 had been put into operation again, the broken cables were repaired. The repair work, and with that the rectification of the damage to set of points 63 (and other points), was finished during the course of the morning of 8 June. At around 12 o'clock the jamming equipment was removed. The train traffic controller also removed the blocking mechanism so that the train traffic controller could use the set of points in both positions again in the operating system.

After that, the train traffic controller allowed a number of trains to travel across set of points 63. When the train traffic controller moved the set of points in the left-hand position, the set of points outside actually moved to the left. However, because of the bridging element, the train traffic controller's operating system continued to indicate that the set of points was right-hand in control. The train traffic controller, who was not aware of the bridging element, interpreted this as a malfunction. Because the train traffic controller was not aware of the existence of the bridging element and because it could be assumed that the system had not failed[20], he concluded that the set of points could be used in the right-hand position but not in the left-hand position. In connection with this malfunction, the train traffic controller generated a (non-urgent) malfunction signal.

[20] Due to the fact that the train traffic controller has no insight into the actual position of the points, he has to rely on the points positions that the control system indicates. In the event of a malfunction, the control system indicates that there is a malfunction but did not do so in this case because of the bridging mechanism.

The train traffic controller allowed a number of trains to pass over this set of points on the assumption that these were in the right-hand position (as indicated by the system) while the set of points was actually in the left-hand position. As a result, the set of points was opened and damaged by the passing trains (see the following illustration).

Illustration 3 Set of points 63B in the position found directly after the derailment. The open tongues can be clearly seen.

5.3 THE DERAILMENT

On 10 June 2005, the empty coal train left Emmerich at 2:04 with its final destination being the goods emplacement at Amsterdam Westhaven. The train, with number 47760, was an electrical engine type 1600 and 36 empty 'fcs' type coal wagons. The train was 346 metres long (incl. engine) and weighed 506 tons. Railion Nederland was responsible for the train's journey. The wagons were the property of Railion Germany.

The train travelled through Amsterdam Central Station via track 3 to track 21 at 3:12. The air pipe broke on track 21 after which the engine driver noticed that the train was losing air. The train then came automatically to a standstill. It transpired that the last three wagons had derailed. One had tipped over on its side. It turned out that the second wagon from the back had derailed on the set of points which, as described in the above paragraph, had been damaged. Because these were open, one of the wheels of the wagon was guided in the wrong direction causing the wagon to derail.

6 ANALYSIS

6.1 INTRODUCTION

The description of the direct cause (paragraph 5.3) shows that two important safety mechanisms failed successively during the derailment. These mechanisms are:

1. adequate decision-making relating to the fitting of the bridging element (as a result of which it was not removed on time);
2. a check of the infrastructure prior to the putting into operation again (as a result of which the error made remained undetected).

Both aspects are analysed in greater detail in the following paragraphs (6.2 and 6.3).

A more detailed analysis of this underlying cause can be found in paragraph 6.4. Paragraph 6.5 contains an examination of the defects in the rules and procedures to ascertain whether these were the underlying cause and a discussion of ProRail's safety management system. Annex 3 contains summarised organisation charts of the regional organisation of ProRail Inframanagement and of the calamity procedures used by ProRail Traffic Control.

6.2 UNDERLYING CAUSE: FAULTY DECISION-MAKING AS REGARDS THE BRIDGING ELEMENT

Rules for the placement of a bridging element
Both the Inspectorate for Transport, Public Works and Water Management and ProRail concluded in their reports that the use of the bridging element, as in the case of set of points 63, was not permissible. According to them, one of the basic rules is that work may only be carried out on operational installations with due regard for precise limiting conditions. Only selected engineering firms are authorised to do this work, and not contractors.

However, Strukton claims it acted in accordance with its own procedures for the use of bridging elements for level crossing installations and the IF 6100 regulations. Regulation IF 6101 describes the possibility of using bridging elements in operational safety installations and IF 6102 describes the regulations for the use of bridging elements in level crossing installations.
An essential element of Strukton's own procedure for the fitting of bridging elements in level crossing installations is the approval of the use of a bridging element by the ProRail inspector. Strukton maintains it applied this procedure to the fitting of the bridging element in question. The chief engineer drew up a plan and consulted with a ProRail inspector. ProRail and Strukton had their own different interpretations as to the involvement of the inspectors in the decision to use bridging elements. In any case, one ProRail inspector was aware of the bridging element.

It can be concluded that the fitting of bridging elements in operational installations is not, by definition, prohibited. There were different views on the conditions under which this was allowed to take place.

Decision-making
In this case, the decision was taken to fit a bridging element to supplement points jamming equipment because of the need to restore rail movements at the earliest opportunity. The fitting of a bridging element in a (partially) operational track is an exceptional measure about which the regulations are unclear. Such a step requires careful decision-making at a high level and safety guarantees which are commensurate with the exceptional situation. This was insufficiently the case in the situation in question.

The decision to put tracks 1 to 4 back into service as quickly as possible was taken by the Railways Calamities Team (RCT). At that point in time, the RCT was the highest decision-making body available, representing, among others, the rail transport companies concerned, ProRail Inframanagement and Traffic Control. The contractor is not represented in the RCT. When the RCT took the decision to put the tracks in question rapidly back into service, people were already aware of technical sign malfunctions due to broken cabling. The sub-aspect manager for infrastructure repairs was responsible for solving this problem (of tracks being in service before a certain point in time despite there being unspecified technical sign problems). As the party with final responsibility for restoration of the infrastructure, this sub-aspect manager should have recognised this problem and consulted with the contractor on the matter during execution. This was not the case. As a result, the problem was actually the contractor's responsibility. The person with final responsibility (at that moment) at ProRail IM, namely the sub-aspect manager for infrastructure repairs, was unaware of the problems which eventually arose when the tracks were put into service and of the eventual decision to bridge set of points 63. The lack of clarity regarding the responsibilities of a sub-aspect manager vis-à-vis the contractor (see also paragraph 6.4) also played a role.

