Havarikommissionen
Accident Investigation Board Denmark

30.08.2013

REPORT

IC4 train set passed signal at danger at Marslev

HCLJ 611-2011-23.	**Incident**	SPAD	Train operation
Date:	07.11.2011	Time:	15:17
Place:	Marslev		
Infrastructure manager:	Rail Net Denmark (Banedanmark)	Railway undertaking:	DSB
Personal injury:	None		

Through independent surveys, the Accident Investigation Board in Denmark will make recommendations to prevent accidents and incidents in rail and aviation in the future. The Accident Investigation Board in Denmark does not place blame and liability.

The Danish edition is the current version.

1 Summary

On Monday 7 November 2011, L 47 passed an AM signal (automatic block signal) at danger at Marslev by 651 metres. The train which was a single-operated IC4 train set used approx. 2,800 metres to brake from a speed of 180 km/h to a standstill. The train stopped 374 metres behind the freight train ahead of it.

Shortly after the incident, the Accident Investigation Board was notified about three other incidents where the engine driver had experienced problems or irregularities with a train of that type.

The investigations showed that the brake system generally worked according to applicable standards, but that applicable standards did not cover all conditions that were expectable in daily operation (very low adhesion).

. The investigations also showed that the functionality of the brake system during brake applications under very low-adhesion conditions led to the wheels blocking and the distance travelled not being recorded correctly. Several physical and software-related (parametric) faults were found in the brake system in connection with the further investigations. Tests of brake computers and the Wheel Slide Protection (WSP) system showed that the WSP system was not able to identify the actual speed (bring the reference speed back up to the actual speed) when the brakes were applied under low-adhesion conditions and thus prevent the wheels from blocking, and that the train was not able to identify the distance actually travelled and the actual speed of the train..

Against this background, the Accident Investigation Board made the following recommendations:

- The **E**uropean **R**ail **A**gency (ERA) must ensure that applicable international standards for approval of brake systems for rolling stock are revised so that the accumulated functionality of the brake system is documented in all applications of the rolling stock, including under adhesion conditions that must be regarded as probable in daily operation.
- The Danish Transport Authority (Trafikstyrelsen) must ensure that applicable national standards for approval of brake systems for rolling stock are revised so that the accumulated functionality of the brake system is documented in all applications and under all operating conditions and adhesion conditions that must be regarded as probable in daily operation.
- The Danish Transport Authority must ensure that the braking power is documented in all applications of the rolling stock, including the adhesion conditions which may be expected to prevail in daily operation
- The Danish Transport Authority must ensure that the IC4 train type records correct data regarding the actual distance travelled and the actual speed, also under low-adhesion conditions.

This report is essentially structured in accordance with Annex V to the Railway Safety Directive, see Executive Order No. 1249 of 11 November 2010 on the implementation of the railway safety directive. For the sake of readability, the Accident Investigation Board has chosen to generally use the designations IC4 train sets instead of the correct rolling stock class MG and IC3 train sets instead of the correct rolling stock class MF in this report.

2 Facts

2.1 *Description of the accident*

2.1.1 Date, time and location of the incident

Monday 7 November 2011, 15:16 h at Marslev station.

2.1.2 Description of the events and the accident site

On Monday 7 November 2011, high-speed train L 47 departed from Copenhagen Central Station for Jutland.

The high-speed train, consisting of a single-operated IC4 train set with an active ATC, departed from Copenhagen Central Station with a delay of 13 minutes due to a generator fault. The high-speed train was caught behind an Intercity train until Slagelse where it passed the Intercity train. The high-speed train then proceeded at line speed to Ullerslev station.

Having passed Ullerslev station, the next signal showed AM signal 2133 ”Go forward” (two steady green lights, vertical green over green), meaning that the line is clear beyond the next main signal.

The next signal AM signal 2153 showed “Go” (steady green light), meaning that the next main signal must be expected to be at “Stop”. The engine driver initiated braking approx. 220 metres before AM 2153. The braking power was gradually increased to full braking without any substantial deceleration. Consequently, the engine driver applied the emergency brake. Soon after, the train passed AM signal 2173 in position “Stop” and stopped 651 metres after AM signal 2173. The train stopped approx. 374 metres from the rear wagon of the freight train ahead of it.

The freight train ahead of L 47, G9233, had braked for “Stop” on the entry signal to Marslev station. The freight train was switching onto the passing track at Marslev station to allow L 47 to pass.

Soon after, L 47 was granted authority to Go to Odense station where the train set was stopped and the passengers continued their journeys by other trains.

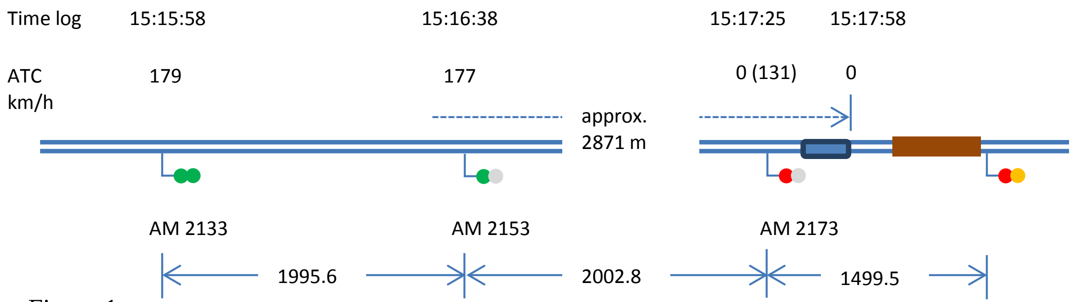


Figure 1

2.1.3 The accomplishment of the investigation

Based on the engine driver’s statements regarding lacking braking power and the extraordinarily long stopping distance, the Accident Investigation Board launched a preliminary investigation of the incident.

As the preliminary investigation showed that:

- under slightly different circumstances, the incident might have led to a serious accident
- there had been several reports of braking problems with this train type
- the incident happened with a new type of rolling stock that was being introduced in Denmark and had not yet been fully placed in service,

the Accident Investigation Board chose to launch an investigation of the incident.

In connection with the investigation, the Accident Investigation Board established three working groups:

- Analysis of Sequence of Events
- System Components – Interactions between the Subsystems
- Analysis of Test Results

with participating specialists from DSB, AnsaldoBreda, Faiveley Transport Group and other sub suppliers as required.

In December 2011, the Accident Investigation Board carried out a brake test with IC4 rolling stock on a closed track near Vojens in collaboration with DSB.

On 7 January 2012, the Accident Investigation Board published a preliminary account (of the facts) describing the event chain and the preliminary investigations.

Following a review of test results and analyses of the test carried out in South Jutland, it was decided to carry out additional tests with IC4 and IC3 rolling stock. These tests were carried out in January 2012.

On 30 January 2012, the Accident Investigation Board published an updated preliminary account which based on data from the test runs recommended that the Danish Transport Authority take the following issues into consideration when placing the IC4 in service again:

- that the wheel slide protection system (WSP system) of the IC4 train sets cannot protect against total or partial wheel slide under low-adhesion conditions.
- that total or partial wheel slide can lead to incorrect recording of the actual distance travelled and the actual speed upon brake application under low-adhesion conditions.
- that lacking/incorrect data to the ATC system regarding the actual distance travelled and the actual speed may lead to the safety system (ATC) not being able to intervene as expected.

Based on the incidents and the rest results, the Accident Investigation Board made a decision in March 2012 to carry out tests of brake computers and the WSP system. These tests were carried out by experts from DB-Minden in the summer/autumn of 2012.

2.2 *The settings*

2.2.1 Involved staff and contractors and other parties and witnesses

The driver was employed with DSB on 1 May 2005. Before completing the IC4 training, the driver was certified for the following rolling stock classes: Abns, Abs, Adns-e, ER, ET, ME, MF and MR. In June 2011, the driver completed the IC4 training and obtained a certificate for rolling stock class MG on 19 July 2011. Prior to his employment with DSB, the driver had been employed with Arriva from 1 June 2013.

2.2.2 The trains and their composition

In December 2000, DSB ordered a total of 83 IC4 train sets from AnsaldoBreda for delivery during the period 2003 to 2006. Halfway through 2013, the trains have still not been fully placed in commercial operation.

The train implicated in this incident, L 47, consisted of a single-operated IC4 train set with the rolling stock class numbers MG 5627 (M1), FH 6627 (T2HK), FG 6827 (T3) and MG 5827 (M4), MG 5627 being the leading coach in the direction of travel. In this composition the train set is designated MG 5627.

Drawing/outline of MG 5627

MG 5627 (M1C) FH 6627 (T2HK) FG 6827 (T3) MG 5827 (M4C)

Axle 1 2 3 4 5 6 7 8 9 10

Bogie 1 2 3 4 5

Figure 2

The IC4 train set has four engines of 560 kW each and had been authorised for a speed of 180 km/h. One train set has 204 seats.

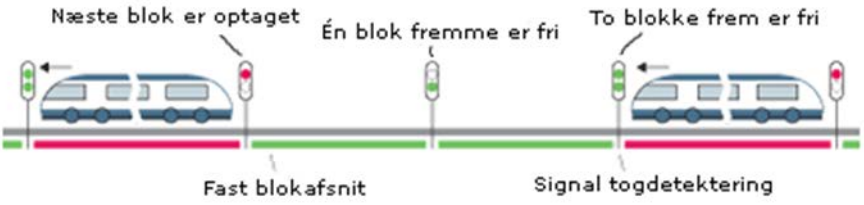
A Længde.	Togsæt længde over koblingerne.	86,0 m	
B Vægt.	Togsæt vægt køreklar.	170,5 t	
C Bremsesystemer.	Indirekte pneumatisk bremse (IP bremse) Elektropneumatisk bremse (EP bremse) Hydrodynamisk bremse (Retarder) Magnetskinnebremse (MG bremse) Parkeringsbremse (Fjederbremse)		
D Bremsearter.	Bremseart »P«.	Bremseprocent: 170	
E Bremsevægt.	Bremsevægt total: 290 t	Aksel 1: 29 t Aksel 2: 29 t Aksel 3: 29 t Aksel 4: 29 t Aksel 5: 29 t	Aksel 6: 29 t Aksel 7: 29 t Aksel 8: 29 t Aksel 9: 29 t Aksel 10: 29 t
	Maks. stigning for afbremsning med parkerings-bremse.	30 ‰	
F Togets sammensætning.	Bus konfiguration suppleret med trainlines.	Maks. 2 togsæt i konfigurationen.	
G Belastning af traktionsanlæg.	Ved beregning af belastning anvendes togvægt.	Maks. 90 t pr. aktivt traktionsanlæg.	
H Sikkerhedssystem.		ATC	

Figure 3. IC4 rolling stock information (Source: DSB, ODI MG)

2.2.3 Signals and interlockings

The incident took place on the line between Ullerslev and Marslev (Nyborg and Odense) at between 141.5 and 151.0 kilometres. The line is a double-track remotely controlled main line with line block type 1954 and the line has an automatic train control system, ATC, without a continuous line conductor (ATC line plan, Appendix 1.1). The line is electrified. The line speed – the maximum speed permitted – is 180 km/h for special train sets and 160 km/h for other trains and train sets fully monitored by the automatic train control system, ATC.

The main signals on the line presignal the next main signal, i.e. the exit signal in Ullerslev for “Go” (one green light) or “Go forward” (two green lights, vertical green over green) shows whether the next AM signal must be expected to be at "Stop" or "Go"/"Go forward".



Source: Rail Net Denmark

Generally, the distance between the block signals is approx. 2,000 metres (see Figure 1) here, but the distance between AM signal 2173 and the entry signal to Marslev station is only approx. 1,500 metres.

The signalling between the stations is controlled by the train movements, as insulated track sections – track circuits – register whether or not the track is occupied by rolling stock. A signal is set at “Stop” when the track circuit immediately behind the signal is occupied by a train and the signal automatically switches to “Go” when the safety distance behind the signal and the block section after the signal (until the next signal) is registered as unoccupied by trains and the subsequent signal has been set at “Stop” and is registered as being passed by the train. When two block sections after a signal are unoccupied by trains this way, the signal automatically switches to "Go forward" (two unoccupied block sections ahead of the train before a "Stop" must be expected at the end of the second block section).

The safety distance after a signal is calculated in such a way as to prevent the consequences of a miscalculation of the stopping distance and/or the prevailing braking conditions. The safety distance after each of the AM signals involved was approx. 105 metres.

The ATC system is only updated on signals – including the signals pre-signalling the next signals – for single points (through track magnets at the signals). Braking the train as a consequence of lacking information about the clear distance ahead of the train must be avoided. Consequently, the line block system has been expanded so that the signals to the ATC may indicate information in the cab signal if the line is unoccupied for several blocks ahead of the train, which can be indicated by the exterior signal showing two green lights.

As an expansion of the interlocking, the line was equipped with the train control system ATC in 1993, which through track magnets can provide point information about the signals etc. to the trains, such information being adapted to the characteristics of the individual train and being presented to the engine driver in the cab signal of the train. At certain main signals – e.g. entry signals – the track magnet point has been extended by a trackside line conductor of up to 1,000 metres.

2.2.4 Works carried out at or in the vicinity of the site

Rail Net Denmark has stated that no infrastructure work was carried out on the line Nyborg – Odense during the period preceding the incident, which could be of importance to the incident.

The area was not known for having slippery rails in connection with leaf-fall, nor was it being monitored for slippery rails. The leaf buster which clears the rails during leaf-fall was not used on this line.

2.3 *Fatalities, injuries and other damage*

2.3.1 Passengers, staff and other involved parties

No persons were injured.

2.3.2 Rolling stock, infrastructure and the environment

The infrastructure was not damaged.

Wheel flats on train set axles 3, 4, 5, 7 and 8 had been caused by the braking.

2.4 *External circumstances*

2.4.1 Weather conditions

At the time of the incident, the weather was hazy, i.e. with a high atmospheric humidity on 92.62. No rain. The air temperature was approx. 8^{o}C (Weather data for Marslev from the Danish Meteorological Institute (DMI), Appendix 1.2).

2.4.2 Geographical references

The line is a main line with no curves of importance (Rail Net Denmark line information, TIB ØV, Appendix 1.3). The ATC track magnets at AM signals AM 2133, AM 2153 and AM 2173 were all coded with a 4 ‰ downward gradient after the signal (until the next signal). The gradient figure was part of the mobile ATC system’s calculation of i.a. service and emergency braking distances.

Between Langeskov and Marslev the track is generally above or on a level with the surrounding terrain. There are no actual forest areas near the track, but there is vegetation consisting of a mix of leaf-bearing trees and conifers as well as windbreak belts, mostly with leaf-bearing trees. In addition, there are a number of open spaces.

AM signal 2153

AM signal 2173

3 Investigations

3.1 *Summary of testimonies (Driver testimony)*

The engine driver has stated that he had completed the IC4 training and obtained his certificate on 19 July 2011. After obtaining the certificate, he had four duties with IC4 rolling stock, including the duty on which the incident happened.

The driver has stated that he was driving L 47 departing at 13:50 from Copenhagen. The train arrived late at the platform. When the train was handed over to him, the driver found that only one generator was connected. He tried to correct the fault and had to start and stop the engines several times before the generator started working again. The driver acknowledged the faults displayed in the IDU screen[1] and saw that the magnetic track brake on MG 5627 was suspended. He carried out a brake test twice, as he had to unrig the train in his attempt to get the generator to work. During the brake test, the IDU screen displayed the magnetic track brake in MG 5827 as green, indicating that the magnetic track brake was active. Both brake tests were completed without faults and showed a braked weight percentage of 170, which was the normal braked weight percentage for an IC4 train set.

L 47 was further delayed due to the generator problems and departed from Copenhagen Central Station at approx. 14:03 after IC train 149 which departed at 14:00. Due to IC 149 ahead, the engine driver had to apply the brake several times and the train speed was between 40 km/h and 120 km/n until Slagelse station where L 47 passed the IC train.

The train speed reached 180 km/h until Korsør and again after the Great Belt Tunnel. Operation was normal until the second but last AM signal 2153 before Marslev. This signal showed “Go” (one green light) and the engine driver switched off traction power and initiated braking. When the engine driver placed the master controller in the brake step, the speed indicator in the cab signal fell from 180 km/h to 110-120 km/h and he saw that brake cylinders 1 and 2 started “fluttering” (the indicator oscillated between 1 and 2 bar) on the manometer. The engine driver did not feel the train braking and applied the emergency brake. The engine driver did still not feel the train braking and tried to activate the magnetic track brake by pushing the MTB button on the front panel.

The engine driver saw that the next AM signal 2173 was at “Stop”. When passing the AM signal, the speed displayed in the cab signal was approx. 110 km/h, but the IDU screen showed a speed of 168 km/h. As he did still not feel the train braking and there was nothing more he could do, he contacted FC[2] on the line radio saying ”… *I can’t stop*…”. Then he felt the train starting to brake. First he saw the entry signal at Marslev showing ”yellow over red” [”Stop”] and then he saw the rear end of a freight train. The train stopped at the 800 metres marker, a distance of 800 metres from the entry signal to Marslev. The engine driver believes the distance to the rear wagon of the freight train to have been approx. 100 metres.

3.2 *The safety management system*

See description regarding authorisation of the train sets under item 3.4.4.

[1] IDU Integrated Diagnostic Unit, information panel, screen displaying the train status.
[2] Traffic control centre, Rail Net Denmark.

3.3 *Safety regulations*

When operating a train with an active ATC, the engine driver must, pursuant to SR [3] follow the directions from the ATC cab signal, i.e. regardless of what other signals show he has to act according to the maximum allowed supervised train speed indicator in the ATC cab signal, which shows the current permitted speed and apply the brakes according to the distance column's indication of how long ahead the ATC expects the track to be clear as well as to the speed at the next signal. When the permitted speed is reduced, the engine driver must brake the train so that the train speed is kept below the maximum allowed supervised train speed. If the engine driver does not brake the train sufficiently, the ATC system will sound an alarm at an overspeed of 4 km/h, and at an overspeed of 7 km/h the service brake will be applied with a braking power sufficient for reducing the train speed to the permitted speed. If the permitted speed is exceeded by 10 km/h, an ATC emergency braking is initiated.
When the ATC system is activated, the engine driver must enter, correct (if relevant) and acknowledge train data such as length of train, braked weight percentage and the maximum speed permitted for the train. This information is not transferred from the train computer to the ATC; only in connection with change of driver's cab are data transferred from one driver's cab to the other. The following data were entered for train L 47 at 13:39:23:

- Length of train: 90 m
- Braked weight percentage: 170
- Maximum speed: 180 km/h
- ATC direction: B

3.3.1 *IC4 training of engine drivers*

The driver must have a valid engine driver's licence, a certificate and be certified for minimum one other type of train set and must have driven trains for two years before he can commence the IC4 training. The engine driver's training for rolling stock class MG alternated between theory and practical training and had a duration of 16 days excluding certificate driving. DSB has stated that the training had been approved by the Danish Transport Authority. The engine driver had to pass theoretical tests and be approved by a driving instructor to obtain a certificate. "Requirements for certificate driving for engine drivers" formed part of DSB's training standard 9-01 (DSB – Excerpt from USTD 9-01, Appendix 2.1). These requirements listed a number of competency requirements to be fulfilled by an engine driver, including operating and driving issues, such as e.g. knowledge about special braking requirements in connection with downward gradients, topographic features of the line and attention to special infrastructure features.

3.3.2 *IC4 training of engine drivers and precautions for driving in slippery conditions*

The IC4 operating instructions (ODI MG) described the safety-related conditions for operating the IC4, including instructions for the engine driver in case the wheels block during brake application. The instructions for blocking (wheel slide and wheel blocking) during brake application prescribe a gradual application of the brake instead of speed automatics, and that in case of continuous blocking of the wheels a lower brake step should be selected (ODI MG section 4.3, Figure 4).

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[3] "For fully ATC monitored trains, the cab signal shows the maximum speed permitted and the clear distance ahead of the train. The train must be operated according to the cab signal information".

Operation under low-adhesion conditions is not systematically practised in the standard training programme, as low-adhesion conditions depend on the weather.

In the autumn of 2011, DSB had issued information to the driving crew regarding operation during leaf-fall (Tema løvfald 2011 (Theme leaf-fall 2011), Appendix 2.3). The information in this material covered all DSB's rolling stock types and was taken from the operating instructions (ODI). The material reproduced the instructions regarding IC4 and wheel slide; there were no instructions for wheel lock.

3.4 *Functioning of rolling stock*

3.4.1 Adhesion/friction in general

The level of adhesion/friction between wheel and rail is generally expressed as a coefficient of friction (symbol μ). The lower the value of μ, the lower the adhesion (and the more slippery it is) between wheel and rail. Typical μ values for dry rails will be over 0.20. In damp weather, μ may drop to around 0.10. If the rails are very slippery, μ may drop below 0.03.

As the trains depend on the coefficient of friction between wheel and rail to be able to brake, the level of friction available decides the retardation achievable by the train, i.e. the speed by which the train can brake/stop.

Modern train sets normally have several brake steps available to the engine driver and the retardation increases the higher the brake step. The highest brake step (full braking) will normally provide a mean retardation of minimum 1.2 m/s^2.

Even though there is no exact connection, a brake application/retardation of 0.3 m/s^2 can only be expected to be achieved, if μ is minimum 0.03 – and μ must be minimum 0.12 to achieve a retardation (in connection with e.g. full braking) of 1.2 m/s^2, without supplemental braking power independent of friction between wheel and rail or a friction enhancing system (Source: RAIB "Autumn Adhesion Investigation", January 2007).

Based on experience from railway operations in Europe, it is probable that there will be locations with a very low adhesion (coefficients of friction under 0.04) in normal operation, e.g. during leaf-fall (Source: Report from the Danish Transport Authority and Rail Net Denmark: "Glatte skinner, september 2012" (Slippery rails, September 2012), Appendix 6.3).

3.4.2 Quality of wheels/material

The wheels on IC4 train sets were of DSB's standard type (monoblock wheels and DSB 97-1 wheel profile and material type R7T), identical to the wheel type on i.a. the IC3 train sets except for the wheel material type. IC4 had wheels of material type R7T and IC3 and ER train sets have wheels of material type R9T.

The only difference between the two material types is the carbon content of the steel, which may not exceed 0.52 percent carbon in R7T and 0.60 percent carbon in R9T. The carbon content is primarily of importance in relation to the tensile strength and hardness of the material. Metallurgy experts from Force Technology have described that "in terms of braking performance for a wheel/rail system, the static coefficient of friction [the coefficient of friction when the two surfaces are in relative motion] is what matters" and they have assessed "this modest variation (material type R7T versus R9T) to be of no importance to the static coefficient of friction". Consequently, the assessment is that the difference between the two material types is of no importance insofar as the braking performance of the two wheel types is concerned.