The eventual decision to install the bridging element was taken at operational contractor level. The chief engineer drew up a plan which stated that set of points 63 had to be bridged because it was continuing to generate malfunction reports in the operating system. When taking decisions related to this plan, those responsible for implementation on behalf of Strukton settled for implicit permission from the ProRail inspector (which entailed him being present when the bridging element was fitted) and did not involve a manager in the decision-making who would then have proposed the decision to the appropriate ProRail official (the sub-aspect manager for infrastructure repairs, see paragraph 6.4). No formal liaising took place between the Strukton and the ProRail managers regarding the work which they carried out.

Recording of and communication on the bridging element
Besides the faulty decision-making regarding the bridging element, the recording of, and communication on, the bridging element was also insufficient. As a result, teams (and train traffic controllers) that became involved at a later stage were no longer aware of the bridging element's existence.

The measures which are relevant to safety and which are implemented during function repair work are recorded in the WOCO, a work contract between the train traffic controller and the workplace safety manager (WSM). The scope of a WOCO is formally limited to the recording of workplace safety measures such as points jamming equipment. However, the bridging element was not fitted to protect the workplace but to initiate rail traffic or keep it going. It is therefore illogical to expect measures such as the bridging element to be laid down in a WOCO. The workplace safety manager has his own specific tasks for a good reason. The Railways Staff Decree describes the two tasks of a workplace safety manager as: ensuring the safety of the work as regards rail traffic and the planning of railway vehicle movements while that work is being carried out. The laying down of technical sign measures which are not related to work safety is not a feature of this job description.

The only time the bridging element is indicated in black and white is in a sketch on a sheet of paper showing the way in which the bridging element ought to be installed. However, this document had no official status and not everyone was aware of its existence. The communication relating to the bridging element was primarily verbal. Opinions differ as to who informed who. It is clear, however, that one or more train traffic controllers knew about it. All the same, this begs the question as to what extent train traffic controllers know what a bridging element is and what they are able to do with that information. A number of people interviewed stated that train traffic controllers do not have enough knowledge about the safety installation to know what a bridging element is and to be fully aware of the consequences of one being present. As already mentioned, at least one inspector knew about the bridging element but the information was not passed on to the superiors (sub-aspect manager for infrastructure repairs) nor to those in other teams.

The weaknesses in the recording of, and communication on, issues relevant to safety are particularly evident in the event of calamities whereby it takes a long time to repair the infrastructure. Interviews with ProRail staff revealed that in the majority of malfunction repair situations the work is carried out by a single team which means there is a certain 'inbuilt guarantee' of safety. There were only a few instances of repairs to the infrastructure being carried out over a longer period of time by a number of different teams. If the work can be done by one team, everyone remains fully informed of the measures taken. As a result, the chance of communication problems and of forgetting to do things is smaller.

It can be concluded that the decision-making, recording and communication relating to the bridging element were insufficiently attuned to the (hectic) situation and the safety-critical aspects of this operation. As a result, only a few people knew about the bridging element and this led to it not being removed when the mechanism used to jam the set of points was removed. It was at that moment that a derailment risk came about. Responsibility for the track was transferred to the train traffic controller together with this inherent derailment risk. The following paragraph examines the transfer in greater detail.

The following conclusions can be drawn from this analysis of the use of the bridging element:

1. During the infrastructure repair process, the decision was taken to install a bridging element as an exceptional solution to facilitate railway traffic.

2. The regulations relating to the use of bridging elements were not clear and were not geared to a calamity situation.
3. The responsible parties involved (RCT) decided to put tracks 1 to 4 back into service despite knowing that there were technical sign problems. The fact that this was a safety-critical problem should have been reason enough to maintain close contacts with the contractor. This did not happen.
4. The people carrying out the work (from Strukton) were insufficiently aware that such an exceptional solution, which involved changes to the safety installation, required approval at a high level within the organisation and extra safety measures.
5. Crucial safety installation measures, namely the use of bridging elements, were not, or were inadequately, recorded at the time of the derailment. Insufficient backup resources and/or procedures are available for repairs to the infrastructure after a calamity which would guarantee that safe serviceability measures are properly laid down[21]. The work contract (WOCO) is not supposed to be used for this purpose since it is intended to record measures taken within the framework of work safety.

6.3 UNDERLYING CAUSE: LACK OF A CHECK BEFORE RESPONSIBILITY FOR THE TRACK WAS TRANSFERRED

Transfer
As concluded in the previous paragraph, the risk of derailment came about when the points jamming equipment was removed but the bridging element was left in place. The railways manager ought to have checked the quality of the tracks before responsibility for them was transferred to the train traffic controller. If this had been done, the fault (the unwanted presence of the bridging element) might have been detected in time.

Division of responsibilities
ProRail is responsible for the safe serviceability of the track. The organisation in the region is divided into two parts, namely Inframanagement and Traffic Control. The responsibility for safety is shared in such a way that Inframanagement is responsible for the quality and safety of the infrastructure and Traffic Control for the provision of safe tracks. Traffic Control assumes that the infrastructure is safe to use as long as no signals are received from Inframanagement or from engine drivers and the traffic controls system (for points and signs) does not generate any warnings of malfunctions. As soon as the train traffic controller receives a notification of a malfunction or of damage, s/he takes the section in question out of use because the safety of the tracks can no longer be guaranteed. The situation is reported to ProRail Inframanagement where staff ask a contractor to assign a workplace safety manager (WSM) who can create a safe workplace so that the infrastructure can be repaired on behalf of Inframanagement. The track is formally taken out of service. This transfer of responsibility (from Traffic Control to Inframanagement) is laid down in a work contract (WOCO) that is signed by the train traffic controller on duty and the WSM. This WOCO also records the measures taken within the framework of work safety. After the work has been completed, only the WSM (either the same person or a successor from a later team) can formally return the track to the train traffic controller. This again occurs by means of signatures, with responsibility for using the track being returned to Traffic Control. This transfer in fact means that the track is safe to use again. If any restrictions apply to the use (e.g. temporary speed restrictions or a set of points which may only be passed over in one position), these are laid down in writing at the time of transfer.

[21] The WOCO is not intended for this purpose. ProRail is working on the implementation of a new guideline with a view to improving this situation.