3.4.3 Brakes in general

The primary brakes of conventional rolling stock work by reducing the number of revolutions of the wheel/by braking the wheel rotation relative to the train speed, thereby transferring the braking force from the train wheels to the rail. The effect of the primary braking system does therefore, in addition to the system's ability to transfer braking power to the wheel, also depend on its ability to transfer the power from the train wheels to the rail and thus depends on the friction between wheel and rail.

Today European rolling stock (train sets) for intercity passenger traffic is normally equipped with compressed-air disc brakes as the primary safety brake system. In addition, the rolling stock is normally also equipped with one or more supplemental systems that can either apply braking power independent of the friction between wheel and rail or enhance the friction between wheel and rail and with dynamic brakes ("engine brakes") e.g. hydrodynamic brake on diesel train sets or electrical brake on electrical train sets.

Braking power independent of friction between wheel and rail

Magnetic track brakes (MTB) are a type of supplemental brakes which are independent of friction between wheel and rail and the type that is most common in Europe. In Denmark i.a. DSB's ET train sets, IC3 train sets, ER train sets, MQ train sets, MR train sets and double-decker coaches are equipped with magnetic track brakes.

Magnetic track brakes are typically fitted between the two wheels on a bogie and function by a metal rail being lowered onto the rail which through magnetisation "sucks" the magnets onto the rail. The magnetic part of the brake effect is independent of the friction between infrastructure (rail) and the magnetic track brake, but the friction does have an impact on the mechanical part (steel against steel) of the brake effect.

IC4 – Magnetic track brake

The brake effect for a set of magnetic track brakes is normally between 10 and 19 for magnetic track brakes with a metal rail made from steel.

Magnetic track brakes are normally activated either automatically in connection with emergency braking and below a certain speed or manually by the engine driver.

3.4.3.1 Systems for enhancing friction between wheel and rail

Sanding devices are the type of device for enhancing friction that is most widely used in Europe. Sanding devices are used in connection with starting up (wheel spin) and braking (wheel slide). In Denmark, i.a. locomotives, S-trains and MR train sets have a sanding devices.

A sanding device functions by discharging quartz/sand from a container via a nozzle onto the rail just in front of the wheel, thereby increasing the friction in connection with start-up and braking. Originally, sanding devices only had the purpose of providing traction in case of slippery rails, i.e. to prevent wheel spin.


Photo: DB Minden

3.4.3.2 Control of wheel block (WSP system, principle)

The wheel block system (the WSP system) on rolling stock is comparable to the ABS system on a car where the system is active when driving in slippery circumstances (e.g. when driving in snow or on ice). The purpose of the WSP system is to avoid material damage to the train wheels when braking (wheel slide).

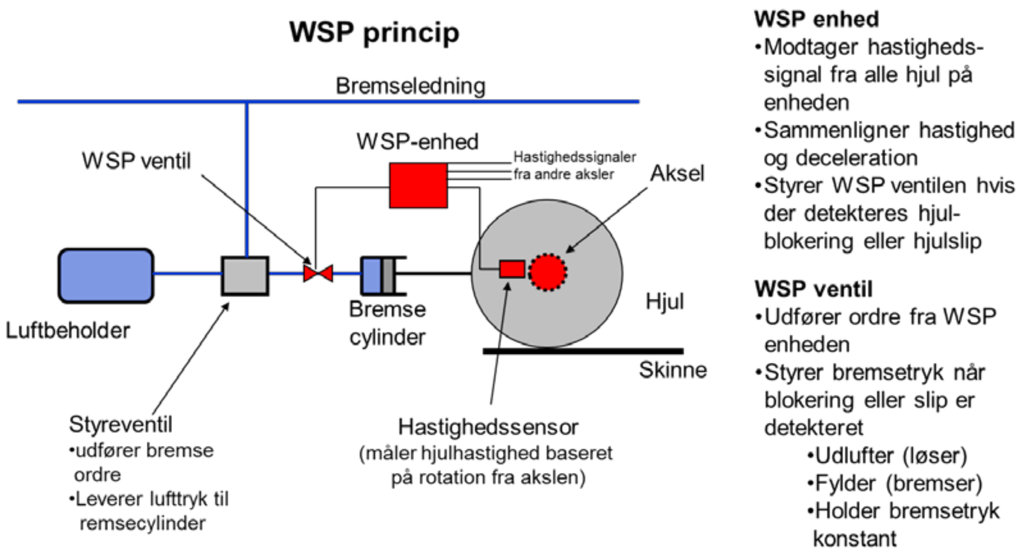


Figure 5

The purpose of the WSP system is to ensure optimal transfer of force from the train wheels to the rails during braking. This means that the system to the greatest extent possible must prevent the train wheels from blocking during braking. The system records the speed measured on axles and calculates the expected train speed during brake application relative to the speed measured and the desired braking/retardation (pressure reduction via brake pipe and distributor valve) etc. – and vents and fills air into the brake cylinder. On IC4 train sets the WSP valve is called the DV valve (dump valve). The WSP system on IC4 train sets only reacts in connection with full or partial wheel slide in relation to braking. The WSP system on IC4 train sets does not make any adjustment in connection with starting the train (slip) The WSP system for the IC4 (type SWPK AS20) was delivered by Faiveley Transport Group.

3.4.4 Authorisation of IC4 train sets in general

Rolling stock requires authorisation from the Danish Transport Authority before being placed in service. The Danish Transport Authority has stated that the IC4 was authorised according to DSB's specification of requirements/the original requirements in connection with the signing of the IC4 contract as no other basis for the authorisation was available at that time.

The Danish Transport Authority has stated that the general authorisation procedure for the IC4 until 2009 consisted in the supplier preparing a Safety Case (safety documentation) based on DSB’s specification of requirements. This Safety Case was assessed by an assessor approved by the Danish Transport Authority, and the type approval issued for the IC4 train sets was based on the Safety Case.

DSB has stated that the specification of requirements contained the entire standard basis for authorisation of the IC4 (Appendix 2.2 – Standards – Excerpt from the IC4 contract – Appendix 6-0).

Based on i.a. the type approval, the certificate of conformity from infrastructure managers and test documentation, the Danish Transport Authority issued individual authorisations for placing in service of the individual IC4 train sets. Testing and authorisation of the brake system of the train consequently constituted part of the overall authorisation procedure for the train.

DSB has stated that the most important types of tests used in connection with the authorisation procedure for the IC4 were:

- type tests which are extensive tests that cover all train sets of the same type and which document the correctness of a structure in relation to the standards and functional requirements applicable to such structure. It could e.g. be tests where a single component, several components combined in a system or a functionality in several components or systems is tested against the requirements (specifications) the system must fulfil. A type test can also include integration tests documenting that individual systems are able to interact as specified.
- series/individual tests (routine tests) which are tests documenting that the characteristics of the individual train set are in compliance with those of the type. The tests could be of the functionality in relation to the requirements (specifications) for the component or the train set as stipulated in the type approval.

The individual test may be carried out e.g. as a static test carried out when the train is at a standstill, or a dynamic test carried out under operating conditions (e.g. during a test run).

Brake systems on IC4 train sets

IC4 train sets are equipped with five different brake systems:

1. Indirect pneumatic brake (IP brake), a traditional pneumatic brake which is the train's safety brake. The IP brake functions by the engine driver reducing the pressure in the brake pipe; distributor valves with air from the air reservoir in the train increase the pressure in the brake cylinders correspondingly. In case of emergency braking all air is bled from the brake pipe and the distributor valves activate maximum pressure in the brake cylinders. The train has eight brake steps, step 1 being the lowest brake step. The brake pressure increases gradually until brake step 7 which is full braking and where the distributor valves activate maximum pressure in the brake cylinders, i.e. brake step 7 brakes the train using the maximum braking power of the pneumatic brake. In brake step 8, emergency braking, all air is bled from the brake pipe, and connected magnetic track brakes are activated.
2. Electro-pneumatic brake (EP brake), a directly electrically controlled pneumatic brake.
   Also known as the train service brake, this brake is used as the primary brake in normal operation. The EP brake is computer controlled and functions by the train computer electrically ensuring that the brake pressure or the braking power specified by the engine driver is provided by the brake computer unit (BCU).
3. Hydrodynamic brake (retarder).
   The four engine axles of the train set are equipped with a retarder which works like an engine brake. The train computer (IDU) sends a request for a given braking power to the engine traction module (Power Pack) which controls the retarder. The braking power from the retarder forms part of the cross blending function of the train. In case of emergency braking or registration of a wheel slide, the retarders are immediately disconnected, which physically takes place after 0.3 to 0.5 seconds.

4. Magnetic track brake (MTB).
   A train set has two sets of magnetic track brakes, one on the front bogie (bogie 1) and one on the rear bogie (bogie 5). The magnetic track brakes can be activated manually by the engine driver by means of a push-button in the driver's desk. Connected magnetic track brakes are automatically activated in case of emergency braking when the brake pipe pressure drops to 2.8 bar or less and a train speed in excess of 20 km/h is recorded.
5. Parking brake (spring-loaded brake).
   The parking brake is a mechanically spring-loaded brake used to prevent the train from moving when it is at a standstill/is to be parked. The parking brake is active when there is no air in the brake system. It can normally only be released by means of either pneumatic pressure when air is in the brake system or by manual release. Six of the train axles have parking brakes, i.e. axles 3 to 8.

On IC4 train sets the train brake computer units (BCU) are physically integrated with the WSP unit. An IC4 train set has three brake computers and three WSP systems:

- Located in M1C, BCU M1 controls the braking process on bogies 1 and 2 (axles 1 to 4). The associated WSP unit controls the four axles on axle level, i.e. the WSP unit can bleed and refill the air pressure in the brake cylinder on each axle individually if a wheel slide or wheel spin is registered.
- Located in T3, BCU T3 controls the braking process on bogie 3 (axles 5 and 6). The associated WSP unit controls axles 5 and 6 on bogie 3 on axel level, i.e. the WSP unit can bleed and refill the air pressure in the brake cylinders on the two axles individually if a wheel slide or wheel spin is registered.
- Located in M4C, BCU M4 controls the braking process on bogies 4 and 5 (axles 7 to 10). The associated WSP unit controls the four axles on axle level, i.e. the WSP unit can bleed and refill the air pressure in the brake cylinder on each axle individually if a wheel slide or wheel spin is registered.

All axles are equipped with speed sensors which transmit information about the recorded speed to the BCU and the WSP. In the driver's cab, the engine driver can get information about the train speed from the cab signal and from the train computer. The cab signal shows the speed recorded by the ATC system which is measured on axle 5. The IDU shows the speed recorded by the BCU on the first two bogies in the direction of travel in the first coach.

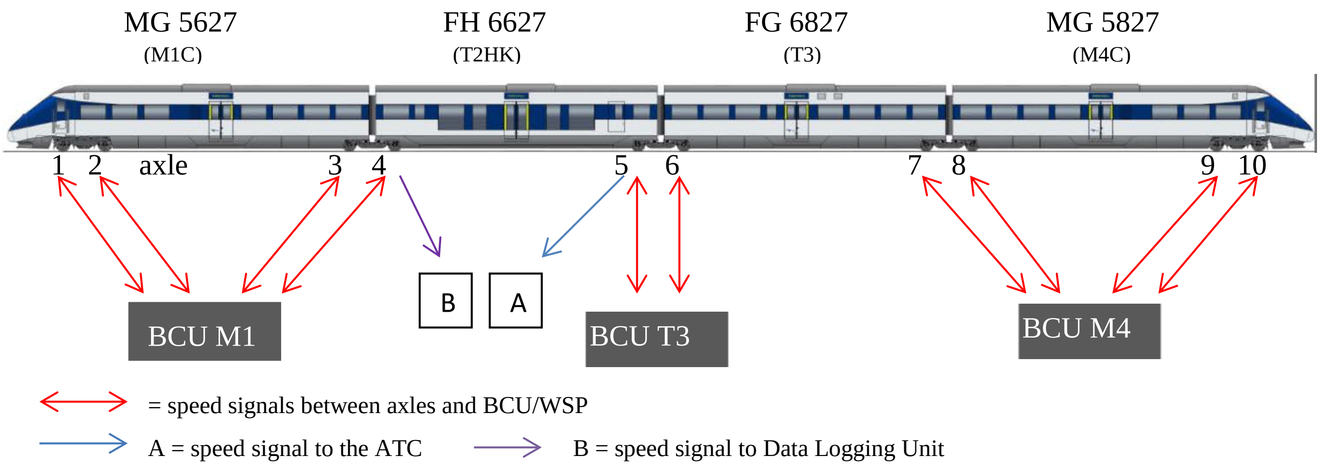


Figure. 6

The IC4 has a cross blending function, which is an optimisation of the brake system with the purpose of minimising physical wear on the brake blocks and brake discs on the train. By means of the cross blending function the train computer ”orders” a specific braking power, corresponding to the brake step selected by the engine driver by means of the master controller. The traction module instructs the retarder to start braking. If the braking power applied by the retarder is not sufficient to provide the “ordered” braking power, the train computer will send a command to the brake computers to supply the additional braking power required. The brake computer subsequently applies braking power to the running axles, which are axles 1, 4, 5, 6, 7 and 10. If applying the brake to the running axels does still not provide sufficient braking power, the pneumatic brake of the engine axles, which are axles 2, 3, 8 and 9, is used for braking. The retarder is disconnected in connection with emergency braking or if wheel blocking is recorded.

DSB has stated that IC4 train sets have a braked weight percentage of 170. This braked weight percentage is fixed without an active magnetic track brake and i.a. requires a utilisation of adhesion for IC4 train sets of up to 0.15.

Approval of the WSP system for IC4

Part of the basis of authorisation included type tests of the brake and WSP systems, of which tests and approval were required according to the requirements in UIC 541-05, which is the applicable standard i.a. for testing brake and WSP systems.

DSB has stated that it has used three different versions of UIC 541-05 since the IC4 contract was signed in year 2000.

1. UIC 541-05 (version 1st Ed 1985) was the applicable standard when the contract was signed. In this version, it was a requirement that the WSP system for IC4-type train sets should be tested at a speed of minimum 120 km/h.
2. In connection with the IC4 type test in the spring of 2005, the applicable UIC fiche was being revised and DSB has previously stated that the type test of the WSP system was carried out according to the draft revised UIC fiche UIC 541-05 "2004 02 05 de". This draft contained a number of changes/higher requirements for testing of the WSP. Among other things, the speed requirement for WSP tests for IC4-type rolling stock had been changed to a minimum of 160 km/h. Similarly, a requirement had been introduced for testing WSP under conditions with a friction of less than 3 percent at 100 km/h over a distance of minimum 500 metres. In connection with the consultation relating to this report, DSB specified that this only concerned use of the new methods (definitions and specifications) for tests that are described in “2004 02 05 de”, but that, in terms of scope, the tests was completed according to the requirements in “version 1st Ed 1985” which applied when the contract was signed.
3. With only a few adjustments, "2004 02 05 de" became the final version: UIC 541-05 2nd Ed 2005, applicable from November 2005.

The WSP type test was completed on 14 March 2005. It appeared from the type test documentation from AnsaldoBreda that tests had been specified for speeds of up to 120 km/h (DSAT 21, Dynamic performance test: Wheel Slide Protection System, Appendix 2.11). Neither DSB nor the supplier has been able to supply documentation of the completion of WSP type tests at speeds of more than 120 km/h.

For IC4-type train sets, UIC 541-05 generally prescribes the WSP test to be performed within the scope of application of the rolling stock in terms of speed, but appendix F to the standard states that this requirement only applies up to a speed of 160 km/h and that calculations may replace tests in this regard in connection with approval of train sets for the speed interval from 160 km/h to 200 km/h. (UIC 541-05 2nd Ed 2005 (excerpt), Appendix 2.4).

Requirements for supplemental brake systems on IC4

The Danish Transport Authority has stated that the Hazard Log for the IC4 (AA02RXH – rev 10, Appendix 2.9) which mentioned the risks/hazards identified for the IC4 was included in the Safety Case. It appeared i.a. from the Hazard Log that the supplier had calculated that sufficient braking power could be obtained by using the train safety brake alone, and that there e.g. were no requirements for supplemental braking power from the magnetic track brake.

AnsaldoBreda ATTACHMENT to STE RAM AA02RXH rev10 Page 199 of 694

HAZARD LOG	N. 20	OF 84

- As for mechanical failure of discs, cylinders/calipers; in order to have a loss of brake on more axles, many discs/ cylinders must fail (at least 2 for each axle). Since a multiple failure scenario yields however a neglibible contribution, this kind of failure has not been considered.
- As for the MTB; in order to have the complete loss of MTB application, it must be lost on both Bogie 1 and Bogie 5.
It has however to be reminded that even if the MTB is activated during an emergency brake, it is neither necessary nor sufficient to the braking (the purely pneumatic brake must guarantee the emergency brake independently from the correct functioning of MTB).
Since a multiple failure scenario yields however a neglibible contribution, this kind of failure has not been considered.

Figure 7. Excerpt from Hazard Log rev 10 (Annex 12 to Safety Case document P/N STE RAM

In the type test programmes, AnsaldoBreda has subsequently verified that the braking power was within the theoretically calculated value and that the WSP system worked according to UIC 541-05 (DSAT 21, Dynamic Performance Test: Wheel Slide Protection System, Appendix 2.11).

In connection with the placing in service of the individual train sets, series tests were carried out (DRDT 40, "Braking test", see "Authorisation of MG 5627 as individual train") to verify the braking performance of the train set. In connection with the series test, also the ATC system was tested, i.e. that the ATC service and emergency braking is effected as specified. There were no specified requirements for active supplemental braking power in addition to the safety brake (IP brake) of the train set.

3.4.5 Standards for testing brake systems under slippery conditions

The applicable UIC standard (UIC 541-05 2nd Ed 2005) for testing of traditional brake and WSP systems in rolling stock includes i.a. specifications for testing under slippery conditions with a coefficient of friction of less than 0.03 at a speed of 100 km/h over a distance of 500 metres. The tests can either be carried out with oil or soap on the rails, or be simulated in a test rig. Under these conditions, the standard does not specify any requirements for the brake distance, but only requires the wheels not to block.

3.4.6 Authorisation of MG 5627 as an individual train set

MG 5627 has been authorised for operation with a maximum speed of 180 km/h.

The basis of authorisation of MG 5627 i.a. included:

- The Danish Transport Authority: Conditional type approval MPTO P1 (of 4 November 2010, Appendix 2.5)
- The Danish Transport Authority: Authorisation for placing in service of MG 5627 (MPTO1, of 10 December 2010, Appendix 2.6)
- Rail Net Denmark: Certificate of conformity for diesel train set, rolling stock class MG (of 7 September 2011, Appendix 2.7)
- DSB: Authorisation for commercial operation with rolling stock class MG in configuration MPTO P1 (of 26 May 2011, Appendix 2.8)

In connection with placing in service of the individual train sets, a number of static and dynamic tests had to be carried out on the train sets, including a dynamic brake test of the WSP system according to UIC 541-05. The dynamic brake test of the WSP system on MG 5627 was carried out on 8 - 9 November 2010. The test was carried out under weather conditions (season, temperature, atmospheric humidity) that are comparable with the weather conditions prevailing at the Marslev incident. The test was carried out at speeds of up to160 km/h. It was carried out without remarks regarding the functionality of the brake system (DRDT 40, "Braking test", Train 27, Appendix 2.10).

3.4.7 Data recording

The IC4 has a number of logging systems of which primarily the Data Logging Unit and the train computer log contain information about recorded data in terms of safety and operating conditions.

Recorded data from departure from Copenhagen Central Station to braking at AM 2153

In the train IDU log it was found that the train set had two magnetic track brakes that were disconnected at 06:04 that morning in the workshop before departure from Aarhus.

The train Data Logging Unit did not contain any recorded blocking of wheels from the train’s departure from Copenhagen until braking was initiated immediately before AM 2153. There had been one case of full braking (brake step 7) at Høje Taastrup and at Roskilde.

There were many recorded occurrences of wheel spin or wheel slide in the Data Logging Unit in connection with acceleration from departure from Copenhagen to initiation of braking immediately before AM 2153. The recorded data are the same in the Data Logging Unit and include wheel spin (traction) and wheel slide (braking). DSB has stated that the recorded wheel spin on MG5627 is not valid, but that the wheel slide recordings are valid. This is due to the fact that it is not possible to calibrate the speed calculations of the individual engine system relative to other speed calculations for the train and that the wheel diameter is not updated in connection with e.g. reprofiling of wheels. This means that the engine systems control assumes that the train wheel diameter is permanently that of a new wheel, which leads to recording of wheel spin during traction/acceleration. The wheel spin recorded in the Data Logging Unit can consequently only be regarded as valid when the train is operating with new wheels, i.e. the first few thousands of kilometres. When this incident happened, MG 5627 had travelled approx. 93,000 km since being placed in service.

3.4.7.1 Loggings from braking/passage of AM signal 2133 to standstill

Data from the logging systems of the train showed i.a. that due to total or partial wheel slide the train had not recorded the distance travelled correctly (Excerpt from Data Logging Unit – Marslev, Appendix 3.1). Between AM signals 2153 and 2173, between which the actual distance was 2,000 metres, the Data Logging Unit had recorded a distance travelled of 1,400 metres. The Data Logging Unit proved that none of the magnetic track brakes on the train had been active during the brake application.

Excerpt from loggings from passing of AM signal 2133 to standstill between 15.15.58 and 15.17.58.

Time	Speed Rec. km/h	Brake step	Data Logging Unit km	Data Logging Unit Rec. metres	Signal #	Line km #	Distance Approx. metres	Wheel slide
15:15:58	179		577,002	-	Track magnet	13,275¤	- 1,975	-
15:15:58	179				2133	13,300	- 2,000	-
15:16:34	181	1	578,794	0		Approx. 220 m before 2153	0	-
15:16:34	181	1-2	578,806	12				-
15:16:35	179	2	578,844[1]	38				X
15:16:36	179	2	578,923	79				X
15:16:38	177	2	578,989	66	Track magnet	15,275¤		X
15:16:38	177	3	579,012	23				X
15:16:38	177	2			2153	15,300	220	X
15:16:39	176	3	579,048[2]	36				-
15:16:40	175	3	579,094	46				-
15:16:40	175	3	579,102	8				X
15:16:48	168	4	579,459	365				X
15:16:51	150	5	579,598	139				X
15:16:55	153	6	579,743	145				X
15:17:01	124	7	579,974	231				X
15:17:08	115	8 (emergency)	580,203	229				X
15:17:09	130	8	580,247	44				X
15:17:16	0	8	580,389	142				X
15:17:25	0 / 131*	8	580,389	-	Track	17,275¤	2,195	X

Time	Speed Rec. km/h	Brake step	Data Logging Unit km	Data Logging Unit Rec. metres	Signal #	Line km #	Distance Approx. metres	Wheel slide
					magnet			
15:17:25	0	8	580,389	-	2173	17,300	2,220	X
15:17:55	10	8	580,391	2				X
15:17:55	6	8	580,393	2				-
15:17:57	6	8	580,393					-
15:17:58	0		580,393	Σ 1607			2,871*	

Figure 8.

Speed and distance data (6 digits) are from the Data Logging Unit recordings from axle 5.

¤: track magnet is approx. 25 metres before the signal.

*: calculated.

#: Rail Net Denmark, kilometre information about railway lines, line 22, Nyborg - Fredericia. ATC line plan

[1]: First recording of wheel slide.

[2]: Wheel slide stopped briefly for approx. 1-2 seconds, after that there was a permanent recording of wheel slide until the train stopped.

According to the log, wheel slide was recorded from the driver started applying the brake until the track magnet at AM signal 2133 was passed. As the ATC system checks that the distance between the track magnets (here between the track magnets at AM signal 2133 and AM signal 2153, respectively) is measured correctly and no faults are registered, the wheel slide only affected the measurement of the distance in this interval to a limited extent.

When passing the ATC track magnet before AM signal 2153, the train speed was recorded as 177 km/h, and the distance to the next signal was indicated as 2,000 metres.

As the wheels blocked, it was not possible to record the actual speed of the train. Therefore, the speed has been calculated (interpolated based on various speed signals) at approx. 131 km/h when the train passed the ATC track magnet.

The train stopped 651 metres after AM signal 2173, 542 metres after the danger point and 374 metres before the rear wagon of a freight train.

The train Data Logging Unit had recorded 1,607 metres out of the approx. 2,871 metres actually travelled by the train.

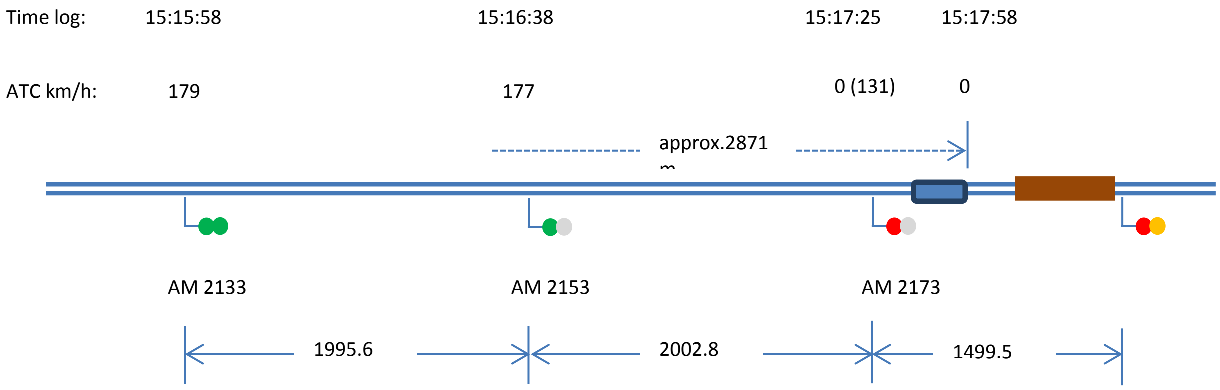
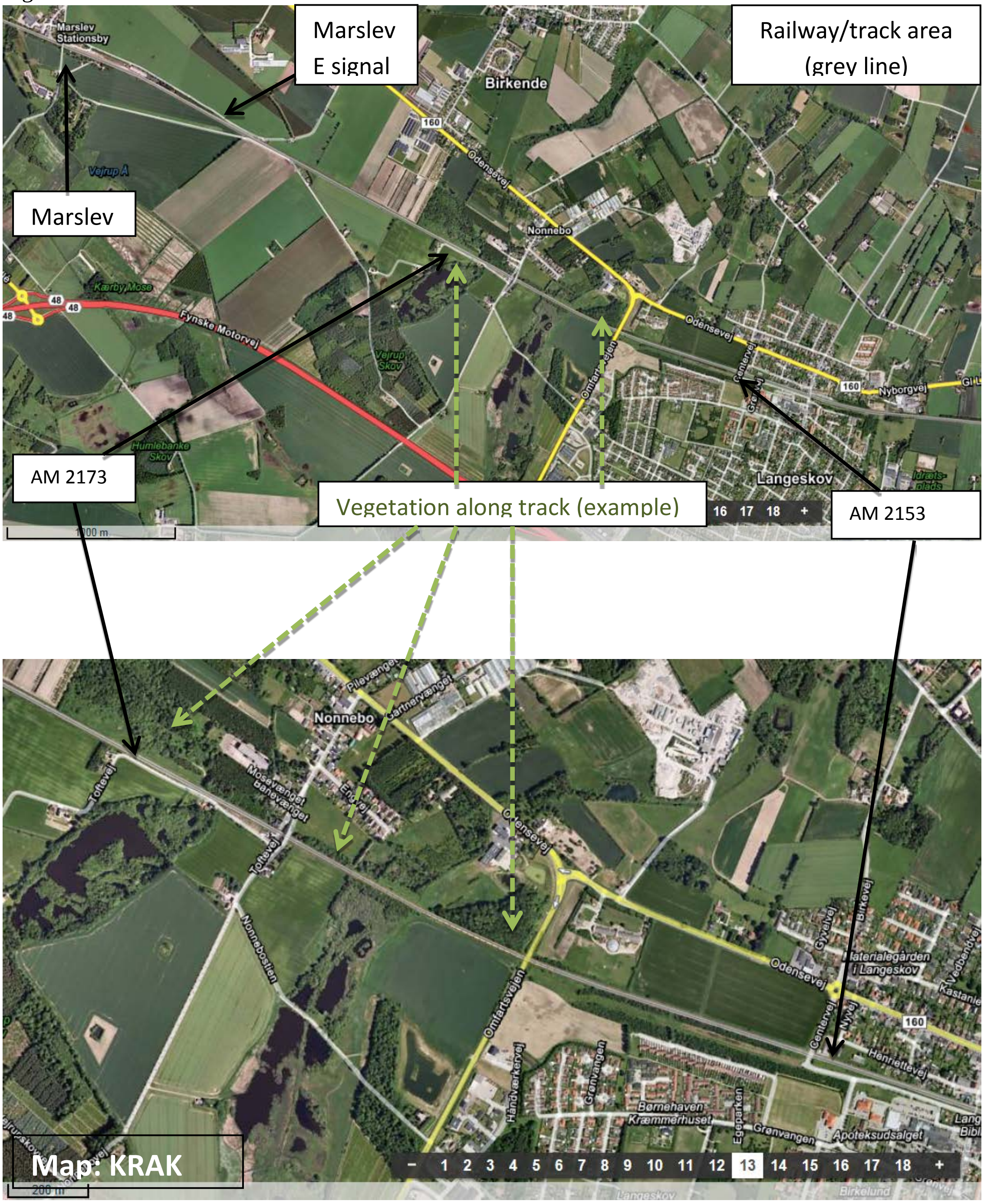


Figure 9

Infrastructure

The line is a heavily trafficked main line (Figure 9). The incident took place in the autumn. Immediately before the site of the incident there were a few trees, primarily on the north side of the track, but no forest. On the line before the site (1-3 km), there was quite a lot of low vegetation 3-10 metres from the track.

Figure 10



In the morning of 8 November 2011 the line was visually inspected (from the driver's cab of another train). A physical inspection was carried out on Friday 11 November 2011. Only a limited amount of leaves (a few leaves) was found on or near the track. On 11 November 2012 the area was manually inspected without any circumstances being found that could have explained the incident (Memorandum regarding examination of the rails, Appendix 4.1). In the beginning of December, samples were taken of the rail surface. Only a mixture of corrosion (iron oxide), grains of sand and small stones/silicates was found (the Danish Technological Institute, Appendix 4.2).

Rail Net Denmark has stated that the line immediately before Marslev is not known for any special risks of slippery rails, as opposed to other line sections in Denmark which are known for an increased risk of slippery rails during leaf-fall.

Rail Net Denmark further stated that there were three planned passings in Marslev on 7 November 2011 and that the freight train ahead, G9233, was to wait in Marslev to be passed by other trains. The passing by L 47 had not been planned, as the train was outside the train path allocated to the train due to the delay.

The engine driver of G9233 had not experienced problems when braking the freight train for the entry signal (E signal). It appeared from the train Data Logging Unit that the engine driver had not initiated braking until approx. 100 metres after AM signal 2173, when the rear part of the freight train was approx. 400 metres before AM signal 2173 and thus braked later on the line than MG 5627. G9233 was inspected after the incident, and no irregularities were established.

3.4.8 Other investigations

During the period 9 November 2011 to 11 November 2011, technical investigations were carried out (visual inspection and control of physical connections) of MG 5627 at DSB's workshop in Århus as well as static tests of the brake system (DRDT 15, Appendix 4.3. Items not carried out are crossed out).

In this connection a type fault was found in the IDU database. The fault was a keying error (programmer's error) which led to a particular type of door fault (fault in relay 5y01). The IDU screen displayed the fault as a fault on relay 5k01 for the magnetic track brake as well as an instruction to suspend the magnetic track brake.

An individual fault was found on MG 5627. The wheel diameter of axle 5 (where the speed sensor for the ATC was located) was erroneously registered as 860 millimetres in the brake computer of the train. The wheel diameter was correctly registered as 849 millimetres in the ATC system.

Other than the above, the technical investigations did not expose any other faults or defects which, in isolation, could explain or render probable the events of 7 November 2011.

From 16 November 2011 to 18 November 2011, a number of static tests of MG 5627 was carried out at DSB's workshop in Århus. These tests i.a. covered components and communication lines in connection with the function of the brake system of the train set. The static tests did not expose any faults or defects which could explain or render probable the events of 7 November 2011.

The Accident Investigation Board and the operator decided to carry out brake tests on a test line between Vojens and Tinglev with the purpose of testing the braking performance of MG 5627 on:

- normal/dry rails
- slippery rails
- very slippery rails (no UIC definition)

After fitting diagnosing and monitoring equipment and soap devices, a number of dynamic brake tests was carried out on a test line between Vojens and Rødekro on 2 to 5 December 2011. The tests were carried out according to the applicable standard for brake tests (UIC fiche 541-5), on which approval of rolling stock is generally based in terms of brake technology. The test i.a. included a speed-up test from 120 km/h to 180 km/h on dry rails and on slippery rails (soap covered rails to simulate slippery rails).

When carrying out brake tests according to the UIC fiche for brake tests on dry rails and on rails sprayed with soap, it was not possible to reproduce the same abnormal braking pattern. Not even varying concentrations of soap to make the rails more slippery resulted in an abnormal braking pattern.

The Accident Investigation Board and the operator then decided to carry out brake tests on rails sprayed with oil with the purpose of simulating slippery rails with a coefficient of friction close to 0. Approx. 2,000 metres of rail were sprayed with oil and braking was performed from 180 km/h to 0. In the brake test on rails sprayed with oil, it was possible to reproduce a stopping distance corresponding to the incident on 7 November 2011, and it was ascertained that large parts of the stopping distance were not recorded in the train logging systems to the same extent as in the Marslev incident (Test schedule, Test MG 5627, Appendix 4.4).

With the purpose of testing data from other IC4 rolling stock compared with the Marslev train set (MG 5627) and test IC4 train sets relative to existing IC3 train sets (rolling stock class MF) under similar circumstances as the tests that were carried out on 2 to 5 December 2011, the Accident Investigation Board and the operator decided to carry out supplementary brake tests. The tests were carried out on 10 and 11 January 2012 with another IC4 train set (MG 5660) and with an IC3 train set (MF5011). IC3 rolling stock was selected because 96 IC3 train sets and 43 train sets of rolling stock class ER had been operating under operating conditions comparable to the circumstances under which the IC4 operates for more than ten years without any similar incidents being registered with either the IC3 or ER rolling stock. On IC3 and ER train sets the magnetic track brake is included in the calculation of the maximum braked weight percentage of the train.

The two types of train sets have two different makes/types of brake computers and WSP systems. On the IC4 the WSP system (type SWPK AS20) performs the functions of the brake computer from Faiveley Transport. On the IC3 the WSP system is integrated into the software of the brake computer, and the brake computer is supplied by Knorr-Bremse AG. The IC3 has two WSP systems which on bogie level each control two bogies.

The brake tests were carried out in two stages: brake test on dry rails and brake test (limited part of UIC standard brake test) on rails sprayed with oil. The brake tests on rails sprayed with oil also included simulations of braking (braking in the individual brake steps) corresponding to the Marslev incident.

Insofar as the brake test on dry rails is concerned, it was not possible to reproduce abnormal brake patterns for neither the IC4 nor the IC3 train set. The same applied to the test on slippery rails. Both the IC4 and the IC3 functioned as intended.

The brake test on rails with low adhesion (sprayed with oil) resulted in a braking distance corresponding to that of the incident on 7 November 2011 for both IC4 (MG 5660) and IC3 (MF 5011). In the brake test with connected magnetic track brakes with the largest difference between the recorded distance and the distance actually travelled, the following data were recorded:

- the Data Logging Unit on the IC3 train set, 2,380 metres out of the 2,396 metres travelled (Test report IC4 and IC3 test, Appendix 4.5). The were no wheel flats of significance on the IC3 and
- the Data Logging Unit on the IC4 train set, 261 metres of the 2,174 metres travelled. There were significant wheel flats on the IC4 in connection with braking (Test report IC4 and IC3 test, Appendix 4.5).

Data from the brake tests carried out in November and January were subsequently reviewed and analysed by specialists in the working groups, and i.a. the following deviations/faults were ascertained:

1: Faulty piping between the pressure sensor/control valve and the spring-loaded brake on bogies 2 and 4 led to unintended activation of the spring-loaded brake in connection with emergency braking combined with wheel slide, thereby disconnecting the WSP system, i.e. the wheel slide continued even though the WSP bled the brake cylinder (Technical report Faiveley, Appendix 4.6). This fault only occurred in connection with emergency braking combined with wheel slide, where the WSP system had bled the brake cylinders on both axles on the same bogie at the same time. This combination had not been present in connection with tests carried out according to UIC 541-05 and had therefore not occurred in connection with the previous tests carried out according to UIC 541-05.

2: Fault in the parameters for calculating the reference speed in brake computer T3, not correct/set too high. This meant that the WSP did partly not work (Appendix 4.6 and Conclusions from WSP Rig Tests, Appendix 6.2) and resulting in periodic wheel slide.

3: Wheel slide on axle 5 which recorded speed and distance travelled for the ATC system, led to incorrect recording of speed and distance travelled.

4: The wheel diameter on axle 5 (where the speed sensor for the ATC is located) was registered correctly as 849 millimetres in the ATC system, but the wheel diameter was registered as 860 millimetres in the brake computer on the train.

Faults 1 to 3 were type faults, i.e. the faults existed in the entire IC4 fleet. Fault 4 was a fault on the train set in question and has not been found in any other train sets than MG 5627.

In case of wheel slide and emergency braking, the retarders were to disconnect within 1 second. The tests carried out in January 2012 verified that the retarders disconnected after 0.3 to 0.5 seconds when a wheel slide was registered and in case of emergency braking, consequently within 1 second as specified. The tests also found that the retarders in brake steps 1 to 7 only provided half of the expected braking power.

The Accident Investigation Board has nationally and internationally sought documentation to explain any cleansing effect sliding wheels or active magnetic track brakes might have in relation to the trailing wheels. The Accident Investigation Board has not succeeded in finding any documentation in the form of data or test results in this regard.

Commissioned by DSB, the Technical University of Denmark (DTU) made i.a. some technical calculations of the brake system functionality, including impact analyses of the piping faults ascertained (Appendix 4.6). DTU concludes that the piping fault led to a longer stopping distance by approx. 70 metres (the report from DTU is available on the University's website). This does not take into account the possibly cleansing effect sliding wheels might have in relation to the trailing wheels. It was not possible for DTU either to find data or test results documenting any cleansing effect.

Faiveley which supplied the BCU and WSP systems assess that the blocked wheels as a consequence of the piping fault probably led to a reduced braking distance "Technical Report Faiveley, Appendix 4.6). DB Minded agrees with Faiveley's assessment.

3.4.9 Test of brake computers

In June to August 2012, functional tests of brake computers and the WSP from MG 5627 were carried out. The tests were carried out on a test rig at DB Minden in Germany with the purpose of examining:
- the brake system functionality when braking under slippery conditions
- BCU and WSP communication, including communication between BCU, WSP, DV and speed sensors.

This test of brake computers and the WSP system found that the BCU and the WSP system, including communication between BCU, WSP, DV and speed sensors, worked as intended under conditions with dry and slippery rails (DB Minden test report: Appendix 5.1).

No significant faults were found in the WSP system functionality which could be of relevance to the Marslev incident. The tests show that the WSP system, in connection with full braking or emergency braking on lines with coefficients of friction between 0.08 and 0.05, following a complete bleeding of the brake cylinder, starts refilling with a delay of approx. 1.5 seconds. DB Minden assessed that the braking power as a consequence of this delay can be improved by approx. 4.5 percent ("IC4 Marslev Investigation, Conclusions from WSP Rig Tests", Appendix 6.2).

The tests showed that the WSP system generally and under normal conditions in terms of friction (friction according to UIC 541-05) worked according to the specifications. The tests also found that the WSP system was not always able to recreate the reference speed, which lead to wheel slide, under particularly slippery conditions (coefficient of friction < 0.03).

Reference speed

Under low-adhesion conditions where the wheels blocked in connection with brake application, the WSP system did not have specific data for the actual train speed due to the blocked wheels. The WSP system calculated an artificial speed (reference speed) in order thus to calculate the speed of the individual wheels relative to the expected train speed – and to individually bleed the brakes to prevent the individual wheels from blocking.

Under low-adhesion conditions, the WSP system on IC4 rolling stock was unable to calculate the reference speed at levels close to the actual speed of the train. This led to the WSP system calculating a wrong reference speed. The test proved this thesis and the results are confirmed by logging data from the Marslev incident and by logging data from the tests on tracks with particularly low friction (oil) carried out in an attempt to reproduce the Marslev incident.

The background to this calculation of a wrong reference speed can roughly be described by the following process:

1. The train brakes under low-adhesion conditions, and all axles controlled by one WSP unit start to slide.
2. The WSP system registers a sliding of all axles as the axles are decelerating/braking faster than possible according to the WSP system's parameters (the parameters correspond to the maximum deceleration of the axles on dry rails, including a safety margin taking any track gradients and measuring tolerances into account).

3. At this point in the process, the WSP calculates an artificial reference speed based on the speed the system had recorded when the deceleration began. This artificial reference speed is higher than the actual axle speed, but lower than the actual speed of the train and with a higher deceleration than the train. If the reference speed continued to be reduced like this, the reference speed would reach zero long before the train stands still, thereby leading to blocked wheels shortly after the deceleration is begun.
4. To avoid this, and to prevent the wheels from blocking, the brake cylinder pressure is bled on one axle, leading to an increase in the axle speed. When the axle speed exceeds the artificial reference speed, the reference speed is correspondingly increased.
5. When some additional criteria – which are known in detail only by the manufacturer – are fulfilled, the WSP system fills the brake cylinder on the bled axle again and the axle speed is reduced again. This is necessary to ensure that the axle can again/continuously contribute to braking the train.

This cycle 2-5 is repeated as long as the friction is very low. The process can be observed on several graphs in the test report from DB Minden, e.g. in appendix 5.40 to the test report. On IC4 train sets, the criteria for step 5 in the process are fulfilled before the reference speed reaches the actual speed of the train. This means that the reference speed on average is reduced quicker than the actual train speed is reduced and that the reference speed thus is close to zero before the train stops, which again leads to blocked axles.

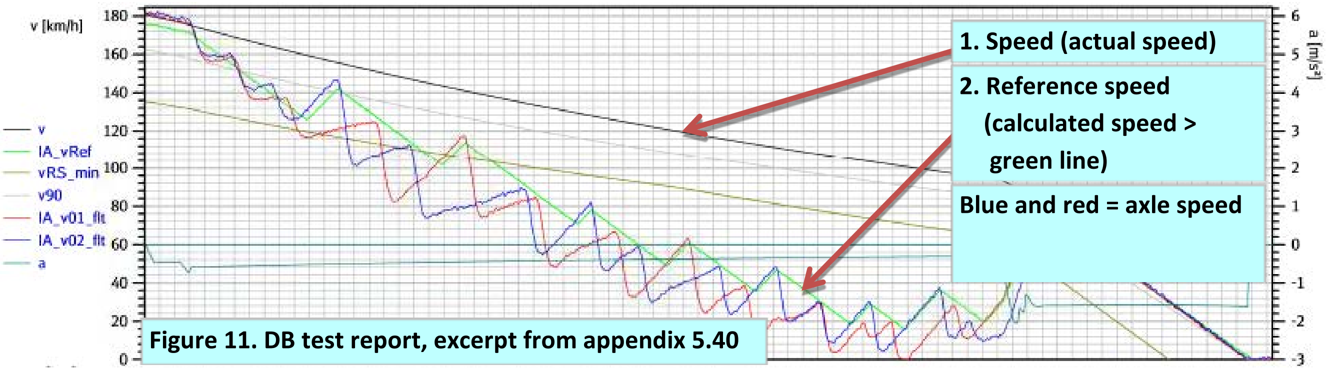


Figure 11. DB test report, excerpt from appendix 5.40

The Accident Investigation Board has not been able to find any applicable national or international standard (other than UIC 541-05 2nd Ed 2005) for testing the functionality of brake systems under conditions with an adhesion below 0.03.

Functionality of connected magnetic track brakes when emergency braking IC4 train sets

According to the design of the magnetic track brake, it should automatically activate in connection with emergency braking if a speed in excess of 20 km/h was recorded. When the speed was recorded to be falling to below 20 km/h, the magnetic track brakes automatically deactivated. At speeds exceeding 20 km/h, the magnetic track brakes could only be activated manually on the driver's desk. When the magnetic track brakes are activated manually, they stay active for up to 60 seconds and are then automatically deactivated. Hereafter the driver can re-activate the magnetic track brakes.

Functionality of active magnetic track brakes in connection with emergency braking IC3 train sets and ET train sets

On other Danish train sets in Intercity traffic (IC3 and ET), the magnetic track brakes were correspondingly activated in connection with emergency braking. On these types of train sets, the magnetic track brake is automatically released at approx. 10 km/h.

3.5 *Traffic safety*

The ATC is designed in such a way that the mobile ATC system constantly monitors the train speed and intervenes with braking if the permitted speed is exceeded, based on information about the train braking performance (braked weight percentage) of the train, the actual speed of the train and information from the signalling system via track magnets (and line conductors) regarding permitted speed, signals, downward gradient, distance to the next danger point (stop signal) etc.

The train speed is recorded on the IC4 by means of a separate speed sensor on axle 5. Among other things, it depends on the correct setting of the wheel diameter. The distance travelled is calculated based on data from the same sensor, but is corrected when passing signal track magnets whose exact position is transferred to the mobile system.