ProRail Inframanagement uses two sorts of tests/checks which can be carried out after damaged infrastructure has been repaired and before it is put back into service:

- a check of individual points (referred to as the 'function test');
- a final check of the entire infrastructure before release (referred to as the 'safe serviceability check').

Both checks are explained below.

Function test of the set of points
The repair work carried out on the infrastructure after calamities is performed by a process contractor (PC), in this case Strukton Railinfra. One aspect of completing the work is the carrying out of function tests. This is laid down in procedures (including If6106 Operating test for technical sign installations). No function test was carried out on set of points 63. If one had been done the bridging element would have been detected. All the parties involved agree that a function test should have been carried out for the set of points concerned. The cables had, in fact, been damaged and had been repaired. According to the procedures referred to a function test should then have taken place. The other sets of points which had undergone repair were subjected to a function test.

At the moment that the other points were tested, set of points 63 was still jammed (making a function test impossible) and was still being used. A function test should still have been carried out when the points jamming equipment was removed. However, for a reason which is as yet unclear, this did not happen. The most plausible explanation for this is that the official who removed the points jamming equipment did not know that the cables of the set of points in question had been broken and repaired. After all, a function test is not required if a set of points has only been jammed without any repair work having been carried out.

Final safe serviceability check
At a certain point in time, the repaired infrastructure is put back into service. This was an important moment because it is when the contractor (the WSM), who acts under the final responsibility of ProRail Inframanagement, hands the track back to ProRail Traffic Control for further use. In effect, therefore, the track is declared 'safe for use'. Depending on the risks and an estimate of the situation, ProRail can opt to have the check of the finished work carried out by the contractor itself or by a third party. In the majority of cases (of limited disruptions) this task is indeed left to the contractor.

The procedures for the final check of the track's safe serviceability are described in, for example, the 'The handbook for inspectors of safe serviceability'. This handbook states that a safe serviceability check has to be performed 'in all cases in which work or calamities may have had an effect on the safe serviceability of the track'. This statement also applies, therefore, to the repair work carried out after this derailment.
This handbook also states that 'If the SI declares that the track is safe for use[22], this is formally regarded as also being a declaration of train safety by the Manager of Maintenance and Restoration'. The position of Manager of Maintenance and Restoration no longer exists. However, this official was the manager responsible for maintenance and repairs at (what is now known as) ProRail Inframanagement. The approval of (repaired) infrastructure by a safe serviceability inspector therefore means that ProRail Inframanagement assumes responsibility for safe serviceability from the contractor. The WSM (as commissioned by the contractor) can then transfer the track to ProRail Traffic Control once s/he has acquired the signature of the SI.

According to the handbook for inspectors of safe serviceability, the inspector certainly should have carried out a safe serviceability check in this situation, before putting the track back into service. However, this check never took place and, as a result, the responsibility for the track was transferred directly by the contractor to ProRail Traffic Control, without any intervention on the part of ProRail Inframanagement. Consequently, ProRail Inframanagement was unable to structure properly its responsibility for the safe serviceability of the infrastructure.

ProRail has not been able to explain why this check did not take place. In its investigation report, ProRail states that it has transpired at national level that this part of the procedure 'is not carried out'. Therefore, the safe serviceability check was apparently not applied on a structural basis to

[22] In the handbook, 'safe for use' is defined as follows: 'a track is safe for use if the risk of a derailment, collision or crash which leads to injury or damage is nil'.

repair work after calamities. As referred to above, the procedure is for the safe serviceability inspector to declare the track safe for use on behalf of the infrastructure manager. However, this did not occur in this instance. At a certain moment in time, responsibility for the infrastructure was transferred by the WSM or the contractor to ProRail Traffic Control without any formal statement of safe serviceability by ProRail Inframanagement. This approach is usual in the case of small-scale work which does not entail any scaling up and which, therefore, does not require ProRail representatives to be present. Reports have shown that ProRail representatives in the RCT (such as the sub-aspect manager for infrastructure repairs) were surprised when they heard that the WSM had already put the track back into service.

ProRail has indicated that the procedure referred to was the reason for reviewing the procedures relating to guaranteeing safe serviceability. The Safe Serviceability Handbook is to be replaced by the revised 00036 procedure which is also applicable after calamities (the old 00036 procedure related only to new construction work). The definitive version of this procedure still has to be finalised. It is, for example, still unclear which criteria are going to apply for safe serviceability.

Incidentally, it is debatable whether the bridging element would have been noticed during a safe serviceability check like the one prescribed in the handbook, since this check is primarily a visual check of the track. This highlights another deficiency in the handbook, since a final check before the track is put back into service ought to enable such faults to be detected; all the more so when one considers that ProRail Traffic Control assumes that the tracks which are being put back into service are safe for use if the system does not generate any malfunctions.

Conclusions
On the basis of the analysis of the way in which the infrastructure is declared safe for use, the following conclusions can be drawn:
- ProRail failed in its duties as regards testing and checking the infrastructure before it was declared safe for use. As a result, no-one noticed that the bridging element was still in place after the points jamming equipment had been removed.
- The applicable procedures for testing and checking the infrastructure are inadequate[23].

6.4 STRUCTURAL LACK OF SAFETY: WEAK SPOTS IN CALAMITY PROCEDURES

Description of calamity procedures
ProRail's calamity procedures are the responsibility of the Traffic Control business unit and apply across the sector. Around 3,000 calamities are dealt with each year. Only a small number of these relate to calamities involving large-scale damage to the infrastructure.

The Railways Emergency Plan (as published and managed by ProRail Traffic Control) describes the framework within which this organisation operates. An important aspect of this Emergency Plan is the distinction into three levels of scaling up, namely:
(1) the general manager (is responsible for operational coordination);
(2) the RCT: Railways Calamities Team (at regional level) and
(3) the RPT: Rail Policy Team (at national level).
In the case of the derailment reported on here, the management of the calamity procedures was scaled up to the second level (RCT).

The Emergency Plan also defines calamities according to certain categories, such as disruption by the weather or infrastructure malfunctions, collisions involving trains, or hazardous and environmentally harmful substances. Each type of calamity is also subdivided into a number of categories according to seriousness and these form the criteria for any scaling up.