If the permitted speed on the line is 180 km/h, the braked weight percentage of the train permits 180 km/h and the track is clear sufficiently long ahead of the train, the brake "curve” will be horizontal, which is presented to the engine driver by the maximum allowed supervised train speed being 180 km/h in the cab signal. If the speed is exceeded by more than 7 km/h, the ATC applies the service brake.

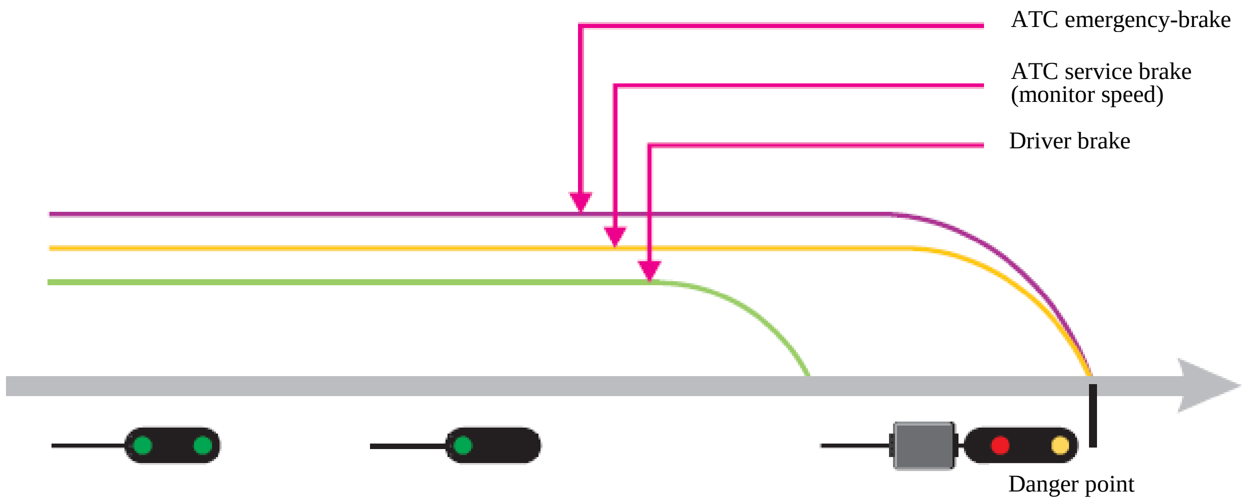


Figure 12.

When an ATC monitored train approaches a signal at “Stop”, the mobile ATC system calculates several brake curves for approaching the signal in order to ensure that the engine driver can apply a suitable brake power and thus retain control of the train without the ATC system intervening. The maximum allowed supervised train speed in the ATC cab signal is reduced and shows the engine driver the maximum permitted speed by monitoring the rate calculated by endpoint at the end of the safety distance signal, while the driver’s braking of the train must lead to stopping directly in front of the signal. The ATC service braking is triggered if the permitted speed is exceeded by 7 km/h and the ATC emergency braking occurs if the permitted speed is exceeded by 10 km/h. The service brake curve as well as the emergency brake curve stop at the end of the safety distance after the signal.

If the axle on which the ATC speed measurement is made is blocked, the measurement of the distance travelled, on which i.a. the calculation of the distance to e.g. the next signal at “Stop” and thus the brake curve is calculated, will be wrong and the speed measurement will be inaccurate. Situations may occur where the ATC does not have sufficient information for intervening.

The ATC is based on certain assumptions to retain safe control of the train braking also in case of wheel spin or wheel slide, i.a. a certain inaccuracy of the measurement of the distance travelled is permitted without the safety limits being exceeded. If the ATC records a speed of less than 0.4 m/s (1.44 km/h) for more than 5 seconds, while the Data Logging Unit records a higher speed (the speed measurement of the Data Logging Unit is on another axle), the ATC speed measurement will be presumed to be wrong and the train will be emergency braked.

In this situation an ATC service or emergency braking would give the same effect as the engine driver’s emergency braking, and even though in the time (47 seconds) from the train passed the track magnet at AM signal 2153 showing ”Go” and the track magnet at AM signal 2173 at ”Stop” both ATC service and emergency braking occur, there is no constant emergency braking until the track magnet at AM signal 2173 is passed where the stop information triggers an unreleasable ATC emergency braking.

3.6 *Man-machine-organisation interface*

The driver’s cab in the IC4 is generally designed in the same way and with the same choice of colours as the driver’s cab in other DSB train sets (MF, ER, ET) with the ATC cab signal right in front of the engine driver, the control panel for the line radio in the left-hand inclined surface, the train information display (IDU) in the right-hand surface and the master controller at the engine driver’s right hand in the vertical surface of the driver’s desk. The button for activation of the magnetic track brake is located to the left of the ATC cab signal.

The master controller is in the centre position, neutral. When pushed forward in steps 1-8 it provides traction, and when pulled back it brakes the train – step 8 is emergency braking; the resistance being slightly increased when the lever is moved from step 7 to step 8.

When operating the train, the engine driver's operation i.a. requires observation of the signals on the line and reading of the ATC cab signal which shows the current speed of the train (measured on axle 5) and the maximum allowed supervised train speed in the cab signal shows the speed currently permitted by the ATC (see Figure 14). In the left-hand side of the cab signal a column indicates the distance ahead of the train which the ATC system knows is clear. By observing the signals and the cab signal the engine driver can adapt the speed to be close to or just below the maximum allowed supervised train speed. If the engine driver does not apply the brake when the permitted speed is reduced, the ATC will, if the speed is exceeded by 4 km/h, sound an acoustic alarm. If the engine driver does not initiate braking or does not apply enough braking power, the ATC service braking will be commenced when the speed is exceeded by 7 km/h until the permitted speed has been reached.

ATC cab signal

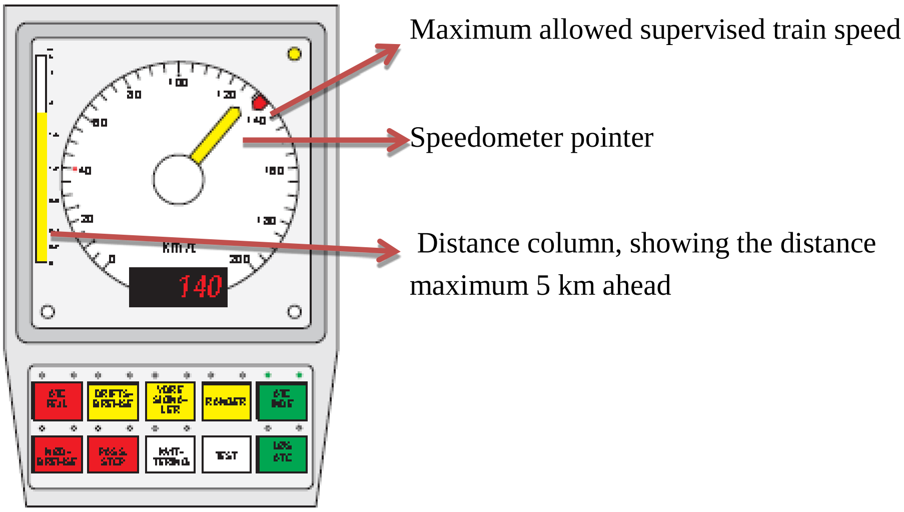


Figure 14.

When the train approached Marslev and the engine driver saw AM signal 2153 at “Go” (one green light), he initiated braking in good time, i.e. before the ATC had started to indicate the brake curve until the next signal via the maximum allowed supervised train speed.

The engine driver applied the brake in brake steps 1-2 without other noticeable effect than the wheel slide recorded even in brake step 2, approx. two seconds after braking had been initiated. After a few seconds, he increased the braking power to step 3. The engine driver has stated that he braked in steps 4-5 to obtain the same braking force as in steps 2-3 on the IC3 trains. As the braking did not have any noticeable effect, he chose to emergency brake the train. He experienced that the speed shown fell instantaneously from 180 km/h to approx. 120-110 km/h.

The varying speeds in the ATC cab signal, in the IDU, the manometers for brake cylinders 1 and 2 ”fluttering” and the acoustic and visual alarms do not provide clear and identifiable information about what is happening and do consequently not indicate what action to be taken. As the train proceeds without any significant reduction of the speed, the logical choice is to maintain emergency braking and let the train’s advanced brake system – including the WSP – bring the train to a stop as quickly as possible. He tried to push the button for the magnetic track brake to activate it even though it was fully suspended.

3.7 *Occurrences of a similar character*

After the incident on 7 November 2011, it was established that there had been an occurrence on 4 November 2011 with an IC4 train set (MG 5643) at Høje Taastrup which was similar to the incident on 7 November 2011 in terms of brake pattern. Investigations of this incident showed that the driver had experienced that the train set did not brake as expected and that the wheels blocked in brake steps 2-3. The distance actually travelled differed significantly from the data recorded by the train. During braking from approx. 140 km/h, the Data Logging Unit of the train recorded a distance travelled by the train of 1,019 metres instead of the 1,418 metres actually travelled. The rear of the two magnetic track brakes on the train set was suspended. The front magnetic track brake was automatically activated when the engine driver braked in brake step 8 (emergency braking), but it was deactivated shortly thereafter as the train recorded a train speed of below 20 km/h due to wheel slide. The engine driver subsequently manually activated the magnetic track brake.

On MG 5643 the same static tests were carried out as on MG 5627. The tests i.a. covered components and communication lines in connection with the function of the brake system of the train set. The static tests did not expose any faults or defects which could explain or render probable the events of 4 November 2011.

Following media coverage of the incident, two other engine drivers came forward explaining that they too had experienced situations where IC4 train sets did not brake as expected. One engine driver describes that the magnetic track brake unexpectedly lifted in connection with emergency braking at a speed in excess of 20 km/h. These reports were received so long after the specific incidents that no detailed data was available from the Data Logging Unit for analysis of the incidents so data from these two reports are not included in this investigation.

On 6 August 2012 there was an incident at Klargøringscenter Kastrup where an IC4 train set (MG 5631) collided with a parked IC4 train set during shunting at low speed (under 20 km/h). Investigations showed that wheels had blocked during application of the brake during shunting and the distance travelled during shunting had not been recorded in the Data Logging Unit. The magnetic track brakes are not automatically activated when the speed is recorded as less than 20 km/h and the depot driver did not activate the magnetic track brake manually. In this case, the Accident Investigation Board found that slippery rails most likely combined with the functionality of the brake system had caused the wheels to block in connection with braking and resulted in a difference between the distance recorded by the Data Logging Unit and the distance actually travelled (HCLJ account – MG 5631 collided with another MG during shunting at KAC, Appendix 5.1).

There is no knowledge in Denmark about similar incidents with an extraordinarily long stopping distance for other rolling stock types than the IC4. There are several similar incidents with extraordinarily long stopping distances in other countries (Figure 15). According to the Accident Investigation Board, investigations of these incidents found that the systems supplementing the primary brake system of the rolling stock were faulty in all these incidents, for instance, a faulty sanding device.

Enquiries to EU member states have shown that the individual member states generally do not have any overall national requirements for systems for enhancing the friction between wheel and rail or requirements for supplemental braking power that is not dependent on friction between wheel and rail (except for England). The enquiries also showed that several national operators have internal requirements for systems for enhancing the friction between wheel and rail or requirements for supplemental braking power that is not dependent on friction between wheel and rail at speeds in excess of 160 km/h.

Experience from railway operations shows that there may be locations with a very low adhesion (coefficients of friction under 0.04) during normal operation, e.g. during leaf-fall (Source: Report from the Danish Transport Authority and Rail Net Denmark: "Glatte skinner, september 2012" (Slippery rails, September 2012), Appendix 6.3). There is no documentation of Danish experience with the occurrence of low adhesion.

Published investigations of incidents with an extraordinarily long stopping distance.

Dato	Sted	Type	Hastighed	Bremselængde	Supplerende udrustning
30.11.2005	Lewes, England	Signal-forbikørsel	Ca. 112 km/t	Ca. 2500 meter	Sandingsanlæg. Anlægget virkede ikke.
25.11.2005	Esher, England	Signal-forbikørsel	Ca. 145 km/t	Ca. 3000 meter	Sandingsanlæg. Løbet tør for sand.
08.11.2010	Stonegate, England	Stations-forbikørsel	Ca. 110 km/t	Ca. 5100 meter	Sandingsanlæg. Ingen sand til rådighed.

Figure 15. Published investigations with extraordinarily long stopping distances (train set)

4 Analyses and conclusions

4.1 *Final account of the event chain*

- On Monday 7 November 2011, high-speed train L 47 departed from Copenhagen Central Station for Jutland. The high-speed train, which consisted of a single-operated IC4 train set (MG 5627), was delayed for 13 minutes on departure because of a generator fault. At 06:04 on the same morning, both of the train's two magnetic track brakes had been manually suspended at the workshop in Århus. The magnetic track brakes are not part of the train set safety brake. Two faultless brake tests had been carried out with a braked weight percentage of 170.
- Due to the delay, the train had to run behind the Intercity train until Slagelse where it passed the Intercity train. Until Slagelse the train had to decelerate and accelerate several times due to the running and stopping pattern of the Intercity train ahead and no problems were experienced in this regard.
- No brake problems (wheel slide or other) were ascertained when the train braked until braking before Marslev.
- L 47 continued at speeds up to the line speed (180 km/h) until Ullerslev station. Having passed Ullerslev station the signal showed “Go forward” (two green lights) on AM signal 2133, i.e. the track could be expected to be clear beyond the next AM signal 2153.
- The next AM signal 2153 was at “Go” (one steady green light meaning that the next signal – AM signal 2173 – must be expected to be at “Stop”).
- The brake application was slight and was initiated by the engine driver at 15:16:34 approx. 220 metres before AM signal 2153. When passing the ATC track magnet before AM signal 2153, the train speed was recorded as 177 km/h and the distance to the next signal was recorded as 2,000 metres in the logging systems. The first wheel slide was registered at 15:16:35 in brake step 2, approx. 150 metres before passing AM signal 2153. The system continued to register wheel slides to a varying/increasing extent until the train was stopped.
- The braking power was gradually increased until 15:17:01 where a full braking (step 7) of the train was carried out. The train emergency braked (step 8, all air bled from the brake system) at 15:17:08.
- Low adhesion led to total or partial wheel slide of several of the train bogies/axles.
- Wheel slide due to the piping fault presumably led to an activation of the parking brake on bogies 2 and 4 during brake application and thereby the WSP system was inactive on these bogies as the parking brake was active.
- At 15:17:25 the train passed AM signal 2173 at "Stop".
- The train stopped at 15:18:00, 651 metres after AM signal 2173 and 542 metres after the danger point. The train stopped approx. 374 metres before the rear wagon of the freight train ahead of it.
- The freight train ahead of L 47, G9233, had braked for “Stop” on the entry signal to Marslev station. The freight train was switching onto the passing track at Marslev station to allow other trains to pass. The freight train had not ascertained any problems in connection with deceleration approaching the entry signal.

- Shortly thereafter, the train continued to Odense station. It operated at a reduced speed, as the engine driver found that the train wheels had flats. In Odense the train set was removed from service and the passengers continued their journeys by other trains.
- The train set was inspected by the Accident Investigation Board and DSB in Odense and subsequently taken to DSB's workshop in Århus for further investigations.
- In Århus wheel damage (flats) was found on all wheels to varying degrees. Data recorded by the Data Logging Unit and by the train computer (IDU log) showed wheel slide on all wheels and prolonged wheel slide on bogies 2, 3 and 4 out of the five bogies of the train.
- Analyses of logging data from the braking of the train at Marslev and logging data from subsequent tests exposed faulty piping on bogies 2 and 4 and established that these faults led to periodic wheel slide on both bogies.
- The piping fault presumably led to an activation of the parking brake on bogies 2 and 4 during emergency braking and thereby the WSP system was inactive on these bogies as the parking brake was active.
- Analyses of logging data from Marslev and logging data from subsequent tests exposed faults in the reference speed in brake computer T3 (for bogie 3) and established that the fault led to higher or total wheel slide on that bogie.
- Total/partial wheel slide led to incorrect recording of the distance actually travelled in connection with brake application as well as to failure to identify the actual speed.
- As the safety system ATC only receives data about the distance travelled from one axle, the system cannot intervene as presumed if the wheels are blocked on this axle, thus exceeding the tolerances on which the safety system is based.
- The line at Marslev is not known for instances of slippery rails.
- The inspection or subsequent samples from the rails did not offer any reason for the rails being particularly slippery.
- There are other line sections in Denmark, particularly in forest areas which are generally known for posing an increased risk of slippery rails, particularly during leaf-fall, among infrastructure managers and engine drivers.
- A WSP type test was carried out at speeds up to 120 km/h and a WSP serial test was carried out of MG 5627 at speeds up to 160 km/h. IC4 has been authorised for a maximum speed of 180 km/h.

4.2 *Analysis (discussion)*

- The IC4 train sets were authorised for operation at line speed of up to 180 km/h on the condition of having a fully functional safety brake (braked weight percentage of 170).
- Calculations from the supplier had shown that the safety brake alone was more than sufficient to ensure the necessary braking power during operation under conditions as described in applicable international standards and brake tests carried out had verified the calculations.

- DSB did not require active additional braking power beyond the train set safety brake (IP-brake) in connection with emergency braking, e.g. the number of active magnetic track brakes.
- The international standards (for train sets) from 2005 described that a brake test should be carried out on slippery rails and that a test should be carried out with a friction between wheel and rail of max. 0.03 at 100 km/h over a distance of 500 metres. Under these conditions, the standard does not specify any requirements regarding braking distance; it only specifies that the wheels must not be blocked. The standards also described that these tests did not need to be carried out in the form of actual test runs, but could be carried out on an approved test rig. This means that the rolling stock only must be tested in part of its overall application area.
- Type tests of braking and WSP systems were carried out in 2005 according to the methods described in the revised version of UIC 541-05 (Edition 2004 02 05 de) and the requirements of the 1985 edition of UIC 541-05. A WSP type test was conducted at speed up to 120 km/h. This means that the rolling stock has only been tested in a part of its applications.
- The WSP series tests of MG 5627 were carried out with speeds of up to 160 km/h. The IC4 had been authorised for operation at a maximum speed of 180 km/h. This means that the rolling stock had only been tested in part of its overall application area.
- A report from the Danish Transport Authority and Rail Net Denmark indicates that normal operation may involve a friction below 0.03. However, there has been no registration of an increased number of SPAD during e.g. leaf-fall where slippery rails must be expected.
- A friction of under 0.03 will primarily occur during leaf-fall, but it may also occur under other circumstances (e.g. rain after a dry period).
- In Denmark 96 IC3 train sets and 43 IR4 train sets have been operating under operating conditions which are comparable to the circumstances under which the IC4 operates for more than ten years without any similar incidents being registered for these train types. IC3 and IR4 train sets have another type of train computer and WSP system than the IC4, and on IC3 and IR4 train sets the magnetic track brake includes as part of the safety brake.
- In Rail Net Denmark’s infrastructure interlocking (signal visibility, signalised distance to danger point, safety distances) are dimensioned based on a mean retardation of 0.6 m/s^2 (adhesion 0.06) always being attainable.
- Registration of beginning wheel slide even at brake steps 1-2 indicates that the rails were slippery.
- The wheel slide protection system (WSP system) was under particularly slippery conditions (a coefficient of friction of 0.02 and below) not able to reproduce the reference speed, which led to the reference speed being reduced faster than the actual speed of the train and led to total or partial blocking of the train wheels.
- When braking under low-adhesion conditions, the friction may be so low that the indirect brake (the safety brake) with the functionality existing at the time of the incident could not alone ensure the braking power that was necessary to stop the train within the safety distance.

- The potential for improvement of approx. 4.5 percent of the braking power as explained in Conclusions from WSP Rig tests (Appendix 6.2) in connection with full or emergency braking on lines with a coefficient of friction between 0.08 and 0.05 would not have made any difference to the Marslev incident as the coefficient of friction is assessed to have been lower until passing the AM signal 2173.
- The line at Marslev where the incident happened was not known for a risk of slippery rails. The inspection or subsequent samples from the rails did not offer any reason for the rails being particularly slippery.
- Other line sections in Denmark, particularly in forest areas are generally known for posing an increased risk of slippery rails, particularly during leaf-fall, among infrastructure managers as well as engine drivers
- Faulty piping on bogies 2 and 4 presumably led to unintended activation of the parking brake and led to periodic wheel slide on the four axles of the bogies, thus leading to a longer stopping distance, which DTU has rated to be approx. 70 metres.
- The supplier of the BCU and WSP systems assesses that the blocked wheels as a consequence of faulty piping on bodies 2 and 4 led to a reduced braking distance.
- A fault in the data set on bogie 3 (brake computer T3 – including axle 5 where the speed sensor for the ATC system was located) led to periodic wheel slide of the two axles of the bogie.
- Total/partial wheel slide led to incorrect recording of the distance actually travelled in connection with brake application as well as to failure to identify the actual speed.
- Total/partial wheel slide meant that the safety system (ATC) was unable to detect when the train, when running without wheel slide, would have to brake according to the ATC system's service or emergency brake curves and thus begin braking the train as specified.
- As the brake system of the train was active and the wheel slide was registered before the ATC system should have effected an ATC emergency braking, it is assessed that a correct detection would not have led to a significantly reduced stopping distance in the Marslev incident.
- The type fault ascertained in the IDU database was a keying error (programmer’s error) which led to a particular type of door fault (fault in relay 5y01). The IDU screen displayed the fault as a fault on relay 5k01 for the magnetic track brake as well as instructions to suspend the magnetic track brake. Consequently, both magnetic track brakes on the train set had been suspended earlier in the day before MG 5627 was operated as L 47.
- The individual fault ascertained on MG 5627 where the wheel diameter on axle 5 was wrongly registered to be 860 millimetres in the train brake computer is not found to have been of any significance to the stopping distance. The individual fault was the reason for wheel spin being registered during acceleration in the Marslev incident. The wheel diameter was correctly registered as 849 millimetres in the ATC system.

4.3 *Conclusions*

The Accident Investigation Board concludes that the brake system on MG 5627 was unable to bring L 47 to a stop from a speed of 180 km/h within the safety requirements of the signal system in the Marslev incident.

Based on similar episodes and the tests and investigations carried out, it is furthermore concluded that the same could have happened on other IC4 train sets.