Within the framework of the calamity procedures, the general manager (GM) is responsible for operational coordination. The GM coordinates and monitors the mutual consistency and effectiveness of all sub-aspects, which include alarms, assistance for passengers, restoration of the traffic function, restoration of the transport function, infrastructure repair, and communication. In the event of scaling up, an official is appointed for each sub-aspect, who then participates in the RCT or RPT.

[23] ProRail is currently working on improvements to these procedures.

If it appears likely that the rescue and control phase is going to last longer than 90 minutes, the GM summons a workplace safety manager (WSM) who is then required to take measures at the scene to guarantee the safety of those present and who assumes responsibility for the track from the train traffic controller.

Emergency plans
In the event of calamities, ProRail Inframanagement is responsible for the safe serviceability of the track. The repair work is carried out by the process contractor and can be checked by ProRail. As regards the work agreements which apply when dealing with calamities, ProRail Inframanagement has made the Malfunctions Management Handbook a feature of the contracts with the process contractors. In addition, Strukton has drawn up its own draft plan for infrastructure repairs.

Three levels of calamity procedures have been found:

- the Railways Emergency Plan: for the basic details on the authorities and responsibilities of all parties;
- the Malfunction Management Handbook: procedures for repairing the infrastructure (one of the sub-aspects);
- the (draft) Calamities Plan: checklist for the staff of the Strukton emergency repair service.

These three levels of regulations ought to link up with each other, but this is not entirely the case. For example, different views are conjured up regarding the responsibility of the sub-aspect manager for infrastructure repairs (see following paragraph). In addition, the Malfunctions Management Handbook focuses primarily on the processing of malfunction reports and not, or scarcely, on dealing with calamities which involve a scaling up of management tasks.

Weak points in the repair process
The reports by the Inspectorate for Transport, Public Works and Water Management and ProRail and the interviews which were held within the framework of this investigation reveal a number of weak points in the calamity procedures. These relate to a calamity whereby considerable damage is caused to the infrastructure and scaling up has taken place, and not to the majority of the calamities which do not entail any scaling up. These weak points or uncertainties are dealt with one by one below.

1. Sub-aspect manager for infrastructure repairs
ProRail Inframanagement is responsible for repairing the infrastructure. After scaling up, the 'sub-aspect manager for infrastructure repairs' (OIR) is the official who bears this responsibility at the scene of the calamity. The reports of the derailment reveal, however, that the general manager played an active role in putting the repaired infrastructure back into service. Strukton's draft plan also states that the process contractor is responsible for function restoration and supports the GM, and also that ProRail Inframanagement fulfils an advisory role in this context. Both observations are not in line with the vision of ProRail, which bears final responsibility for the safety of the infrastructure and controls the repair process via the sub-aspect manager.

2. Inspector
The Safety Board has not acquired any clear insight into the tasks and authorities of the inspectors during the repair work. Formally, the inspector is positioned lower down in the hierarchy than the line manager. The line manager is responsible for the quality of the line and for supervising the process contractor that carries out maintenance work on the line. The inspector supports the line manager by carrying out audits and inspections and by acting as point of contact and informer for the process contractor[24]. During planned work, an inspector is only at the scene from time to time. However, the situation changes in the event of a major calamity. Direct control is then in the hands of the OIR and inspectors are present (almost) permanently. The question is whether the inspector in this situation is an extension of the sub-aspect manager, meaning that a notification to the inspector can be regarded as a notification to the sub-aspect manager. Moreover, can an inspector issue obligatory instructions to the contractor, or can he only advise? The reports of the interviews with the various parties involved, the formal procedures and the inspector's job profile do not provide any clear answers to these questions.

3. Differing expectations

[24] This description of responsibilities is taken from the job profile for inspectors.

One factor that adds to the above-mentioned lack of clarity is the fact that authorities and responsibilities that apply to smaller calamities without any scaling up are different to those that apply to large-scale calamities when scaling up of supervision does take place. Within the railways sector, all disruptions, whether small (for example a defective set of points) or large (such as the current derailment), are covered by the term 'calamity'. The majority of the calamities are small-scale. This does mean, however, that the operating procedure, and the expectations of the process contractor in particular are geared by routine to small-scale disruptions. This is also shown by the contents of the Strukton draft plan and the contractor's methods (see paragraph 6.2). In the event of a small-scale disruption, the contractor has considerable decision-making power, carries out the final check himself and even represents the manager on location. A representative of ProRail Inframanagement is present at the work location occasionally at most. The situation changes entirely when the supervision is scaled up. ProRail then has to play a more direct supervisory role via the 'sub-aspect manager for infrastructure repairs' at the location. However, in the run-up to the second derailment that role was not being adequately fulfilled. The ProRail official did not have a sufficient overview of the safety-critical work that the contractor carried out and was not aware that the bridging element had been fitted.

4. Ultimate responsibility
A lot of staff at both ProRail and the contractor(s) are involved in repair work on the infrastructure. According to ProRail, the general manager does not have final responsibility for supervising the entire process, but plays only a coordinating role. Final responsibility for infrastructural repairs is held by the sub-aspect manager for such repairs, and final responsibility for workplace safety is held by the WSM. In the view of the process contractor and of other parties involved, ultimate responsibility is held by the general manager. This view does not tally, therefore, with the formal ProRail line. Incidentally, this formal line was not always applied by ProRail representatives either. For example, in the case under review there was direct contact between the GM and the contractor, while this contact should have been arranged formally via the sub-aspect manager.

The fact that so many, and so many different, officials have responsibility when repairing the infrastructure means that clear and vigorous supervision is required. The fact that no one party had ultimate responsibility makes this difficult, but not by definition impossible. However, it is then very important that each official knows what his and other people's authorities and responsibilities are. This was by no means the case in the situation reported on here.

Conclusion
The calamity procedures are complicated. This is understandable because the nature and the extent of calamities can vary quite considerably and the calamity procedures have to be adapted accordingly. Formally, the main idea behind the calamity procedures is clear: the responsibility for sub-aspects (from assistance for passengers to infrastructure repairs) is held by a separate official for each sub-aspect (e.g. the sub-aspect manager for infrastructure repairs) while the general manager coordinates the execution of all sub-aspects.