This is primarily due to a combination of the following:

- the brake system of the IC4 rolling stock was unable to provide the braking power necessary to stop under the prevailing adhesion conditions, under the operating conditions approved for the train type.
- the IC4 train sets have not been tested in connection with braking under very low-adhesion conditions, any need for supplemental systems for provision of braking power independent of the friction between wheel and rail or enhancing the friction between wheel and rail has not been assessed
- the IC4 WSP system has a malfunction on the equipment (it cannot recreate the reference speed) when operating under conditions of very low adhesion (at or below 0.02), which may be expected to occur in daily operation. Under these conditions the WSP system cannot prevent sustained wheel lock, and thus cannot provide reliable information on the distance travelled and the current speed..
- -- faulty piping on bogies 2 and 4 led to unintended activation of the parking brake during operation and consequently led to total or partial wheel slide on the four axles of the bogies.
- fault in data set on bogie 3 (brake computer T3) led to even deeper wheel slide on the bogie.
- the keying error in the IDU database was not in itself of importance to the functionality of the magnetic track brake, but only meant that the magnetic track brake had been suspended at the Marslev incident without the magnetic track brake being faulty.

Furthermore, it was concluded that:

- there are no international or national standards or requirements for testing of rolling stock in operation under low-adhesion conditions which can be expected in daily operation in Denmark (very low adhesion) and the IC4 has consequently not been tested under these conditions.
- the brake system on IC4 train sets has not been type tested at speeds exceeding 120 km/h and has not undergone serial tests at speeds exceeding 160 km/h.
- Brake system and WSP system on IC4 train sets have not been tested at adhesion conditions below 0.05.
- IC4 has thus only been tested in a part of the application of the rolling stock.

4.4 *Additional observations*

On the IC4 train the serial connection between the train computer and the ATC had not been established, which was in accordance with Rail Net Denmark's "Authorisation of ATC type certificate for rolling stock class MG" of 22 June 2010. A serial connection would i.a. ensure instantaneous information to the ATC system in case of an acute reduction of the braked weight percentage (recording of acute fault on parts of the brake system/risk of partial loss of braking power) during brake application. As the fault recorded on parts of the brake system at the Marslev incident did only occur after full braking had been initiated, this is not believed to have had any importance in relation to the incident.

The magnetic track brake is automatically activated in connection with emergency braking. When the speed in connection with brake application with an active magnetic track brake falls below 20 km/h, the magnetic track brake is automatically deactivated to protect rolling stock and infrastructure and to ensure a smoother braking procedure (protect the passengers) immediately before the train stops completely. This applies at all brake steps, i.e. also in connection with emergency braking. The means that if the wheel were to block during emergency braking of an IC4 train set and the speed were recorded as lower than 20 km/h regardless of the actual speed of the train, the magnetic track brake would automatically be deactivated. The engine driver can always activate the magnetic track brake manually. The engine driver can do so for up to 60 seconds, after which the magnetic track brake is automatically released. The engine driver must then re-activate the magnetic track brake manually in order to be able to reconnect it. As the magnetic track brakes had already been technically (manually) suspended at the Marslev incident, this functionality was not in itself of importance to the event chain.

On comparable train sets (IC3, ER and ET/Øresund train sets), the magnetic track brake is not automatically deactivated until a speed of approx. 10 km/h is reached.

As brake experts recommend to leave the braking in connection with wheel slide to the modern WSP systems, it is unclear why DSB instructs the engine drivers to release the brake in connection with wheel slide instead of letting the WSP system adjust the braking.

5 Measures already taken

Based on DSB's application of 30 September 2012, the Danish Transport Authority renewed the temporary authority of resumption of passenger operation until 30 September 2013.

In connection with this renewal, the Danish Transport Authority required that the train should be able to measure the correct speed and distance travelled, which led to DSB placing the IC4 train sets in operation on the following conditions:

- restriction of (ATC) braked weight percentage of 130
- active magnetic track brakes and restrictions if faults occur on the magnetic track brake during operation
- brake on axle 5 must be suspended to ensure that the ATC system receives a correctly recorded speed and distance travelled
- maximum permitted speed of 140 km/h until 1 December 2012 (demand from the Danish Transport Authority)
- from 1 December 2012: maximum permitted speed of 160 km/h for train sets on which the piping fault on bogies 2 and 4 has been corrected

DSB has stated that all IC4 train sets used in operation have been rebuilt so that no train sets with the piping fault on bogies 2 and 4 are in operation. DSB has also stated that the correction of the fault in the parameters for calculating the reference speed in computer T3 is undergoing approval.

6 Safety recommendations

Daily railway operations may include areas with very low adhesion. The Accident Investigation Board has not been able to find any applicable national or international standards for fully testing the functionality of brake systems under conditions with an adhesion below 0.03. Tests of the WSP systems were only carried out for a part of the scope of application of the rolling stock, in type tests with a speed of up to 120 km/h and in serial tests at speeds of up to 160 km/h.

1. DK-2013 R 1 of 22 August 2013

   The Accident Investigation Board recommends that the ERA ensure that applicable international standards for approval of brake systems for rolling stock are reviewed so that the accumulated functionality of the brake system is documented in all applications and under all operating conditions, including under the adhesion conditions that must be regarded as probable in daily operation.

2. DK-2013 R 2 of 22 August 2013

   The Accident Investigation Board recommends that the Danish Transport Authority ensure that applicable national standards for approval of brake systems for rolling stock are reviewed so that the accumulated functionality of the brake system is documented in all applications and under all operating conditions, including the adhesion conditions that must be regarded as probable in daily operation.

Under low-adhesion operating conditions the brake system on the IC4 train set was unable to provide the braking power necessary under the prevailing operating conditions to stop the train according to the safety requirements of the signal system.

3. DK-2013 R 3 of 22 August 2013

   The Accident Investigation Board recommends that the Danish Transport Authority ensure that the IC4 train type braking performance be documented in all applications, including the adhesions conditions that may be expected to occur in daily operation.

In connection with braking under the operating conditions prevailing at Marslev, the WSP system of the IC4 rolling stock was not able to prevent continuous wheel slide and consequently it was not possible to identify and record the correct speed and the distance travelled under these conditions.

4. DK-2013 R 4 of 22 August 2013

   The Accident Investigation Board recommends that the Danish Transport Authority ensure that the IC4 train type records correct data on the actual distance travelled and the actual speed.

These recommendations replace the previous recommendations in the preliminary report of the Accident Investigation Report of 30 January 2012.
Definitions and explanations

Drawings: From DSB, if not otherwise stated

Photos: From the Accident Investigation Board, if not otherwise stated

AM signal	Automatic block signal.
AnsaldoBreda	AnsaldoBreda S.p.A., supplier of the IC4 train sets.
ATC	Abbreviation of Automatic Train Control. Train control systems used on long-distance railways. The ATC is a train control system which i.a. by means of information from the signals along the line supervises the speed of the trains and that the engine driver brakes in time.
ATC instructions	The ATC instructions describe the function and operation of mobile ATC systems.
Automatic line block	Line block with train detection using track circuits and stop and pass control.
Track magnet	Point-shaped information provider in stationary ATC systems. Located at the right-hand side in the direction of travel.
Rail Net Denmark	In Danish: Banedanmark. Infrastructure manager for the state railway network in Denmark. Owns and operates track and signal systems, including the ATC.
BCU	Brake Computer Unit = brake computer.
Block section	In order to register whether a track is clear of other trains, traditional signal systems are based on a division of the track into defined block sections. These track sections are called fixed block sections and constitute a central element of any signal system.
Braked weight percentage	The train’s braked weight in percentage of the train weight.
Braked weight	The brake value in tons of the individual vehicle. The braked weight of a train is the sum of the braked weight of the braked vehicles.
DB Minden	Deutsche Bahn Systemtechnik AG.
DLU	Data Logging Unit.
DSB	DSB (formerly Danske Stats Baner) the state railway operator – independent public corporation.
DTU	The Technical University of Denmark.
Dump Valve	Dump valve, bleeder valve.
ERA	The European Railway Agency.
Faiveley	Faiveley Transport Group, AnsaldoBreda’s subsupplier.
Emergency braking	Activation of the brake system of the train in such a way as to obtain maximum braking power.
FC	Traffic control centre (Rail Net Denmark).
Remotely controlled line section	The train traffic can be controlled at several stations at once at the Traffic control centres. Today, Rail Net Denmark’s railway network includes a number of large and small Traffic control centres which are each responsible for

	controlling and monitoring operations in a specific area.
Presignalling	Signal that provides information about the position of the next main signal.
IDU	Integrated Diagnostic Unit – information screen from train computer.
Entry signal	Signal for entry to a station.
Line block	Interlocking for railway section between two stations. The purpose of line bloc systems is to ensure that there is no more than one train in each block section at a time, and that permission to enter a block section is not given from both ends at the same time.
Engine driver	The person responsible for operating the train and for the train safety.
MTB	Magnetic track brake.
ODI	Operating instructions of the operator corporation DSB.
Track circuit	A track section where the two rails are electrically insulated from each other and from the rails in the adjoining track section. By means of a low electric current through the rails the interlocking registers whether or not there are any vehicles in the track section in question.
SR	Safety regulations of 1975, Rail Net Denmark.
Line speed	The maximum permitted speed for operating on a certain line section. Sections with stationary ATC systems may have a special line speed – overspeed – for special train sets.
Special train set	A train set with a documented low effect on the track, which may run at a higher speed than other trains.
TIB	Traffic information about the line, Rail Net Denmark, (Trafikal Information om Banestrækningen) (previously: Introductory remands to the working timetable (Tjenestekøreplanens Indledende Bemærkninger) containing information about permitted speeds and about the equipment of the railway lines with signals, crossings etc.
Train control system	Generic term for ATC, ATC train stop, HKT system (speed check and train stop system) and train stop systems. Consists of stationary systems connected to the interlockings, mobile systems onboard the trains and a cab signal.
The Danish Transport Authority	The Danish Transport Authority (Trafikstyrelsen) is the state railway authority within regulation, planning safety and traffic coordination. The Danish Transport Authority regulates, authorises and supervises railway safety. Among other things, the Danish Transport Authority is responsible for issuing authorisations of type and authorisations of placing in service.
WSP	Wheel Slide Protection – wheel spin and wheel slide protection system.
Wheel slide	(Wheel slide) When a train brakes, the speed of rotation of the wheel may be slower than the actual speed of the train. It may be from 1-2 percent (the wheel only rotates slightly slower than the actual speed) to 100 percent (wheel block, where the wheel is blocked while the train is moving.
DML	Signal lamp.

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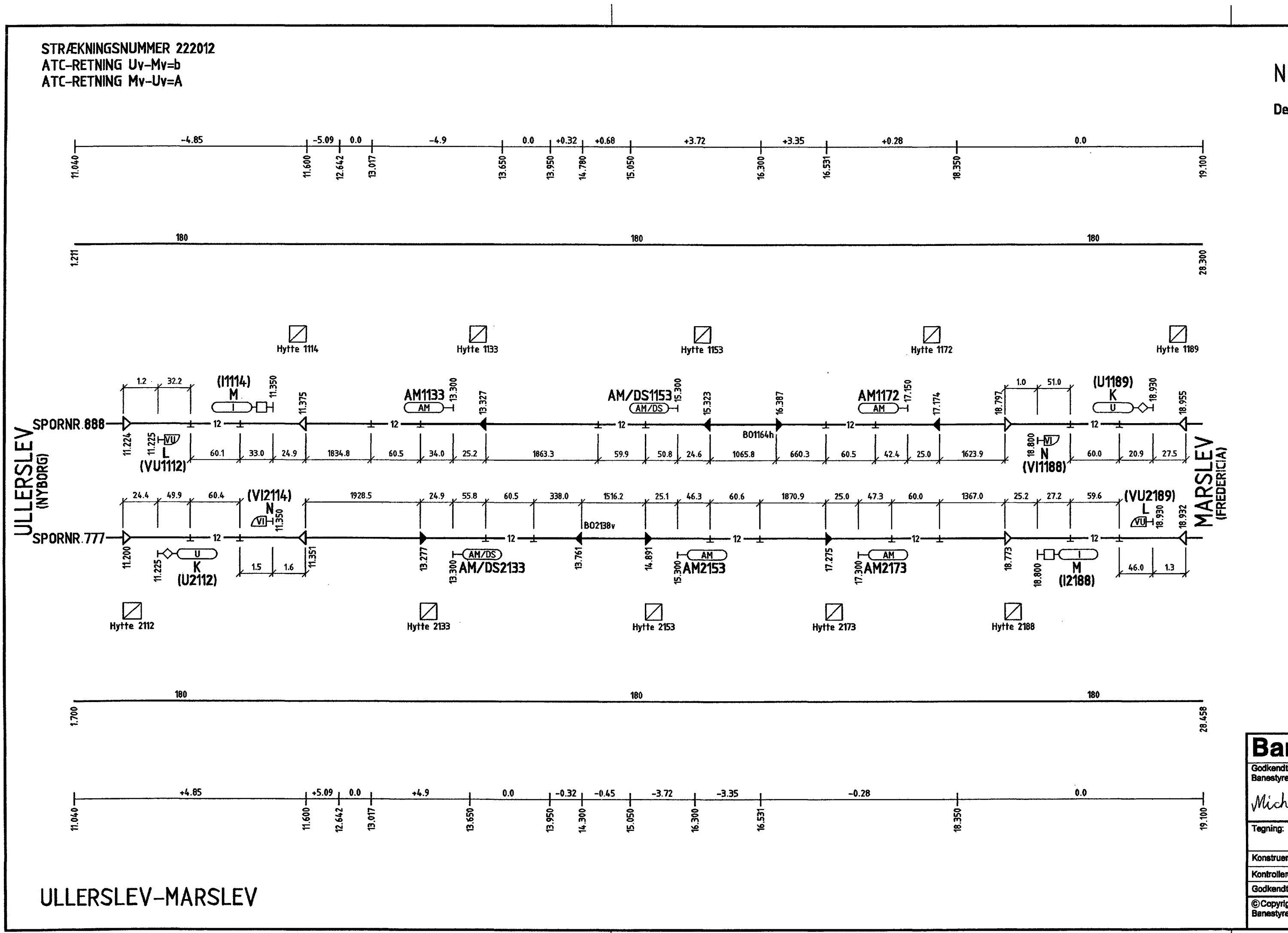
Due to copyright on UIC 541-05, Annex 2.4 contains only the front page..
UIC 541-05 can be purchased from UIC:
http://www.uic.org/etf/codex/codex-detail.php?codeFiche=541-05&langue_fiche=E

Appendix 2.9 and 6.1.

Since these documents are extensive only the front pages are shown in the report.
The two annexes can be downloaded on AIB's website.
Annex 2.9
Annex 6.1

Bilag 1.1
Havarikommissionen
611-2011-23



November 2011

Oplysninger / kilde: DMI

Vejrdata fra vejrstation ved Niels Bohrs allé i Odense d. 7/11 2011 (ca. 9 km fra AM signal 2173)

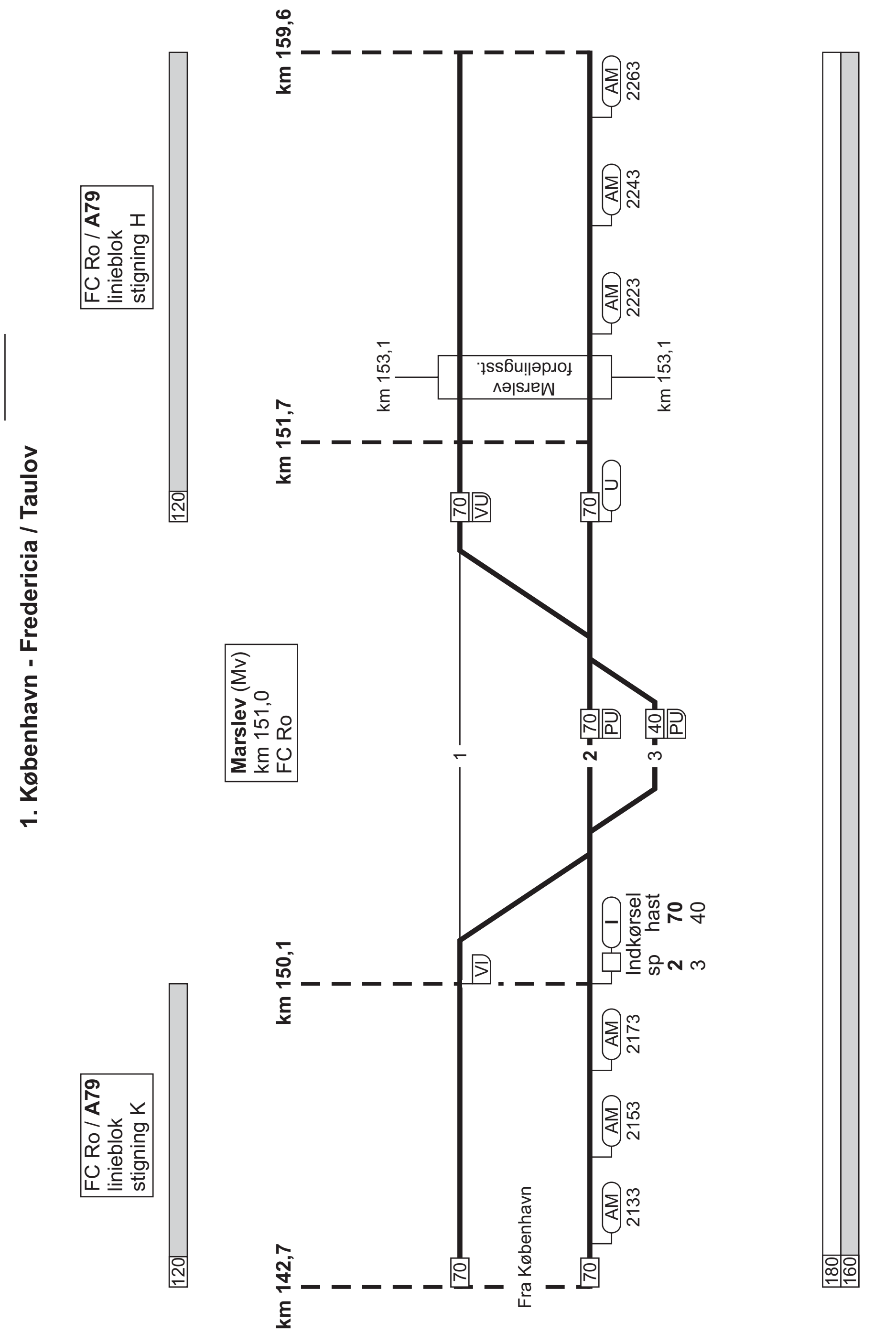
Parameter Dansk tid	Lufttryk	Vindhastighed	Lufttemperatur	Dugpunkttemperatur	Relativ fugtighed	Nedbørintensitet
07-11-2011 15:00	800	2,63736	8,04029	6,92208	92,6007	0
07-11-2011 15:05	800	2,83883	7,99145	6,86216	92,5275	0
07-11-2011 15:10	800	2,52747	8,01587	6,90167	92,6252	0
07-11-2011 15:15	800	2,47253	8,01587	6,90549	92,6496	0
07-11-2011 15:20	800	2,76557	7,99145	6,87362	92,6007	0
07-11-2011 15:25	800	2,83883	8,04029	6,94117	92,7228	0
07-11-2011 15:30	800	2,39927	8,06471	6,95012	92,6252	0
07-11-2011 15:35	800	2,05128	8,08913	6,98963	92,7228	0
07-11-2011 15:40	800	2,32601	8,06471	6,95394	92,6496	0
07-11-2011 15:45	800	2,30769	8,06471	6,95394	92,6496	0
07-11-2011 15:50	800	2,74725	8,06471	6,95776	92,674	0
07-11-2011 15:55	800	2,10623	8,06471	6,96158	92,6984	0
07-11-2011 16:00	800	2,63736	8,04029	6,93353	92,674	0

Bilag 1.3
Havarikommissionen
611-2011-23

69f - 3
333h - 3

1. København - Fredericia / Taulov

TIB (Ø)
TIB (V)



Bilag 2.02.35
strækning 35

Strækning 35						
	§	Krav for	Tekst	Stk	DSB	DSB S-tog
TIB	STR 35	LKF	Trafikal information om banestrækningen strækning 35	35	2	IR
SIN V	35.1	LKF	Kørsel på banestrækningen mellem Skanderborg og Herning	Hel ins	2	IR
SIN V	35.3	LKF	Kørsel til / fra Herning messecenter T	Hel ins	2	IR

Bilag 2.02.36
strækning 36

Strækning 36						
	§	Krav for	Tekst	Stk	DSB	DSB S-tog
TIB	STR 36	LKF	Trafikal information om banestrækningen strækning 36	36	2	IR
SIN DSB	4.5	LKF /TGF	Aflåsning af døre ved kørsel med 2 litra MR/MRD på Grenaabanen	Hel ins	2	

2.03.01
Krav til attestkørsler for Lokomotivførere

Kompetencer til opnåelse af infrastrukturcertifikat

1. Bremsetest.

1.1. Personen skal kunne efterse og beregne, at togets aktuelle bremseevne før afgang er i overensstemmelse med den krævede bremseevne for den aktuelle infrastruktur i henhold til gældende regler.

2. Maksimal hastighed i henhold til strækningsforhold og driftsform.

2.1. Personen skal kunne:

2.1.1. håndtere informationer som f.eks. hastighedsnedsættelser eller andre ændringer i forhold til gældende regler for strækningen, og

2.1.2. fremføre tog under hensyntagen den maksimale hastighed på basis af gældende regler herfor.

3. Kendskab til strækningen.

3.1. Personen skal være i stand til at forudse problemer og reagere herpå på en sikker og effektiv måde, herunder sikre præcision ved at have en gennemgående viden om strækningen og dens installationer samt eventuelle alternative strækninger.

3.2. Særligt skal personen kunne:

3.2.1. håndtere de driftsmæssige betingelser (muligheder for ændring af sporbenyttelse, enkeltsporkørsel, venstresporkørsel osv.),

3.2.2. læse og forstå relevante dokumenter om strækningens udstyrelse og beskaffenhed i denne sammenhæng,

3.2.3. identificere spor, som kan anvendes for en given drift,

3.2.4. kende og anvende gældende sikkerhedsregler og signalsystemer for strækningen,

3.2.5. forstå driftsstyringen af strækningen,

3.2.6. kende og anvende strækningens opdeling i linieblok eller lignende med tilhørende regler herfor,

3.2.7. kende stationernes navne, placering med tilhørende afstandsmærker, signaler, m.v. for at kunne tilpasse kørslen på tilfredsstillende vis,

3.2.8. kende overgangssignaler mellem forskellige driftsformer og køreledningssystemer,

3.2.9. kende den maksimale hastighed for forskellige typer rullende materiel, som anvendes,

3.2.10. kende de topografiske forhold på strækningen,

3.2.11. kende de særlige bremsekrav, f.eks. i forbindelse med faldforhold, og

3.2.12. kende særlige driftsforhold, f.eks. specielle signaler, mærker, afgangsbetingelser, m.v.

4. Sikkerhedsregler.

4.1. Personen skal være i stand til at:

4.1.1. sikre, at toget kun igangsættes, når alle gældende regler herfor er opfyldt (jf. tjenestekøreplan, afgangssignaler, m.v.),

4.1.2. observere ydre eller indre signaler, kunne tolke dem straks og agere korrekt som påkrævet,

4.1.3. fremføre toget sikkert i overensstemmelse med den fastsatte driftsmåde, herunder anvende specielle driftsmåder, hvis det er påkrævet f.eks. i forbindelse med hastighedsnedsættelser, venstresporkørsel, samt tilladelse til forbirangering af signal i stop, omstilling af sporskifter eller kørsel i arbejdsområder, og

4.1.4. håndtere planlagte og ikke planlagte stop, samt hvis nødvendigt yde supplerende service for passagerer ved disse ikke planlagte stop ved f.eks. ind- og udstigning af passagerer.

5. Fremføring af tog.

5.1. Personen skal være i stand til at:

5.1.1. stadfæste togets position i forhold til strækningens mærker og signaler, m.v.,

5.1.2. anvende bremserne for nedsættelse af hastighed eller opbremsning under hensyntagen til det anvendte rullende materiel og infrastrukturen, og

5.1.3. tilrette fremføringen af toget i overensstemmelse med køreplan samt givne krav til energibesparelse, trækkræftens, togets, strækningens og omgivelsernes karakteristika.

6. Uregelmæssigheder.

6.1. Personen skal være i stand til at:

6.1.1. være opmærksom på usædvanlige forhold i infrastrukturen og i omgivelserne hertil, f.eks. ved signaler, køreledningsanlæg, overkørsler, sporomgivelser og anden trafik, i det omfang kørslen tillader det,

6.1.2. vurdere afstande til genstande, der ligger inden for fritrumsprofilet,

6.1.3. informere jernbaneinfrastrukturforvalteren (fjernstyringscentralen) snarest muligt om observerede uregelmæssigheders placering og art, samt sikre at informationen er forstået, og

6.1.4. afhjælpe eller foranledige afhjulpet under hensyntagen til infrastrukturen, at trafikken eller personer udsættes for risici, hvis dette måtte være nødvendigt.

7. Driftsmæssige hændelser og uheld, herunder ildebrand og personskader.

7.1. Personen skal være i stand til at:

7.1.1. tage forholdsregler for at beskytte toget samt kunne tilkalde assistance i tilfælde af uheld, herunder med personskade,

7.1.2. bestemme, hvor toget skal stoppe i tilfælde af brand og evakuering af passagerer, hvis det er nødvendigt,

7.1.3. sørge for relevante oplysninger om ildebrand hurtigst muligt, hvis branden ikke kan bringes under kontrol,

7.1.4. informere jernbaneinfrastrukturforvalteren hurtigst muligt om anførte forhold, og

7.1.5. vurdere, om infrastrukturen tillader videre kørsel med det rullende materiel samt under hvilke betingelser.

8. Sprogkrav.

8.1. Personen, som skal kunne kommunikere med infrastrukturforvalterens fjernstyringscentraler, m.v. om jernbanesikkerhedsmæssige forhold, skal have sproglige færdigheder i dansk eller et andet sprog, som jernbaneinfrastrukturforvalteren fastsætter. Færdighederne i det fastsatte sprog skal være således, at kommunikationen kan foregå sikkert og effektivt i normale og uregelmæssige driftssituationer samt uheldssituationer.

8.2. Personen skal endvidere være i stand til at anvende de for lokomotivføreren krævede beskeder og kommunikationsmetoder specificeret i gældende regler herfor.

8.3. Personen skal være i stand til at kommunikere svarende til niveau 3, jf. nedenstående tabel:

Niveau	Beskrivelse
5	– kan tilpasse måden han/hun taler til enhver samtalepartner
	– kan fremføre en mening
	– kan forhandle
	– kan overbevise
	– kan give råd
4	– kan klare totalt uforudsete situationer
	– kan lave forudsætninger
	– kan udtrykke en argumenteret mening
3	– kan klare praktiske situationer med uforudsete elementer
	– kan beskrive

	– kan holde en simpel konversation gående
2	– kan klare simple praktiske situationer
	– kan stille spørgsmål
	– kan svare på spørgsmål
1	– kan tale ved anvendelse af udenad lærte sætninger

Kompetencer til opnåelse af litracertifikat

1. Afprøvninger og kontroller forud for afgang.

1.1. Personen skal være i stand til at:

1.1.1. indsamle relevant dokumentation og nødvendigt udstyr for det pågældende rullende materiel til brug for lokomotivføreren under kørslen,

1.1.2. tjekke beholdningerne i trækkraftenheden,

1.1.3. tjekke relevante informationer, som befinder sig i trækkraftenheden,

1.1.4. sikre ved udførelse af specificerede checks og tests, at trækkraftenheden er i stand til at yde den krævede trækkraft, og at sikkerhedsudstyret opererer korrekt,

1.1.5. tjekke anvendelighed og funktionaliteten af det foreskrevne beskyttelses- og sikkerhedsudstyr ved opstart eller overdragelse af trækkraftenheden, hvor det kræves, og

1.1.6. udføre enhver rutinemæssig præventiv vedligeholdelsesforanstaltning.

2. Kendskab til det rullende materiel.

2.1. Personen skal være fortrolig med alle til rådighed værende kontrolrutiner og indikationer, herunder særligt for traktionssystem, bremsesystem og jernbanesikkerhedsrelaterede systemer.

2.2. Med henblik på at kunne detektere og lokalisere uregelmæssigheder i det rullende materiel, herunder rapportere og beslutte, hvad kræver reparation og i særlige tilfælde indgriben skal personen være fortrolig med:

2.2.1. den mekaniske opbygning,

2.2.2. ud- og indkobling af udstyr,

2.2.3. det rullende materiels løbetøj (hjul og bogier),

2.2.4. sikkerhedsudstyr,

2.2.5. brændstoftanke, brændstofforsyningssystem, udstødningssystem,

2.2.6. betydningen af ind- og udvendige mærker på det rullende materiel, særligt symboler anvendt til farligt gods,

2.2.7. systemer til registrering af ture,

2.2.8. elektriske og pneumatiske systemer,

2.2.9. strøm- og højspændingssystemer,

2.2.10. kommunikationsudstyr (infrastruktur til togradio, osv.),

2.2.11. organinsering af ture,

2.2.12. komponentdele af det rullende materiel, deres betydning, herunder udstyr til transport af dødt rullende materiel, samt særligt udstyr til bremsning af tog ved udluftning af bremseledning,

2.2.13. bremsesystemet,

2.2.14. delene i traktionsenheden, og

2.2.15. traktionskæde, motorer og transmission.

3. Bremseprøver.

3.1. Personen skal være i stand til at:

3.1.1. beregne og checke før afgang, om togets aktuelle bremseevne i henhold til gældende regler svarer til den krævede på den pågældende strækning, og

3.1.2. afprøve funktionen af trækkraftens og togets bremser ved opstart og inden afgang samt under driften.

4. Driftsbrug og maksimal hastighed af toget i relation til strækningsdata.

4.1. Personen skal være i stand til at:

4.1.1. håndtere givne informationer, og

4.1.2. bestemme fremføringsform og maksimal hastighed af toget på basis af ændret signalisering, vejrforhold og hastighedsbegrænsninger.

5. Fremføring af tog på en måde, som ikke medfører skader på installationer og vogne.

5.1. Personen skal være i stand til at:

5.1.1. benytte alle til rådighed værende kontrolsystemer i overensstemmelse med gældende regler,

5.1.2. igangsætte toget under hensyntagen til adhæsion og trækkraftrestriktioner, og

5.1.3. anvende bremser for deceleration eller bremsning under hensyntagen til det rullende materiel og infrastrukturen.

6. Uregelmæssigheder.

6.1. Personen skal være i stand til at:

6.1.1. være opmærksom på usædvanlige hændelser ved toget,

6.1.2. inspicere toget og identificere uregelmæssigheder ved toget, samt kunne skelne mellem forskellige typer af uregelmæssigheder og kunne reagere i overensstemmelse med deres vigtighed, herunder kunne prøve at afhjælpe dem, samt altid give fortrin til jernbanesikkerheden, og

6.1.3. forstå betydningen af forskellige beskyttelsesforanstaltninger og kommunikation.

7. Driftsmæssige hændelser og uheld, herunder ildebrand og personskade.

7.1. Personen skal være i stand til at:

7.1.1. tage forholdsregler for at beskytte toget samt kunne tilkalde assistance i tilfælde af uheld, herunder med personskade,

7.1.2. konstatere, om toget medfører farligt gods og skal kunne identificere farligt gods vogne på basis af togdokumentation og vognlister, og

7.1.3. have kendskab til procedurer i relation til evakueringen af et tog i en nødsituation.

8. Betingelser for viderekørsel efter en hændelse, hvor det rullende materiel er involveret.

8.1. Personen skal efter en hændelse være i stand til at:

8.1.1. vurdere, om det rullende materiel kan fortsætte kørslen og under hvilke betingelser, og

8.1.2. informere jernbaneinfrastrukturforvalteren om ovennævnte betingelser så hurtigt som muligt.

9. Hensætning af tog.

9.1. Personen skal være i stand til at tage forholdsregler til at sikre, at toget ikke utilsigtet kommer i bevægelse. Endvidere skal personen have kendskab til forholdsregler til at standse et tog eller dele deraf i tilfælde af, at det uventet er kommet i bevægelse.

2.03.02
Krav til attestkørsler for Togførere

Det er et krav at eksaminanden er undervist / sidemandsoplært i de respektive materieltyper med mindst en praktisk arbejdsdag i litraet, og at der er lavet en gennemgang i følgende punkter inden der indstilles til Attestkørsel.

SIN DSB fokuspunkter:

Sikkerhedsledelse
Togpersonalets ansvar og anvendelse af sikkerhedsmæssigt instruktionsstof.
(Eksaminanden udfører og forklarer hvad der skal medbringes til daglig tjeneste)

Færdselssikkerhed
Brug af mobiltelefon under togfremførsel og rangering
(Eksaminandens holdning og adfærd i den daglig tjeneste)

Brug af PC-udstyr under togfremførsel og rangering
(Eksaminandens holdning og adfærd i den daglig tjeneste)

Dør mellem førerrum og passagerafdeling
(Eksaminandens holdning og adfærd i den daglig tjeneste)

Ophold i førerrum
(Eksaminandens holdning og adfærd i den daglig tjeneste)

Togpersonalets håndtering af fejl på materiel
(Eksaminanden forklarer proceduren samt registrerer en fejl)

Indmelding af fejl på intern TV-skærme og spejle på perroner
(Eksaminanden forklarer proceduren for indmelding af fejl)

ODI Fokuspunkter:
Kørselsteknik og forhold under kørsel
Tog med togfører Afgangsprocedurerne
(Eksaminanden udfører og forklarer)

Tog uden togfører Afgangsproceduren
(Eksaminanden forklarer samt forklarer til/fratræden til Lkf.)

Forhold under kørsel Knuste ruder
(Eksaminanden forklarer proceduren samt viser hvor folie er)

Bilag 2.2
Havarikommissionen
611-2011-23

Normer vedr. godkendelse af IC4

(Uddrag af appendix 6-0 fra IC4 kontrakten)

0.12 Overall vehicle standards

0.12.1 Standards

General

If specific standards are not specified for the design, choice of material, manufacture, assembly and testing of the train, the current standards shall apply in the following order:

- European standard (EN)
- National standard, eg. DS
- Other international standards (IEC, ISO, CEE)
- Railway standard, eg. UIC
- Other railway recommendations and reports ERRI (ORE), Community of the Nordic Railways (CNR).
- Other national standards (DIN, VDE, SS, BS etc.)
- Suitable standard for driver and maintenance personnel in other business areas such as: electricity, building, construction, road vehicles and transport.

The most recent version of a standard shall be used. If different standards cover the same area, the most restrictive shall be used.

The Contractor shall submit information about the standards (international, national, trade etc.) used for the design, choice of materials, manufacturing and testing of the train.

If the application of the said rules leads to contradiction, queries or unachievable design interpretations, clarification with DSB, with regard to mutually acceptable final interpretation, shall be ensured.

Deviation from the specified standards, if any, shall be agreed upon between contractor and customer during design phase.

Standards specified in Appendix 6

UIC leaflets

UIC 505-1	Railway transport stock - Rolling stock construction - gauge
UIC 510-2	Trailing stock conditions concerning the use of

	wheels of various diameters with running gear of different types. (In preparation).
UIC 510-5	Lastenheft zur techniscen Zulassung eines Rades. (In preparation).
UIC 512	Rolling stock - Conditions to be fulfilled in order to avoid difficulties in the operation of track circuits and treadles
UIC 515	Coaches - Running gear
UIC 515-1	Passenger rolling stock - Trailer bogies - Running gear - General provisions applicable to the components of trailers bogies
UIC 515-3	Rolling stock - Bogies - Running gear - Axle design calculation method.
UIC 522	Technical conditions to be fulfilled by the automatic coupler of the UIC and OSJD Member Railways.
UIC 518 Draft of February 1999	Testing and approval of railway vehicles from the point of view of their dynamic behaviour - Safety - Track fatigue - Ride quality
UIC 527-1	Coaches, vans and wagons - Dimensions of buffer heads - Track layout on S-curves
UIC 533	Protection by the earthing of metal parts of vehicle
UIC 534	Signal lamps and signal lamp brackets for locomotives, railcars and all tractive and self-propelled stock
UIC 541-3	Brakes - Regulations concerning manufacture of the different brake parts - Driver's brake valve
UIC 541-06	Brakes - Regulations concerning the construction of the various brake components: Magnetic brakes
UIC 541-05	Brakes - Regulations concerning the construction of the various brakes components - Wheel slip prevention equipment
UIC 544-2	Conditions to be observed by the dynamic brake of locomotives and motor coaches so that the extra braking effort produced can be taken into account for the calculation of the braked-weight
UIC 552	Electric power supply for trains - Standard technical characteristics of the train bus
UIC 553 (UIC 553, 2.Ed. 01.01.2000, Ver. I-12/98)	Heating, ventilation and air-conditioning in coaches
UIC 553-1 2. Ed. 01.01.2000 (Ver. D-05/99)	Heating, ventilation and air-conditioning in coaches. Standard tests.
UIC 556	Informationsübertragung im Zug (Zugbus) (In course of preparation)
UIC 557	Diagnosetechnik in Reisezugwagen (In course of preparation)
UIC 568	Loudspeaker and telephone systems in RIC coaches Standard technical characteristics
UIC 564-2	Regulations relating to fire protection and fire fighting measures in passenger carrying railway

	vehicles or assimilated vehicles used on international services
UIC 566	Loading of coach bodies and their components
UIC 568	Loudspeaker and telephone systems in RIC coaches Standard technical characteristics
UIC 571-2	Standard wagons - Ordinary bogie wagons - Characteristics
UIC 615	Tractive units: Bogies and running gear - General provisions.
UIC 642	Special provisions concerning fire precautions and fire-fighting measures on motive power and driving trailers in international traffic
UIC 644	Warning devices used on tractive units employed on international services
UIC 651	Layout on driver's cabs in locomotives, railcars, multiple-unit trains and driving trailers
UIC 751-3	Technical regulations for international ground-train radio systems
UIC 758	Use of mobile radio on the railways - Aerials
UIC 811-1,-2	Technical specification for the supply of axles for tractive and trailing stock - Tolerances
UIC 812-3	Technical specification for the supply of solid wheels in rolled non-alloy steel for tractive and trailing stock
UIC 813	Technical specification for the supply of wheelsets for tractive and trailing stock - Tolerances and assembly
UIC 822	Technical specification for the supply of helical compression springs, hot or cold coiled for tractive and trailing stock

Euro Standards EN an PrEN

EN 286-3	Simple unfired pressure vessels designed to contain air or nitrogen – Part 3: Steel pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock
EN 286-4	Simple unfired pressure vessels designed to contain air or nitrogen – Part 4:Aluminium alloy pressure vessels designed for air braking equipment and auxiliary pneumatic equipment for railway rolling stock
EN 287	Approval testing of welders – Fusion welding
EN 288	Specification and approval of welding procedures for metallic materials
EN 288-2	Part 2: Welding procedure specification for arc welding
EN 288-3	Part 3: Welding procedure tests for the arc welding of steels
EN 288-4	Part 4: Welding procedure tests for the arc welding of aluminium and its alloys

EN 1043	Destructive tests on welds in metallic materials
EN 1321	Destructive tests on welds in metallic materials – Macroscopic and microscopic examination of welds
EN 10002-1	Metallic materials – Tensile testing – Part 1: Method of test (at an ambient temperature)
EN 10045	Metallic materials – Charpy impact test
EN 12062	Non-destructive examination of welds – General rules for metallic materials
EN 25183	Resistance spot welding
EN 25817	Arc-welded joints in steel – Guidance on quality levels for imperfections
EN 28167	Protections for resistance welding
EN 29000-3	Corresponds to ISO 9000-3
EN 30042	Arc-welded joints in aluminium and its weldable joints – Guidance on quality levels for imperfections
EN 45014	General criteria for suppliers' declaration of conformity
EN 50022	Low-voltage switchgear and controlgear for industrial use – Mounting rails – Top hat rails 35 mm wide for snap-on mounting of equipment
EN 50063	Safety requirements for the construction and the installation of equipment for resistance welding and allied processes
ENV 50121	RA – Electromagnetic compatibility
CENELEC Report R009-003 (tidligere prEN 50127-1)	RA – Guide to the specification of a guided transport system
EN 50155	RA – Electronic equipment used on rolling stock
EN 60310	RA – Rolling stock – Traction transformers and inductors
EN 61377	RA – Rolling stock – Combined testing of inverter-fed alternating current motors and their controls
PrEN 256-017 (prEN 13103)	RA – Wheelsets and bogies – Non-powered axles – Design guide
PrEN 256-024 (prEN 13104)	RA – Wheelsets and bogies – Powered axles – Design guide
PrEN 12663	RA – Structural requirements of railway vehicle bodies
PrEN 13298	RA – Suspension components – Helical suspension springs, steel
PrEN 20834-1	Corresponds to ISO 834.(In preparation).
PrEN 45545-1+4+5	RA – Fire safety Part 1: General rules Part 4: Fire safety requirements for railway rolling stock design Part 5: Fire safety requirements for electrical equipment including that of trolley busses
PrEN 50125-1	RA – Environmental conditions for equipment – Part 1 Equipment on board rolling stock
PrEN 50126	RA – The Specification and Demonstration of

	Reliability, Availability, Maintainability and Safety (RAMS)
PrEN 50128	RA – Communication, signalling and processing systems – Software for railway control and protection systems
PrEN 50207	RA – Electronic power converters for rolling stock
PrEN 60721-3-5	Classification of environmental conditions Part 3: Classification of groups of environmental parameters and their severities – Section 5: Ground vehicle installations
PrEN ISO 3381:1999. Draft	RA - Acoustics. Measurements of noise inside railbound vehicles
PrEN ISO 3095:1999. Draft	RA - Acoustics. Measurements of noise emitted by railbound vehicles

Other CEN references

CEN/TC 256 WG 13 doc. no. 1227,	RA - Wheelsets and bogies. Method of specifying structural requirements of bogie frames
CEN/TC 256 WG 14 Final draft doc. no.1155 of April 1996	RA - Suspension components. Helical suspension springs, steel.

ISO Standards

ISO 834	Fire-resistance test - Elements of building construction
ISO 2631-1	Mechanical vibration and shock - Evaluation of human exposure to Whole-body vibration. Part 1: General requirements
ISO 2867	Earth-moving machinery - Access systems
ISO 3537	Road vehicles - Safety glazing materials - Mechanical test
ISO 6072	Hydraulic fluid power - compatibility between elastomeric materials and fluids
ISO 7730	Moderate thermal environments - Determination of the conditions for thermal comfort

DIN Standards

DIN 1630	Nähtlose kreisförmige Rohre aus unlegierten Stählen für besonders hohe Anforderungen, Technische Lieferbedingungen
DIN 2353	Lötlose Rohrverschraubungen mit Schneidring - Vollständige Verschraubung und Ûbersicht
DIN 2391	Nahtlose Präzisionsstahlrohre mit besonderer. Maßgenauigkeit
DIN 5510	Vorbeugender Brandschutz in Schienenfahrzeugen.
DIN 5550	Fahrtechnische Prüfung und Zulassung von Schienenfahrzeugen
DIN 5572	Wellenbremsscheiben für Radsätze

DIN 25008 (Nov 1990)	Grundsätze für die Bestimmung der Fahrzeuggewichte
DIN 25043	Reisezug - und Triebwagen Vermessen beim Neubau
DIN 53218	Prüfung von Anstrichstoffen und ähnlichen Beschichtungsstoffen
DIN 67530	Reflektometer als Hilfsmittel zur Glanzbeurteiling an ebenen Anstrich- und Kunststoff-Oberfâchen
DIN 86229	Feuerwiderstand von Schlauchleitungen
DIN 86230	Feuerwiderstand von Schlauchleitungen

IEC Standards

IEC 9/413/CDV MVB bus	Concerns IEC 61375 Train communication network
IEC 77	Replaced by IEC 60077 Rules for electrical traction equipment
IEC 268	Replaced by IEC 60268 Sound system equipment
IEC 309-1	Replaced by IEC 60309-1 Plugs, sucket-outlets and couplers for industrial purposes – Part 1: General requirements
IEC 331	Replaced by IEC 60331 Fire-resisting characteristics of electrical cables
IEC 349	Replaced by IEC 60349 Electric traction. Rotating electrical machines for rail and road vehicles
IEC 364	Replaced by IEC 60364 Electrical installations of buildings
IEC 750	Replaced by IEC 61346-1 Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations. Part 1: Basic rules.
IEC 1133	Replaced by IEC 61133 Electric traction – Rolling stock – Methods for electric and thermal/electric rolling stock on completion of construction and before entry into service

ORE/ERRI Reports

ORE B55/RP8	Entgleisungssicherheit von Güterwagen in Gleisverwindungen - Schlußbericht
ORE B153 RP10 and RP18	Railway application of ISO Standard 2631 RP10 Vibratory comfort: Drawing up weighting curves RP18 Final report
ORE C163/RP2	Railway noise RP2 Directives for the measurement of railway traffic noise
ERRI B166/RP3 Draft, September 1995	Fault diagnostics for and on trains

ERRI B169/RP9	Standardization of wheelsets Specification for wheels. Mechanical dimensions. Fatique strength.
ERRI B169/RP12	Standardization of wheelsets Production of a universal matrix representative of damage to a railway component with a wiew to performing fatique tests.