The investigation shows, however, that quite different views exist with regard to who exactly is responsible for what. These different views are caused partly due to the responsibilities changing in the event of scaling up and partly by the absence of one person with ultimate responsibility. It is also true that large-scale calamities (fortunately) do not happen very often and this means that the operating procedure for dealing with such events is unlikely to become routine very quickly.

The decision to use scaling up levels in the Emergency Plan and to divide responsibilities is understandable. However, this demands very careful implementation to ensure that all the parties involved at all levels have a clear insight into their responsibilities in different situations. In the situation reported on here, this was not the case.

As regards the calamity procedures, the following conclusions can be drawn:
- The relationship between ProRail and the process contractor is primarily geared to 'standard' work.
- The different levels in the calamity plans are insufficiently coordinated.
- When the first derailment was dealt with (whereby supervision was scaled up), the organisations and officials involved did not have a clear insight into their tasks and responsibilities.

6.5 STRUCTURAL LACK OF SAFETY: INSUFFICIENT REGULATIONS

The previous paragraphs described the derailment as being the result of a lack of clarity in various guises, outdated provisions and contradictions in the (sector) regulations.

The Dutch railway sector is characterised by a large number of detailed sector regulations and procedures. A lot of rules and procedures applied to the various aspects of this derailment as well, for example to the use of bridging elements, the procedures and criteria for declaring safe serviceability of the repaired infrastructure, the division of responsibilities in the event of repair work, etc. After the derailment the different parties involved, namely ProRail and Strukton Railinfra, also defended their actions on the basis of different aspects of the sector regulations.

In view of the lack of clarity, outdated provisions and contradictions in the regulations, it can be concluded that there was a structural lack of safety.

Safety management system
ProRail's safety management system (SMS) includes a chapter entitled 'National Critical Processes' in which the most critical process is stated as being, 'Quality, control, communication and implementation of technical and general safety regulations'. ProRail's SMS is currently being developed. On the basis of the above observations it can be concluded that, in any event, the aspect of the SMS referred to has been inadequately applied in practice.

According to the management concession which the Minister of Transport, Public Works and Water Management granted to ProRail, ProRail is required to have an adequate safety management system as of 1 January 2007.

Following the derailment, ProRail itself also observed that the quality management system (that is linked to the SMS) needs to be improved. ProRail is now taking action on this point by improving procedures relating to temporary adaptations in technical safety systems and the safe serviceability check.

Inspectorate for Transport, Public Works and Water Management
The Inspectorate for Transport, Public Works and Water Management has formally been responsible for supervising ProRail since April 2005. Until that time, this organisation was not subject to any statutory supervision. The supervision by the Inspectorate takes place on the basis of the aspects of the management concession which are oriented around safety and the environment. The Inspectorate recently carried out an initial inspection of ProRail Inframanagement's safety management system. The results were published on 30 July 2006. In its final report, the Inspectorate concludes that '*ProRail has an operational safety care system known as the Safety Management System (SMS). The SMS complies with the requirements of the evaluation framework and describes, in a well-organised and thorough manner the activities which are relevant within the rail safety planning and control cycle. Six deficiencies were detected in relation to the assessment framework used and the safety care system is inadequate with respect to these points. The deficiencies observed must be rectified before 1 January 2007.*' In the introduction to the inspection report the SMS is described as 'adequate'.

A number of these six points overlap with the deficiencies identified in this report. For example, the SMS has '*not been updated and improved according to the plan*' and '*the job profiles do not specify the tasks, responsibilities, authorities and training requirements, for example in relation to (railway) safety*'. In addition, the Inspectorate states that '*the status of the requirements and conditions referred to in the regulations for the process contractor is still unclear and may result in different interpretations*'. What is more, '*the critical processes have not been audited in accordance with the annual safety plan'.* The findings of this investigation underline these conclusions. In particular, the conclusion as regards the unclear regulations for the process contractor corresponds with the conclusion of this investigation that the critical process of 'Quality, control, communication and implementation of technical and general safety regulations' has not been sufficiently implemented in practice.

As regards the inspection, it should be noted that the results have been acquired on the basis of document analysis and interviews at management level (centrally and regionally). This means that no investigation was carried out into the effect of safety management on the daily practice of working on the infrastructure. One of the recommendations in the report by the Dutch Safety Board entitled 'Through red at Amsterdam Central Station' is to base 'supervision explicitly… on the assessment of the quality of the application in daily practice of the safety management system of the parties involved'. It can be concluded that this inspection was not carried out with this recommendation in mind. However, the Safety Board does take account of the fact that this was the first inspection of ProRail (the Inspectorate refers to it as an 'initial' inspection). Nevertheless, the Safety Board is surprised that, given the limited depth of the investigation and the seriousness of the deficiencies, the Inspectorate still concludes that ProRail's SMS is operational and adequate.

Response by ProRail
In a response (included as an Annex to the Inspectorate's report), ProRail maintains that work is being done on updating and improving the SMS, improving the job profiles, clarifying the status of the requirements and conditions in regulations for process contractors and on auditing the critical processes.

The Safety Board is of the opinion that the deficiencies referred to concern key issues. Despite the fact that ProRail is actually busy tackling these deficiencies, it should be regarded as well-nigh impossible for these to be resolved before 1 January 2007. For example, the clarification of the status of requirements and conditions for process contractors is an extensive and difficult task. This is illustrated by the fact that ProRail is still working on drawing up clear rules for working on safety installations as a consequence of the collision near Veenendaal, and that is just one issue.

Conclusions
- The (sector) regulations contain outdated provisions and contradictions, and are interpreted in different ways.
- ProRail's safety management system still requires improvement as regards quality, control, communication and the implementation of technical and general safety regulations.
- The Inspectorate for Transport, Public Works and Water Management carried out an initial inspection of the SMS used by ProRail Inframanagement but did not assess its operation in practice.

7 CONCLUSIONS

7.1 DIRECT CAUSE

After the derailment on 6 June, the repair work took several days. In the night of 7 to 8 June, tracks 2, 3 and 4 were put into service because tracks 11 to 15 had to be taken out of service for other work. This meant that railway traffic was still possible on the west side of Amsterdam Central Station. Set of points 63 plays an important role in the use of these tracks. However, the train traffic controller's system continued to indicate malfunctions relating to set of points 63. In order to make these tracks useable, set of points 63 was jammed in one position and bridged in the operating system. As a result, the train traffic controller was able to allow trains to pass over the set of points in question in the jammed position from 8 June onwards.

On 9 June, the set of points was released without the bridging element being removed. This made it possible for the physical position of the set of points to differ from the signal generated in the operating system. The system indicated to the train traffic controller that the set of points was right-hand in control while, in reality, that was not the case. The train traffic controller therefore unwittingly allowed a number of trains to pass over this set of points which were then opened up and damaged as a result. It was this damage that caused the derailment of an empty coal train at 03:12 on 10 June. Three wagons derailed, of which one tipped over on its side.

7.2 UNDERLYING CAUSES

Bridging element

- During the infrastructure repair process, the decision was taken to install a bridging element as an exceptional solution to facilitate railway traffic.
- The regulations relating to the use of bridging elements were not clear and were not geared to a calamity situation.
- The responsible parties involved (RCT) decided to put tracks 1 to 4 back into service despite knowing that there were technical sign problems. The fact that this was a safety-critical problem should have been reason enough to maintain close contacts with the contractor. This did not happen.
- The people carrying out the work (from Strukton) were insufficiently aware that such an exceptional solution, which involved changes to the safety installation, required approval at a high level within the organisation and extra safety measures.
- Crucial safety installation measures, namely the use of bridging elements, were not, or were inadequately, recorded at the time of the derailment. Insufficient backup resources and/or procedures are available for repairs to the infrastructure after a calamity which would guarantee that measures aimed at safe serviceability are laid down[25]. The work contract (WOCO) is not supposed to be used for this purpose since it is intended to record measures taken within the framework of work safety.

Check

- ProRail failed in its duties as regards testing and checking the infrastructure before it was declared safe for use. As a result, no-one noticed that the bridging element was still in place after the points jamming equipment had been removed.
- The applicable procedures for testing and checking the infrastructure are inadequate [26].

7.3 STRUCTURAL SAFETY DEFECTS

Calamity procedures

- The relationship between ProRail and the process contractor is primarily geared to 'standard' work.
- The different levels in the calamities plans are insufficiently coordinated.

---

[25] The WOCO is not intended for this purpose. ProRail is working on the implementation of a new guideline with a view to improving this situation.
[26] ProRail is currently working on improvements to these procedures.

- When the first derailment was dealt with (whereby supervision was scaled up), the organisations and officials involved did not have a clear insight into their tasks and responsibilities.

Regulations
- The (sector) regulations contain outdated provisions and contradictions, and are interpreted in different ways.
- ProRail's safety management system still requires improvement as regards quality, control, communication and the implementation of technical and general safety regulations.
- The Inspectorate for Transport, Public Works and Water Management carried out an initial inspection of the SMS used by ProRail Inframanagement but did not assess its operation in practice.

8 RECOMMENDATIONS

The previous chapters described the derailments on 6 and 10 June. Because the (underlying) causes differ, it was decided to present the circumstances, analysis and conclusions of the two derailments in two separate parts. This chapter contains the Safety Board's recommendations based on its findings. For the sake of clarity, the Safety Board has opted to combine the recommendations into one chapter.

8.1 RECOMMENDATIONS RELATING TO THE DERAILMENT ON 6 JUNE

1. Voestalpine Railpro is advised to develop the maintenance system for its railway equipment in such a way as to guarantee that the equipment continues to fulfil the applicable requirements. This includes a complete and clear registration of the state of repair of each vehicle.

2. The Inspectorate for Transport, Public Works and Water Management is advised to implement, as a priority, the plan described in the Second Framework Policy Document on Rail Safety in the Netherlands to maintain strict supervision of the maintenance and maintenance processes for goods equipment. In particular, the Safety Board recommends an improvement in the system of technical checks and regular maintenance which ensures that deficiencies such as the lack of wheel markings can no longer occur.

8.2 RECOMMENDATIONS RELATING TO THE DERAILMENT ON 10 JUNE

3. ProRail is advised to ensure that the safety management system is implemented in a way that guarantees the safety of the daily work processes used by ProRail and the contractors.
   On the basis of the investigation at hand, the Safety Board particularly recommends that:
   - rail safety is demonstrably included in the decision-making process when dealing with calamities.
   - the safety of the track is explicitly assessed, communicated and recorded whenever responsibility for the infrastructure is transferred.
   - the SMS aspect of 'quality, control, communication and implementation of technical and general safety regulations' is adapted and executed in such a way that unclear and outdated regulations (can) no longer apply.
   - the Railways Emergency Plan is implemented and communicated in such a way that it is clear to all the parties involved in calamities which responsibilities and authorities apply in the situation that has arisen (depending on the level of scaling up).

4. The Inspectorate for Transport, Public Works and Water Management is advised to assess the operation of ProRail's safety management system in practice.

Administrative bodies to whom a recommendation is directed are required to inform the responsible minister of their point of view relating to compliance with this recommendation within six months of publication of this report. Non-administrative bodies or people to whom a recommendation is directed are required to inform the responsible minister of their point of view relating to compliance with this recommendation within a year. A copy of the responses must also be sent to the chairman of the Dutch Safety Board and the Minister of the Interior and Kingdom Relations.

ANNEX 1 EXPLANATION OF THE INVESTIGATION

Start of the investigation
On 6 June, 10 June and 15 August 2005, trains derailed at the western emplacement at Amsterdam Central Station. In the first instance an exploratory investigation was carried out into the first two derailments. After the third derailment, the Safety Board decided to carry out an investigation into all three derailments. On 14 September, the investigation's plan of approach was approved after which the investigation could be started.