BS Standards

BS 6853	Code of practice for fire precautions in the design and construction of passenger carrying trains
BS 5852	Methods of test for assessment of the ignitability of upholstered seating by smouldering and flaming ignition sources

Other standards and references

SS 224407	Float-glass
TSI Rolling Stock	Trans-European High-Speed Rail System Technical Specification for Interoperability “Rolling Stock” Sub-System Draft rev 7a, 13.07.99
MIL HDBK-217F	Military Standardization Handbook 217F (DOD) “Reliability Prediction of Electronic Equipment”
EURO 3 og 4	cf EU Directive 88/77/EEC
EUROCODE No 3 Part 9	Fatique strength of the welds. Fatique curves.
NES 713, Issue 3	Naval Engineering Standard
OECD test 301A-F	OECD test guidelines, cf EU Directive 92/69/EEC

Bilag 2.3
Havarikommissionen
611-2011-23

Undgå forsinkelser når bladene falder

TEMA LØVFALD 2011

Efteråret er kommet. Træerne klæder sig i rødt, brunt og gult, og bladene er begyndt at falde. Det giver os på banen udfordringer og koster hvert år store summer i form af forsinkelser og skader på hjul og skinner.

Sidste efterår havde vi en god løvfaldsperiode. Præcisionen var god, og vi havde halvt så mange "løvfaldsdage" som normalt. Det lykkedes, fordi vi alle var opmærksomme på, hvad vi hver især kan gøre for at få togene så rettidigt gennem efteråret som muligt. Igen i år skal vi samarbejde og gøre vores bedste.

I denne folder kan du læse, hvordan du skal håndtere hjulblokering og hjulslip for hver litra type (Instrukserne er hentet fra ODI).

Hjulblokering

Handling	Kontrol
MF/ER:	
DML for »Hjulblokering« lyser.	
Sæt K/B-kontroller i lavere bremsetrin.	Bremsecylindertryk falder
Aktiver LTT »MG-bremsen« og forsøg gradvis bremsning med K/B-kontroller.	Bremsecylindertryk stiger
MG-bremsen må ikke anvendes ved passage af sporskifter.	
MG:	
Vedvarende hjulblokering ved bremsning med hastighedsreference: Skift umiddelbart til bremsning med trinregulering.	Bremsecylindertryk falder og at DML »Hjulslip/Blokering« slukker.
Vedvarende hjulblokering ved bremsning med trinregulering: Vælge lavere bremsetrin.	Bremsecylindertryk falder og at DML »Hjulslip/Blokering« slukker
MQ:	
Sæt kørerbremsekontroller (K/B) i en lavere bremsestilling.	Bremsecylindertrykket falder.
Aktiver LTT »MG-bremsen« og forsøg gradvis bremsning med K/B-kontroller.	Bremsecylindertryk stiger
MR:	
Sæt kørerbremsekontroller (K/B) i en lavere bremsestilling.	Bremsecylindertrykket falder.
Aktiver LTT »MG-bremsen« og forsøg gradvis bremsning med K/B-kontroller.	Bremsecylindertryk stiger
MG-bremsen må så vidt muligt ikke anvendes ved passage af sporskifter.	
Aktiver sandingsanlægget manuelt, ved brug af »Kontakt for sanding«.	

Hjulblokering

Handling	Kontrol
BR 605:	
Betjen kiptaste for sanding. **Der må ikke sandes ved passage af sporskifter**	Hastighedsviser bevæger sig fra 0.
ME	
Betjen »Tryktast for sanding«. **Der må ikke sandes ved passage af sporskifter.**	Meldelampe for »Hjulslip/Blokering« slukker.
Vedvarende blokering: Sæt køre/bremsekontroller, førerbremsehåndtag eller direkte bremsehåndtag i et lavere bremsetrin.	Bremsecylindertryk falder. Meldelampe for »Hjulslip/Blokering« slukker. **Særlig opmærksomhed påkrævet ved udkoblede impulsgivere.**
ABS	
Betjen »Tryktast for sanding«. **Der må ikke sandes ved passage af sporskifter.**	Meldelampe for »Hjulslip/Blokering« slukker.
Vedvarende blokering: Betjening som anført i ME ovenfor.	Meldelampe for »Hjulslip/Blokering« slukker.
EA	
Betjen »Tryktast for sanding«. **Der må ikke sandes ved passage af sporskifter.** Vedvarende blokering: Sæt køre/bremsekontroller i bremse kontrollertrin »løse«.	Bremsecylindertryk falder. Meldelampe for »Hjulslip/Blokering« slukker. **Særlig opmærksomhed påkrævet ved udkoblede impulsgivere.**

Hjulslip

Handling	Kontrol
MF/ER:	
Hvis DML for »Hjulslip« lyser vedvarende: Indstil til lavere køre/bremsetrin.	DML »Hjulslip« slukker.
MG:	
Ingen forholdsordre.	
MQ:	
Gentagende hjulslip: Sæt kørerbremsekontrolleren (K/B) i stilling »0«. Derefter sættes kørerbremsekontrolleren (K/B) i kørerstilling, samtidig med at der sandes. Sandingen kan ophøre når dieselmotoren har overtaget fremdriften uden hjulslip. **Der må så vidt muligt ikke sandes ved passage af sporskifter.**	Display afgiver en melding.
MR:	
Hvis meldelampe for »Hjulslip« lyser vedvarende, indstil til lavere køretrin.	Meldelampe »Hjulslip« slukker
BR 605:	
Hjulslipsystemet regulerer automatisk trækkraft og motoromdrejninger. Gentagende hjulslip: Stil kørekontrolleren i mindre ydelse. Stil herefter kørekontrolleren i en kørestilling, samtidig med der sandes. Sanding kan ophøre når traktionsanlægget har overtaget fremdriften uden hjulslip. **Der må ikke sandes under passage af sporskifter**	Trækkraftmåler stabiliseres.

Hjulslip

Handling	Kontrol
ME	
Påvirk »Tryktaste for sanding«. Meldelampe for »Hjulslip/Blokering« slukker. Der må ikke sandes ved passage af sporskifter.	Meldelampe for »Hjulslip/Blokering« slukker.
Vedvarende hjulslip: Sæt kørekontrolleren i et lavere køretrin. **Særlig opmærksomhed påkrævet ved udkoblede impulsgivere.**	Meldelampe for »Hjulslip/Blokering« slukker.
ABS	
Ved indikering af hjulslip: Betjening som anført i ME ovenfor.	Meldelampe for »Hjulslip/Blokering« slukker.
EA	
Ved indikering af hjulslip aktiveres sanding og trækkraft nedreguleres om nødvendigt	Kontrollér meldelampe for »Hjulslip/Blokering«.

Bilag 2.4
Havarikommissionen
611-2011-23

UIC CODE 541-05

2nd edition, November 2005

Translation

OR

Brakes - Specifications for the construction of various brake parts - Wheel Slide Protection device (WSP)

Frein - Prescriptions concernant la construction des différents organes de frein - l'anti-enrayeur
Bremse - Vorschriften für den Bau der verschiedenen Bremsteile - Gleitschutzanlage

UNION INTERNATIONALE DES CHEMINS DE FER
INTERNATIONALER EISENBAHNVERBAND
INTERNATIONAL UNION OF RAILWAYS

Trafikstyrelsen
Public Transport Authority

Til DSB IC4 Programmet

Adelgade 13
1304 København K
Telefon 7226 7000
Direkte 7226 7075
Fax 7226 7070
lfu@trafikstyrelsen.dk
www.trafikstyrelsen.dk

Journal T541-000765
Dok. nr. 1070107
Dato 4.11.2010

Betinget Typegodkendelse MPTO P1 (Litra MG)

Europæisk køretøjsnummer, EVN	-
Køretøjsbetegnelse	IC4 / Litra MG, koblet togsæt
Fabrikant betegnelse	DMU IC4 – MPTO Pakke 1
Køretøjsnummer / Stel nummer	-

Med hjemmel i

- Lov om jernbane § 21 k, stk. 2, jf. lovbekendtgørelse nr. 969 af 8. oktober 2009.
- Bekendtgørelse om godkendelse af rullende materiel (køretøjer) på jernbaneområdet nr. 686 af 2. juli 2009

har Trafikstyrelsen truffet følgende afgørelse:

Trafikstyrelsen skal herved meddele betinget typegodkendelse for Litra MG som anført nedenfor.

Typeidentifikation

Typekonfigurationen er identificeret i dokumentet AQU IO/045 rev. 22/AE. inkl. Design konfiguration MPTO Pakke 1 revision 1. (Ref. [5] Annex 22)

Gyldighed

Godkendelsen er gyldig indtil videre, forudsat nedenstående vilkår er opfyldt, og der ikke opstår uforudsete sikkerhedsmæssige hændelser, der kan henføres til typen. Ved manglende dokumentation for vilkårsopfyldelse bortfalder typegodkendelsen.

Anvendelsesområde

Anvendelse af typen fremgår af Ref. [5] Annex 22: AQU IO/045 rev 22/AE kapitel 7.2 og er:

1. Almindelig kommerciel drift med højst to togsæt sammenkoblet og maksimal hastighed 180 km/t.

Betingelser for typegodkendelsen

Inden 31.12.2010:

2. Udestående betingelser fra C-MTTA Ref. [9], der udgøres af Ref. [8] ACS 4, 17, 90, 91 og 92 skal være opfyldt/afklaret.
3. De i Safety Case Ref. [5] Annex 18 afsnit 15 planlagte emner til lukning (Id 7, 8 og 9) skal være lukkede. Dokumenteres med supplerende assessment rapport.

Inden 30.6.2011:

4. Udestående i ACS Ref. [8] 59 skal være lukket. Dette indbefatter Assessors opfølgningspunkt 4 i konklusionen Ref. [6]
5. Assessors opfølgningspunkt 1 i konklusionen Ref. [6] skal være indarbejdet af IC4 Programmet. Dokumenteres overfor Trafikstyrelsen via lukning af ACS Ref. [8] 105.
6. Der skal hos Trafikstyrelsen foreligge endelig assessment rapport uden mangler. Ref. [6] konklusion.

Inden 30.10.2011

7. Assessors opfølgningspunkt 3 i konklusionen Ref. [6] skal være indarbejdet af IC4 Programmet. Dokumenteres med supplerende assessment rapport.

Ibrugtagningsbetingelser

Forudsætninger for ansøgning om ibrugtagningstilladelse for typen

8. De i Ref. [5] Safety Case rev. 8/AD Annex 21 anførte sikkerhedsrelaterede anvendelsesbetingelser (SRAC) skal implementeres.
9. Assessors opfølgningspunkt 2 og 5 i konklusionen Ref. [6] om arbejdsbelastning af lokomotivfører og flerfejls håndtering skal iværksættes og assessors accept af implementering foreligge.
10. Udestående ACS 101 Ref. [8] skal være lukket.

Begrundelse

Ad 1	Betingelserne fremgår af Safety Case konklusionen.
Ad 2	DSB IC4 Program har ikke opfyldt betingelserne sat for C-MTTA med udløbsdato 27. juli 2010. I stedet er der lavet en handlingsplan. Med udgangspunkt i, at antallet af idriftsatte togsæt under betingelserne fra C-MTTA kun er to togsæt har Trafikstyrelsen accepteret at betingelser udskydes og gennemføres under/ved nærværende betingede typegodkendelse. For at minimere risikoeksponeringen er datoen sat tidligere end øv-

	rige udeståender. For så vidt angår ACS 17 har Banedanmark i godkendelsen af ATC-typecertifikat for litra MG (Ref. [10]) eksplicit krævet sikkerhedssløjfen for multiple koblede togsæt godkendt. Godkendelsen kan ske når ACS 17 kan lukkes.
Ad 3	IC4 Programmet har foreslået at udeståender fra CFG implementeringen, assessment og Safety Case skal være afsluttet 31.12.2010. Trafikstyrelsen støtter denne milepæl og forventer milepælen dokumenteret afsluttet via en assessment rapport.
Ad 4	IC4 Programmet har endnu ikke dokumenteret et virksomt 'Failure Reporting and Corrective Actions System' som anbefalet af ISA for C-MTTA. Især med den nye mission for sammenkoblet kørsel forventer Trafikstyrelsen at systemet implementeres.
Ad 5	Størsteparten af ansøgningsmaterialet Ref. [4] har været underlagt assessment – primært af intern assessor ved DSB Jernbanesikkerhed bistået af Scandpower. På trods heraf - og baseret på det foreliggende grundlag - er Trafikstyrelsen usikker på IC4 Programmets fortsatte proces med færdiggørelsen af IC4 (Litra MG) – herunder afslutning af åbne sikkerhedsemner. Emnet er yderligere uddybet i den nævnte ACS.
Ad 6	Af rapporten fremgår: *Arbeid med stikkprøver av lukkede punkter er ikke avsluttet pr fredag 08.10.2010. Det kan derfor komme flere punkter*
Ad 7	Vilkåret baseres på assessors opfølgningspunkt 3, der omhandler synkronisering af fakta tal for IC4 driften med de teoretiske tal opstillet i risikoanalyserne for IC4.
Ad 8	Forud for enhver ibrugtagning af en ny type tog skal der foreligge bevis for, at de fra typen genererede sikkerhedsmæssige anvendelsesbetingelser er opfyldt ved aktuel virksomhed.
Ad 9	Assessor har opstillet en række opfølgningspunkter (anbefalinger) som IC4 Programmet skal følge op på. To af disse anser Trafikstyrelsen for signifikante i forhold til idriftsætningen.
Ad 10	Udestående handler om DSB's proces med udarbejdelsen af overensstemmelser for et togsæt til typen. Denne proces skal være entydig, da den ligger til grund for de fremtidige ibrugtagningstilladelser.

Baggrund

AnsaldoBreda har den 4.5.2009 opnået betinget typegodkendelse (C-MTTA) af togsættypen DMU IC4 i konfigurationen AA07189 rev.9. til sammenkoblet drift. Ref.[9]

Betingelser heri med udløbsdato 27.7.2009 er indfriet.

DSB, ved IC4 Programmet, har maj 2009 overtaget ansvaret for færdiggørelsen af IC4, herunder afslutning af betingelser og udeståender.

Siden C-MTTA har AnsaldoBreda og DSB indført en række ændringer på typen, der nu kaldes MPTO Pakke 1.

IC4 Programmet har den 24.8.2010 ansøgt om fornyet typegodkendelse. Ref.[2]. Trafikstyrelsen har den 31.8.2010 påpeget en række uklare forhold i ansøgningen Ref. [3], og den 8.10.2010 har IC4 Programmet fremsendt en opdateret ansøgning Ref. [4] hvor manglerne Trafikstyrelsen har påpeget er medsendt.

Betingelser fra Ref.[9], med udløb 27.10.2010, som ikke er opfyldt er overtaget og indarbejdet i grundlaget for den opdaterede ansøgning Ref. [4].

Grundlag

[1]. IC4 Program Sikkerhedsplan. DSB dok. P000170011 rev. 4. Journal T541-001161, dok 1067700.

[2]. Ansøgning om typegodkendelse MPTO Pakke 1 (DSB litra MG), IC4 Program, 24. august 2010. Journal T541-000765, dok 1053956.

[3]. Fremsendelse af overordnet erklæring, Trafikstyrelsen, 31.08.2010 og Forslag til DSB IC4 Programmet af 16.09.2010. Journal T541-000765, dok 1054332 og 1058856

[4]. Opdateret ansøgning om typegodkendelse MPTO Pakke 1 (DSB litra MG), IC4 Program, 08. oktober 2010. Journal T541-000765, dok 1067686.

[5]. DSB – IC4 Programmet Safety Case. AA02RX5 Rev. 8/AD af 7. oct. 2010. Journal T541-000765, dok 1067668.

[6]. Intern assessorrapport IC4 Programmet, vurdering av Safety Case rev 8AD. Scandpower, 8. october 2010. Journal T541-000765, dok 1067685.

[7]. Sammenfattende assessment af IC4 Programmet, Udgave G. DSB Risk Management Jernbanesikkerhed, 8. oktober 2010. Journal T541-000765 dok 1067682.

[8]. Authority Clarification Subjects DMU IC4 (ACS) Rev. 44. Journal T541-000481.

[9]. Betinget Typegodkendelse af DMU IC4, C-MTTA, Trafikstyrelsen 4.5.2009. Journal T541-000765, Dok 841563 og 841562.

[10]. Godkendelse af ATC-typecertifikat for litra MG. Banedanmark TSA for mobil togkontrol, 22.06.2010. Ref. [4] reference 5.

Klagevejledning

Denne afgørelse kan påklages til

Jernbanenævnet
Gl. Mønt 4, 1.
1117 København K

Klager over afgørelser, som skal behandles af Jernbanenævnet, skal være indgivet til Jernbanenævnet senest 4 uger efter, at Trafikstyrelsens afgørelse er meddelt den pågældende, jf. § 17, stk. 1 i bekendtgørelse nr. 1549 af 17. december 2007 om Trafikstyrelsens opgaver og beføjelser.

Med venlig hilsen

Leif Funch
Kontorchef
Jernbanesikkerhed

Godkendelseskode, EIN DK5120100047

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Journal T541-001448
Dok. nr. 1079341
Dato 10.12.2010

Ibrugtagningstilladelse til DSB litra MG 5627 i konfiguration MPTO Pakke 1

Europæisk køretøjsnummer, EVN	
Køretøjsbetegnelse	DSB Litra MG
Fabrikant betegnelse	DMU IC4 – MPTO/1
Køretøjsnummer / Stel nummer	MG 5627

Baggrund

DSB ansøgte den 1. december 2010 om ibrugtagningstilladelse til ovennævnte togsæt.

Ansøgningen er baseret på typegodkendelsen angivet under [2] og DSB's dokumentation for opfyldelse af betingelserne opført i typegodkendelsen.

Afgørelse

Trafikstyrelsen skal herved meddele ibrugtagningstilladelse på følgende vilkår.

Gyldighed

Nærværende tilladelse er gyldig indtil videre forudsat at typegodkendelsen [2] er gyldig, at nedenstående betingelser er opfyldt og at der ikke er foretages større arbejder på togsættet.

Betingelser

- Trafikstyrelsen forudsætter at DSB inden drift med passagerer gennemfører en passende erfaringsdrift med togsættet uden passagerer og indsender rapportering fra erfaringsdriften, som redegør for, at sikker drift med passagerer kan foretages til Trafikstyrelsen.
- DSB skal under henvisning til dette dokument sikre, at Trafikstyrelsen er i besiddelse af en opdateret operatørtilladelse, før hhv. erfaringsdrift og passagerkørsel iværksættes.
- Evt. jernbanesikkerhedsmæssige hændelser skal straks meddeles Trafikstyrelsen

- Denne ibrugtagningstilladelse forudsætter, at togsættet vedligeholdes efter dokumentation under [12].
  Trafikstyrelsen forudsætter at jernbanevirksomheden DSB via sit sikkerhedsledelsessystem løbende sikrer, at togsættet vedligeholdes i overensstemmelse med den aktuelle anvendelse efter en af Trafikstyrelsen godkendt vedligeholdelsesforskrift for køretøjet.

Overensstemmelseserklæring

Det nævnte køretøj må benyttes på de strækninger og på de vilkår, der fremgår af nedenstående overensstemmelseserklæring(er), så længe disse er gyldige:

- Banedanmark: Overensstemmelseserklæring af 4.12.2009, TS journal nr. T541-001429, dok. nr. 1070267
- DSB: Overensstemmelseserklæring af 6.12.2007, TS journal nr. T541-001429, dok. nr. 1059006

Grundlag

1. DSB's Ansøgning dateret 1.12.2010, TS dok. nr. 1079422
2. Typegodkendelse MPTO/1 dateret 4.11.2010, TS journal nr. T541-000765, dok. nr. 1070107
3. DSB overensstemmelseserklæring for 'MPTO pakke 1' CoC_5627_101130, TS dok. nr. 1079429
4. Assessor kommentarskema: "Komformitetserklæring (CoC) for togsæt 27" revision 3, dateret 17.11.2010; TS dok. nr. 1079431
5. Review report STTA (NT+) and MTTA configuration, SRAC IC4-4624H dateret 22.11.2010, TS dok. nr. 1079424
6. Assessorrapport: IC4 programmet tiltak ifm. Feiltilstander i multippel kjøring, dateret 26-11-2010, TS dok. nr. 1079428
7. ACS rev. 45 (id 101 lukket), TS dok. nr. 1079468
8. TS' supplerende spørgsmål og DSB's svar, del af sagsbehandling dateret 10-12-2010, TS dok. nr. 1079451
9. Subsystem review – DRDT 46 app A – Train MG5627, dateret 1-12-2010, P000211371, TS dok. nr. 1079423.
10. Udkast Tilladelse til kommerciel drift med litra MG 5627, TS dok. nr. 1079433
11. Rapportering om sikkerhedsrelaterede forhold i forbindelse med afvikling af kørsel i overvåget prøvedrift med passagerer

med togsæt 21 og 22 og bilag, fremsendt 8.12.2010, TS. Dok. 1078848 og 1078847

12. Preventive Maintenance Programme AA046N9 version 10 (som fremgår af typegodkendelsens Grundlag [8]), TS dok. 1079593

13. Driftsinstruktion ODI MG version 5 gældende fra 6-9-2010, TS dok. 1079227

14. Gyldige overensstemmelseserklæring(er) jf. ovenstående.

Regelhenvisning

- Lov om jernbane § 21 k, jf. lovbekendtgørelse nr. 969 af 8. oktober 2009, senest ændret ved lovbekendtgørelse nr. 1249 af 11/11-2010
- Bekendtgørelse om godkendelse af rullende materiel (køretøjer) på jernbaneområdet nr. 686 af 2. juli 2009, herunder § 4

Klagevejledning

Denne afgørelse kan påklages til

Jernbanenævnet
Gammel Mønt 4, 1. sal
1171 København K

www.jernbanenaevnet.dk

Klager over afgørelser, som skal behandles af Jernbanenævnet, skal være indgivet til Jernbanenævnet senest 4 uger efter, at Trafikstyrelsens afgørelse er meddelt den pågældende, jf. § 17, stk. 1 i bekendtgørelse nr. 1549 af 17. december 2007 om Trafikstyrelsens opgaver og beføjelser. For indgivelse af en klage opkræver Jernbanenævnet et gebyr der kan ses på www. jernbanenaevnet.dk.

Med venlig hilsen

Katrine Frellsen
Civilingeniør

(Denne tilladelse er fremsendt elektronisk og er gyldig uden underskrift)

Distributionsliste:

DSB
sikkerhed@dsb.dk; ic4sig@dsb.dk

Banedanmark Trafiksikkerhed
trafiksikkerhed@bane.dk, sikkerhedogkvalitet@bane.dk

banedanmark

DSB
Jernbanesikkerhed
Sølvgade 40
1349 København K

07.09.2011

Trafikstyrelsen
Trafikplanlægning, UT

Overensstemmelseserklæring for Dieseltogsæt litra MG (IC 4)

Nedennævnte køretøj er vurderet egnet til kørsel på Banedanmarks spor i henhold til gældende normer, regler og bestemmelser.