The investigation had three aims:
- To verify the direct cause of all three derailments on the basis of information provided by the Inspectorate for Transport, Public Works and Water Management and the parties involved.
- To carry out more detailed investigations into those aspects from which, in the Safety Board's opinion, most lessons could be learned. Given the Safety Board's wish to combine the three derailments into one investigation, it was important to limit the number of aspects to be investigated in detail.
- To investigate common safety defects which caused the three accidents.

How the investigation progressed
On 30 September, an initial meeting was held in The Hague at which all the parties involved were represented. During this meeting, the aim, the general operating procedure and the schedule were discussed.

The Safety Board's investigation into the fire in the cellblock at Schiphol-East on 26 October 2005 made considerable demands on the Board's capacity and this, in turn, had an effect on the turnaround time of the new investigation.

In March 2006, the Safety Board decided to divide the investigation into two. By that time it had become clear that the first two derailments were due to a different cause than the third, meaning that there was no common cause for all three derailments. The (limited) investigation into the first two derailments was by then almost finished, while the investigation into the third was still in full swing. It was therefore decided to publish a report into the first two derailments first and then a separate report into the third derailment at a later stage.

Limitations imposed on the investigation
As mentioned above, a decision was taken to limit the investigation into the derailments on 6 and 10 June to those aspects which would supplement the reports by the Inspectorate for Transport, Public Works and Water Management on these derailments.

The investigation into the underlying causes of the first derailment (6 June) was limited to a brief analysis of the system of technical checks before the train's departure and of the responsibilities relating to the maintenance of goods equipment. This led to a number of deficiencies being established. It was decided, within the framework of this investigation, to limit these analyses and, as a result, the extent to which these deficiencies were of a structural nature was not determined in all cases. For example, no investigation was carried out into the safety management system used by Railion, Voestalpine Railpro and NedTrain.

In the case of the second derailment (on 10 June) the investigation focused on the bridging element that had been fitted. No investigation was carried out into the technical state of the points which had been damaged during the first derailment and then repaired.

Methods and techniques
The investigation started with the collection and analysis of the reports by the parties involved on the derailments and the equipment. A Tripod analysis was made for each of the two derailments to support the analysis. A time line analysis was made of the work carried out after the first derailment. After that, interviews were held and company visits arranged to verify the details and ask additional questions. The reports of the interviews were submitted to the interviewees so that they could add their comments.

Perusal
After approval had been received from the Rail Traffic Committee and the Safety Board, a draft report was sent to the following parties for perusal:

- ProRail
- Voestalpine Railpro
- Railion
- Strukton
- Head of the Railway Department of the Ministry of Transport, Public Works and Water Management
- Inspectorate for Transport, Public Works and Water Management.

All the parties provided feedback. Factually-based comments were included wherever possible. The final version took account of comments on the analysis. This does not mean, however, that there is a common view on the derailments and the causes.

The perusal period lasted from the beginning of July to the beginning of August. At the beginning of September, the Rail Traffic Committee approved the publication of the amended final report. The Safety Board gave the go-ahead for publication at the end of October.

ANNEX 2 ASSESSMENT FRAMEWORK

In principle, the way an organisation interprets its own safety responsibility can be tested and assessed from different perspectives. There is, therefore, no universal handbook that applies in all situations despite the fact that a greater emphasis has been placed on individual responsibility for safety since the 1990s. It is for this reason that the Safety Board itself selected five points for attention as regards safety which give an insight into which aspects may play a role (to varying degrees). The Safety Board is of the opinion that this choice is justified given that these points for attention as regards safety are included in numerous (inter)national laws and regulations and in a large number of widely accepted and implemented standards. These points for attention are as follows:

1. Insight into the risks as a basis for the approach to safety
The starting point when it comes to achieving the required safety is:
- an examination of the system, and then
- an analysis of the related risks.

This basis is then used to determine which dangers need to be controlled and which preventive and repressive measures are required to achieve this.

2. A demonstrable and realistic approach to safety
In order to prevent and control undesirable events, a realistic and practical approach to safety (or safety policy) needs to be laid down, along with the related points of departure. This approach to safety should be recorded and supervised at management level and is based on:
- relevant and applicable legislation and regulations;
- available standards, guidelines and 'best practices' from the sector, and individual insights and experiences of the organisation and the safety objectives drawn up specifically for the organisation.

3. The execution and enforcement of the approach to safety
The execution and enforcement of the approach to safety and the management of the identified risks is carried out by:
- A description of the way in which the adopted approach to safety is implemented, while taking account of the concrete objectives and plans, including the resulting preventive and repressive measures.
- A transparent, unequivocal and generally accessible division of responsibilities on the work floor for the execution and enforcement of safety plans and measures.
- A clear specification of the required deployment of staff and expertise for the various tasks.
- Clear and active central coordination of safety activities.

4. A tightening of the approach to safety
The approach to safety must be continually tightened on the basis of:
- The execution of (risk) analyses, observations, inspections and audits (proactive approach) which take place periodically and, in any case, whenever the points of departure are changed.
- A system for the monitoring and investigating of incidents, near-accidents and accidents, as well as an expert analysis thereof (reactive approach).

The above is used as a basis for evaluations with the management and for adjusting the approach to safety as necessary. In addition, points for improvement are identified which can then be actively pursued.

5. Management control, involvement and communication
The management of the parties/organisation involved must:
- Create clear and realistic internal expectations relating to the safety ambition, generate a climate of continual improvement of safety on the work floor by, in any case, setting a good example and also by making sufficient people and resources available.
- Provide clear external communication on the general operating procedure, method of assessment thereof, procedures in the event of discrepancies, etc. on the basis of clear and recorded agreements with the various interested parties.

ANNEX 3 ANNEX RAIL TRAFFIC REGULATIONS

Article 5 of the Rail Traffic Regulations, Annex 1

In this annex the following terms have the meanings shown:

1. SLC: safe loop check.

2. Transport arrangement: arrangement by a railway company governing the transport of a train containing wagons which require exceptional measures to be taken.

3. Measure A (repairs at the scene)
The railway company arranges (provisional) repairs at the scene.

4. Measure B (interrupt journey / emergency repairs / technical supervision)
The railway company arranges (provisional) repairs at the scene, or assesses whether the wagon can be transferred to a workshop with a transport arrangement, subject to supervision by an expert who continually assesses whether the wagon can continue its journey safely.

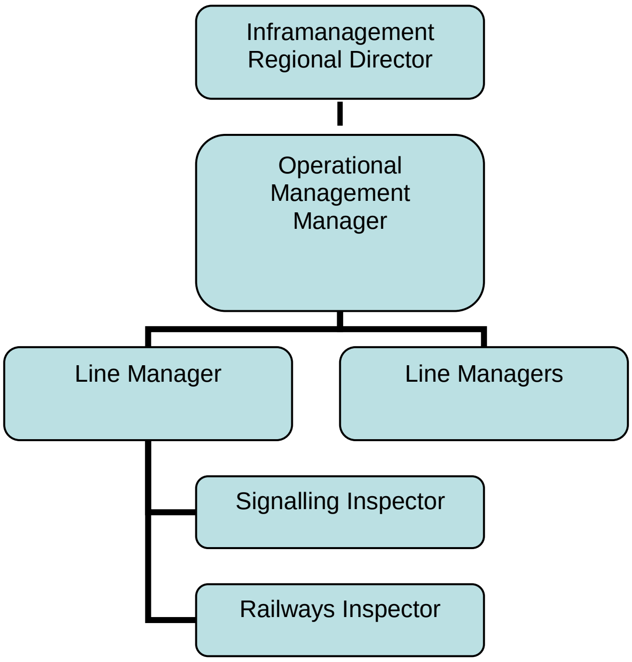
5. Measure C (interrupt journey / transport arrangement)
The journey is interrupted and the wagon may be transferred to a workshop with a transport arrangement without (provisional) restoration. The wagon may not be loaded and any hazardous substances (RID) are discharged. A bill/document is affixed to the defective wagon which indicates the nature of the defect and how it needs to be dealt with.

6. Measure D (loaded wagon to workshop / repair after unloading)
The journey may be continued without (provisional) repairs and the wagon may be transported to a workshop in a loaded state. Repairs are carried out after unloading. A bill/document is affixed to the defective wagon which indicates the nature of the defect and how it needs to be dealt with.

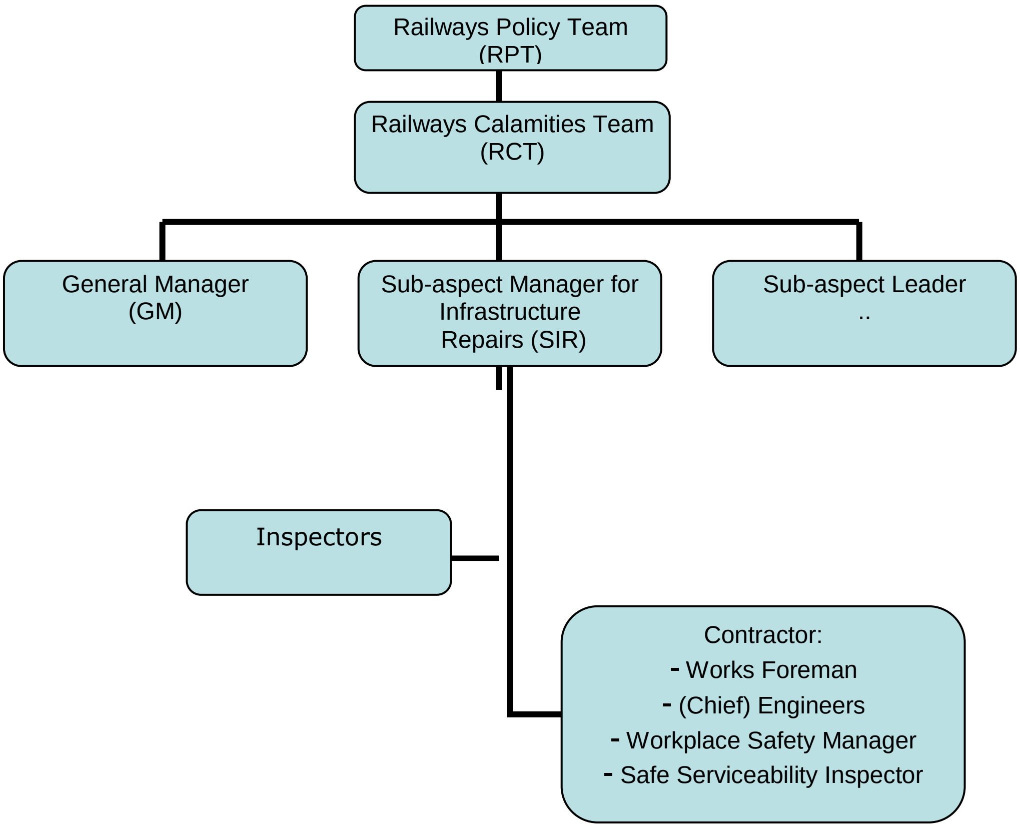
7. Measure E (repairs not immediately necessary)
The wagon may be unloaded and loaded again. Notification of the defect is given when the wagon is transferred to another railway company. The schedule included in this annex applies in full to the technical check and to the check safe loop in so far as this is indicated for the unit concerned using 'SLC'.

Component	No.	Defects/criteria/instructions	SLC	Measures
Wheels with tyres	1.1			
	1.1.1	Thickness less than − for 120 km/h wagons (wagons bearing the inscription ‘SS' or ‘**’)....35 mm − other wagons ....30 mm		B
	1.1.2	Tyre − broken − longitudinal and transverse tear	SLC	A
	1.1.3	Loose tyre − check displacement of marks or − unclear sound or − loose tyre clip / closure or − traces of rust between tyre and rim in excess of 1/3 of the circumference	SLC	A
	1.1.4	Check marks − not present − not clearly visible		B
	1.1.5	Tyre displaced sideways − tyre clip / loose or visible distorted	SLC	A
	1.1.6	Damage to tyre clip − torn − broken − missing − locking pin missing (if prescribed)		A

ANNEX 4 PRORAIL ORGANISATION CHARTS



Organisation chart 1 Organisation chart showing the regional organisation of ProRail Inframanagement



Organisation chart 2 Calamity procedures organisation chart