Type: Dieseltogsæt litra MG (IC 4)

Køretøjsnr.: MG 5601-5683

Kategori: Dieseltogsæt med dansk togkontrolanlæg

Hoveddata:
Længde: 86 meter

Højest tilladte hastighed: 200 km/h

Ansat vognvægt: 171 tons

Bremsevægt (procent)
P-bremse: 291 tons (170 %)

Maksimal aksellast: 21,3 tons
Maksimal metervægt: 2,29 tons/meter

Grundlag for erklæringen:

- Ansøgning fra DSB dateret 30.08.2011
- Systemansvar hjul/skinne's notat, dateret 13.06.2006
- Systemansvarlig fritrumsprofil's vurdering af fritrumsprofil
- Systemansvarlig togkontrolanlæg's vurdering af typecertikat for ATC
- Systemansvarlig hjul/skinne's notat "IC 4, vurdering af løbeegenskaber med henblik på udstedelse af overensstemmelseserklæring", dateret 01.04.2009
- Systemansvarlig spor's tilladelse dateret 07.09.2011
- Overensstemmelseserklæring for samme togsæt dateret 04.12.2009.

Drift
Trafiksikkerhed
Amerika Plads 15
2100 København Ø

Telefon
8234 0000
Direkte
8234 5926

Telefax
8234 2556
jbb@bane.dk
www.banedanmark.dk

Journalnr.
11-06941
CVR 18632276

banedanmark

Gyldighed:
Indtil videre, under forudsætning af at der ikke sker ændringer af køretøjet, som har betydning for fremførsel og trafiksikkerhed.

Hvis der sker ændringer af ovenstående karakter skal der ansøges om ny overensstemmelseserklæring hos Banedanmark.

Overensstemmelseserklæring for samme tog dateret 04.12.2011 ophæves.

Særlige forhold:
Ved test- og prøvekørsler udover gældende sikkerhedsbestemmelser, skal der køres efter godkendte dispensationer fra Prøvekørselskommissionen

Togkontrolanlæg:
ATC skal være tillyst med tilfredsstillende resultat, og ATC typecertifikat skal være udarbejdet og godkendt af Banedanmarks systemansvarlige for mobilt ATC inden idriftsættelse.

Hjul/skinneforhold:
- Maksimal tilladelig hastighed er **V** ≤ 200 km/h
- Maksimal tilladelige manglende overhøjde er **I** = 160 mm
- Dette betyder, at IC4 kan anvende hastighedsprofil for ”særlige togsæt”.

Andet:
Da toget ikke har puffer og traditionelt træktøj, skal der altid medbringes en nødkobling, således at toget kan fjernes ved havari.

Godkendelse af materiellet:
Trafikstyrelsen skal godkende materiellet, før dette må anvendes i Danmark.

Som udsteder:

Jens Bonde
Materielkoordinator

Overensstemmelseserklæringen er sendt via e-post og er gyldig uden underskrift.

Bilag 2.8
Havarikommissionen
611-2011-23

Tilladelse til kommerciel drift med litra MG 5621, 5622, 5624, 5627, 5629, 5632, 5635, 5636, 5639, 5640, 5641, 5643 og 5644 (konfiguration MPTO Pakke 1).

Forudsætninger:

- *Betinget Typegodkendelse MPTO P1 (Litra MG)* (Trafikstyrelsen, 04.11.2010, Journal T541-000765, dok. nr. 1070107).
- Ibrugtagningstilladelse i henhold til Bilag 1: *Oversigt over ibrugtagningstilladelser fra Trafikstyrelsen*.
- Overensstemmelseserklæring for kørsel på DSB's infrastruktur, 06.12.2007.
- Overensstemmelseserklæring for dieseltogsæt litra MG (IC4) (Banedanmark, 04.12.2009 (journal nr. 305-0064/jbb)).
- "Godkendelse af ATC-typecertifikat for litra MG" (Banedanmark, 22.06.2010).
- SIN DSB Cirkulære 131/2010: Supplerende forholdsregler for Litra MG vedr. automatkobling, DSB Jernbanesikkerhed, 28.10.2010.

Omfang:

Tilladelsen omfatter kommerciel drift med litra MG i konfiguration MPTO Pakke 1 på Banedanmarks og DSB's infrastruktur med følgende undtagelse:

- Togsættet må ikke befare TIB strækning 29 Lunderskov-Esbjerg.
- Planmæssig passagerudveksling må kun finde sted på stationer, hvor diagonalafstand mellem perron og trin ≤ 350 mm.

Generelle betingelser:

1. Togsættet skal fremføres i overensstemmelse med godkendte driftsinstruktioner (ODI) til litra MG.

2. Kun togsæt med konfiguration MPTO Pakke 1 må sammenkobles. Der må maksimalt sammekobles to togsæt. Togsæt med konfiguration MPTO Pakke 1 er kendetegnet ved **ikke** at have synlig rød mærkat i frontruden.

3. Togsættet skal altid medgives MG-uddannet tog-/lokomotivførerpersonale. Det pågældende personale skal være specielt instrueret om forhold vedrørende multipelkørsel.

4. Togsættet skal vedligeholdes i overensstemmelse med leverandørens præventive eftersynsprogram ("Preventive Maintenance program"). Vedligeholdelsesarbejdet skal styres iht IC4 Programmets QA system Procedure 13.

5. Såfremt der foretages ændring af køretøjets myndighedsgodkendte konfiguration, skal køretøjet tages ud af drift og **Sikkerhedsstyring og godkendelse** (under DSB Vedligeholdelse, Teknik) skal underrettes på ic4sig@dsb.dk.

6. Alle jernbanesikkerhedsmæssige hændelser skal straks indmeldes til DSB Risk Management, Uheldsundersøgelser. Såfremt jernbanesikkerheden er eller har været truet, skal driften straks indstilles.

Særlige litrabetingelser:

a. Før togsættet indsættes i drift første gang , skal "IC4 Program Drift & Vedligehold" gennemføre DRDT 46 (Safety Functional Test), appendix A uden anmærkninger.

IC4 Program

DSB
IC4 Program
Otto Busses Vej 5
DK-2450 København SV

Telefon 24 68 32 25
E-mail ic4sig@dsb.dk
Internet www.dsb.dk

Vores ref.: BCV
Journal nr. Rb 001.703
Dok. Nr P000213369

Fordeles til:

DSB Trafikplanlægning

DSB Fjern- og Regionaltog
- Togproduktion
- Togpersonale
- Togvedligeholdelse
- IC4 Program

DSB Risk Management
- Jernbanesikkerhed
- Uheldsundersøgelser

b. Togsæt, som er opgraderet med godkendte ændringer, jf. bilag 2, må sættes i drift når en opdateret konformitetserklæring (CoC) er indsendt til Sikkerhedsstyring og godkendelse (under DSB Vedligeholdelse, Teknik) ic4sig@dsb.dk.

c. I forbindelse med passagerdrift må der ikke udføres teknisk funktionsafprøvning under kørsel eller stationsophold.

d. Monitoreringsudstyr, bærbare PC'er eller andet måleudstyr må kun være tilkoblet togets styresystem når togsættet befinder sig i værkstedet eller ifm. prøvekørsel under ledelse af "IC4 Program Drift & Vedligehold". Håndtering af overvågningsudstyr skal ske iht. DSB monitoreringsprocedure "Monitoring equipment" af 04.09.2008.

e. Serviceteknikere ansat i "IC4 Program Drift & Vedligehold" må observere togsættets tekniske installationer under drift. Alle andre serviceteknikere skal være under ledsagelse af personale fra "IC4 Program Drift & Vedligehold" eller have skriftlig tilladelse fra enten "IC4 Program Drift & Vedligehold" eller IC4 SIG.

f. "IC4 Program Drift & Vedligehold" skal foretage følgende klargøring og inspektion i henhold til "Inspektionsskema MPTO RTR og Blandet trafik Daglig og 7 døgns (P000174697)", rev. 2.:

- Dagligt før dagens kørsel påbegyndes: Klargøring
- En gang om ugen: Udvidet inspektion

For disse aktiviteter gælder følgende:

- Kvittering for klargøring og inspektion noteres i SAP.
- Udfyldte checklister opbevares af "IC4 Program Drift & Vedligehold".
- Alle afvigelser skal rapporteres til IC4 SIG ic4sig@dsb.dk ved indsendelse af checklister.

g. Alle teknikere og reparatører eller lign, som har adgang til togsættet, skal være instruerede og godkendt til det pågældende arbejde af "IC4 Program Drift & Vedligehold". Indgreb i togsættets sikkerhedsmæssige funktioner, herunder ATC udrustningen, ikke må ske uden forudgående aftale med "IC4 Program Drift & Vedligehold" jævnfør "Instruks før indgreb i IC4 togsættets sikkerhedsmæssige funktioner" af 13.06.2007.

h. Såfremt der skiftes sikkerhedskritiske komponenter eller udføres vedligeholdelsesarbejder af sikkerhedsmæssig betydning, skal testomfanget specificeres af "IC4 Program Drift & Vedligehold" i MPTO dokumentationen og efterfølgende skal testomfanget verificeres/godkendes af "IC4 Program Test" før togsættet sættes i drift igen.

Efter udført vedligeholdelse, indgreb eller ændringer, som berører systemer med sikkerhedsmæssig funktion, skal "IC4 Program Drift & Vedligehold" sikre at DRDT 46 (Safety Functional Test), appendix A gennemføres uden anmærkninger.

- Kvittering for det udførte arbejde og de tilhørende test noteres i SAP
- Udfyldte testrapporter opbevares af "IC4 Program Drift & Vedligehold".

Ophævelse af tidligere tilladelse:

Denne tilladelse erstatter *Tilladelse til kommerciel drift med litra MG 5621, 5622, 5624, 5627, 5629, 5632, 5635, 5636, 5639 og 5643 (konfiguration MPTO Pakke 1)* af 15. april 2011.

Gyldighed:

Tilladelsen er gyldig indtil videre, dog må togsættet maksimalt køre 89.999 km.

Navn: ______________________
Bent C Van

DSB IC4 Program/SIG: 26. maj 2011

Bilag 1: Oversigt over ibrugtagningstilladelser fra Trafikstyrelsen:

Køretøj	Reference
MG 5621	*Ibrugtagningstilladelse til DSB litra MG 5621 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 07.03.2011, journal nr. T541-001448, dok. nr. 1100679).
MG 5622	*Ibrugtagningstilladelse til DSB litra MG 5621 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 29.03.2011, journal nr. T541-001448, dok. nr. 1109291).
MG 5624	*Ibrugtagningstilladelse til DSB litra MG 5624 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 17.12.2010, journal nr. T541-001448, dok. nr. 1081841).
MG 5627	*Ibrugtagningstilladelse til DSB litra MG 5627 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 10.12.2010, journal nr. T541-001448, dok. nr. 1079341).
MG 5629	*Ibrugtagningstilladelse til DSB litra MG 5629 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 20.12.2010, journal nr. T541-001448, dok. nr. 1082529).
MG 5632	*Ibrugtagningstilladelse til DSB litra MG 5632 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 17.12.2010, journal nr. T541-001448, dok. nr. 1081881).
MG 5635	*Ibrugtagningstilladelse til DSB litra MG 5635 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 07.01.2011, journal nr. T541-001448, dok. nr. 1086989).
MG 5636	*Ibrugtagningstilladelse til DSB litra MG 5636 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 01.02.2011, journal nr. T541-001448, dok. nr. 1092484).
MG 5639	*Ibrugtagningstilladelse til DSB litra MG 5639 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 07.02.2011, journal nr. T541-001448, dok. nr. 1093657).
MG 5640	*Ibrugtagningstilladelse til DSB litra MG 5640 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 24.05.2011, journal nr. T541-001448, dok. nr. 1132789).
MG 5641	*Ibrugtagningstilladelse til DSB litra MG 5641 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 24.05.2011, journal nr. T541-001448, dok. nr. 1132787).

MG 5643	*Ibrugtagningstilladelse til DSB litra MG 5643 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 15.04.2011, journal nr. T541-001448, dok. nr. 1113593).
MG 5644	*Ibrugtagningstilladelse til DSB litra MG 5644 i konfiguration MPTO Pakke 1*, (Trafikstyrelsen, 24.05.2011, journal nr. T541-001448, dok. nr. 1132771).

Bilag 2:

Oversigt over ændringer, som er internt godkendt jf. §13 i "Bekendtgørelse om godkendelse af rullende materiel (køretøjer) på Jernbaneområdet" (BEK nr. 686 af 02/07/2009).

ID	CFG nr.	Reference til assessorrapport/godkendelse (titel/dato)	IC4 Programmet, DCD Konfigurationsdokument for "MPTO Pakke 1" P000174022
1.	CFG-DSB0026	Assessor kommentarskema: "Indstilling til assessment af CFG 0026 Viskervasker" (P000210957)	Revision 2
2.	CFG-DSB0065	Intern assessorrapport IC 4 programmet CFG-DSB0065 Aflastningsventil, (P000213890)	Revision 2
3.	CFG-DSB0079	Intern assessorrapport IC4 programmet CFG-DSB0079 PIS software 1.21, (P000215737)	Revision 3
4.	CFG-DSB0032	Intern assessorrapport CFG-DSB0032 Blader i undervogn, (P000216217)	Revision 4
5.			

Bilag 2.9
Havarikommissionen
611-2011-23

DSB - IC4 DMU TYPE 1

HAZARD LOG

(Annex 12 of Safety Case document P/N STE RAM AA02RX5)

REVISION	CRITICALITY LEVEL	DATE
10	NA	09 April 2009
PREPARED	**VERIFIED**	**APPROVED**
IC4 RAM & SAFETY ENGINEER	IC4 RAM & SAFETY ENGINEER	ANSALDOBREDA RAMS & SAFETY MANAGER

DMU – IC4

Bilag 2.10
Havarikommissionen
611-2011-23

DRDT 40

PROVA DI SERIE SUL VEICOLO
VEHICLE ROUTINE TEST

BRAKING TEST

TEST REPORT

ACCORDING TO PROCEDURE DRDT 40 REV.5			
Train no. 27			
M1C	**T2HK**	**T3**	**M4C**
N°TELAIO AA01KVZ/071/B UNDERFRAME No	N°TELAIO AA01KW0/029/0 UNDERFRAME No	N°TELAIO AA01KW1/024/0 UNDERFRAME No	N°TELAIO AA01KVZ/066/B UNDERFRAME No

Data

Wheel diameter (Ø)	860
Weight=163042 kg	
Rotating mass=11708 kg	
Weather condition	Cloudy and very wet and rainy
Location of the test **Line from km** 58 **to km** 81	
Environmental temperature[°C]	0-5 c°
Wind speed	Windy

Table of the results

Reference procedure	Description	Expected value	Actual Value
9.1.2	5S33 pressed	MTB applied	OK
9.1.2	5S33 not pressed	MTB not applied	OK
9.1.3	Bit 4 of board RDI6 CCU	0⇨1	OK
9.1.4a	Bit 17 of board RDI2 CCU	0⇨1	OK
9.1.4b	Bit 4 of board RDI6 CCU	0⇨1	OK

Braking Mode

Si ottiene posizionando in posizione (7ª) di massima frenatura di esercizio il manipolatore; in questo risulterà attiva sia la frenatura EP, sia la frenatura HD.

It is obtained by setting the master controller to max. service braking(7th) position; both the EP braking and the HD braking shall be applied.

Maximum service brake 100% HD ref proc. 9.2

Data	08/11-10
Wheel diameter Ø	860

Nominal values				
Initial Speed(Vnom)	Brake distance m			
Km/h	Ø 860	Ø 840	Ø 820	Ø 800
120	583	572	561	550

Measured values						
Manned cab	Gradient	Initial speed Vmes	Stopping distance		**Brake duration [sec]**	File Identif Number
		Km/h	Smes[m]	S_c [m]		
M1C	0%	118.7	495	505,9	30.12	92120M1
M4C	1.33%	120.0	520	525,99	30.70	92120M4

Acceptance criteria			
speed	Average S_c	Criteria	Expected brake distance (f) Ø +5%
120	515,946	≤	612,15

Braking Mode

Si ottiene posizionando il master controller in 8° posizione

It is obtained setting the master controller in 8th position

Emergency brake with EP and Magnetic track brake ref proc. 9.3

	Data 08/11-10
Wheel diameter Ø	860

Nominal values				
Initial Speed(Vnom)	Brake distance m			
Km/h	Ø 860	Ø 840	Ø 820	Ø 800
120	473	466	458	448

Measured values						
Manned cab	Gradient	Initial speed Vmes	Stopping distance		**Brake duration**	File Identif Number
		Km/h	Smes[m]	S_c [m]	**[sec]**	
M1C	1.33‰	118.3	470	488.78	27.30	93120M1
M4C	0‰	120.1	415	414.31	22.30	93120M4

Acceptance criteria			
speed	Average S_c	Criteria	Expected brake distance (f) Ø +5%
120	451.545	≤	496.65

Braking Mode

L'applicazione del freno a pattino sarà inibito isolando i selettori RIP-1 in M1C e RIP-2 in M4C (Canale 10 di Rdi6 della CCU alto). Questo si ottiene posizionando il master controller in 8th posizione.

The track brake application will be inhibited by cutting out the RIP-1 in M1C and RIP-2 in M4C selector switches (channel 10 of Rdi6 of the CCU is high).
It is obtained setting the master controller in 8th position.

Emergency brake with EP and without Magnetic track brake ref proc 9.4

	Data 08/11-10
Wheel diameter Ø	860

Nominal values				
Initial Speed(Vnom)	**Brake distance m**			
Km/h	Ø 860	Ø 840	Ø 820	Ø 800
120	542	531	521	511
160 (*)	927.35			
180	1158	1133	1109	1086

Measured values						
Manned cab	Gradient	Initial speed Vmes	Stopping distance		**Brake duration [sec]**	File Identif Number
		Km/h	Smes[m]	S_c [m]		
M1c	0%	118.8	415	423,43	25.80	94120m1
M4c	1.33%	117.0	535	569.81	30.70	94120M4a
M1c	1.33%	157.0	840	881.89	37.30	94160M1
M4c	0%	157.0	920	955.5	39.10	94160M4
M1c						
M4c						

Acceptance criteria			
speed	Average S_c	Criteria	Expected brake distance (f) Ø +5%
120	496.62	≤	569.10
160 (*)	918.69	≤	973.72
180		≤	

(*) To be perfoformed only with speed restriction

Braking Mode

La modalità di frenatura d'emergenza puramente pneumatica interviene quando le BCU ed il magnetic track brake sono inibiti, e si preme il pulsante a fungo (5S20). Al fine rendere nulla l'azione delle BCU, il loro contributo alla frenatura sarà inibito scollegando le elettrovalvole IRV. Qualunque operazione, in nessun caso, deve provocare l'inefficienza o l'inibizione, anche temporanea, del sistema WSP (Wheel Slide Protection)

The purely pneumatic emergency brake mode comes into play when the BCU and the magnetic track brake are blocked, and one presses the mushroom push-button (5S20). In order to annul the action of the BCU, their contribution to braking will be blocked by disconnecting the solenoid valves IRV. No operation must in any case lead to the inefficiency, even temporary, of the WSP (Wheel Slide Protection) system.

Safety brake (IP only) ref proc 9.5

	Data 08/11-10
Wheel diameter Ø	860

Nominal values				
Initial Speed(Vnom)	Brake distance m			
Km/h	Ø 860	Ø 840	Ø 820	Ø 800
120	542,47			
160 (*)	927,35			
180	1158	1133	1109	1086

Measured values						
Manned cab	Gradient	Initial speed Vmes	Stopping distance		**Brake duration [sec]**	File Identif Number
		Km/h	Smes[m]	S_c [m]		
M1c	0%	122.0	460	445.04	26.80	95120M1
M4c	1.33%	120.2	490	493.65	27.30	95120M4
M1c	1.33%	158.6	885	910.80	37.50	95160am1
M4c	0%.	158.7	740	752.17	33.20	95160am4
M1c						
M4c						

Acceptance criteria			
speed	Average S_c	Criteria	Expected brake distance (f) Ø +5%
120	469.346	≤	569.593
160 (*)	831.487	≤	973.717
180		≤	

(*) To be perfoformed only with speed restriction

Braking Mode

La modalità di frenatura d'emergenza puramente pneumatica interviene quando le BCU sono inibite, e si preme il pulsante a fungo (5S20). Al fine di rendere nulla l'azione delle BCU, il loro contributo alla frenatura sarà inibito scollegando le elettrovalvole IRV. Qualunque operazione, in nessun caso, deve provocare l'inefficienza o l'inibizione, anche temporanea, del sistema WSP (Wheel Slide Protection)

The purely pneumatic emergency brake mode comes into play when the BCU are blocked, and the mushroom push-button (5S20) is pressed. In order to annul the action of the BCU, their contribution to braking will be blocked by disconnecting the solenoid valves IRV No operation must in any case lead to the inefficiency, even temporary, of the WSP (Wheel Slide Protection) system

Safety brake without EP and with Magnetic track brake ref proc. 9.6

Data 08/11/10	
Wheel diameter Ø	860

Nominal values				
Initial Speed(Vnom)	Brake distance m			
Km/h	Ø 860	Ø 840	Ø 820	Ø 800
160 (*)	845,43			
180	1003	985	968	945

Measured values						
Manned cab	Gradient	Initial speed Vmes	Stopping distance		Average deceleration [m/sec^2]	File Identif Number
		Km/h	Smes[m]	S_c [m]		
M1c	0%	158.4	660	673.4	1.48	96160m1
M4c	1.33%	159.2	825	841.96	1.41	96160m4
M1c	1.33%	158.6	700	718.72	1.54	96160a m1
M4c	0%	159.5	725	729.55	1.50	96160a m4

Acceptance criteria			
speed	Average S_c	Criteria	Expected brake distance (f) Ø+5%
160 (*)	740.9075	≤	887.7015
180		≤	

(*) To be perfoformed only with speed restriction

Braking Mode

Si ottiene rilasciando tutti i safety devices che segnala la presenza vigile del driver (5S91; 5S92; 5S96). Si tenga presente che questa modalità è preceduta da tempi di attesa, che consentono al Driver di porre in essere delle azioni, per evitare l'intervento della frenatura di sicurezza. In questa procedura si terrà conto solo, ed esclusivamente, delle prestazioni che si otterranno, all'esaurimento dei tempi d'attesa

This is obtained by releasing all safety devices signalling the driver's wide-awake presence (5S91; 5S92; 5S96). It should be kept in mind that this mode is preceded by waiting times which allow the Driver to carry out some operations in order to avoid the application of emergency braking. This procedure will only and exclusively take account of the performances which will be reached until the waiting times have elapsed.

Emergency brake requested by DSD ref. Proc.9.7

	Data 08/11-10 – 09/11-10
Wheel diameter Ø	860

Nominal values				
Initial Speed(Vnom)	Brake distance m			
Km/h	Ø 860	Ø 840	Ø 820	Ø 800
120	473	466	458	448

Measured values						
Activated by	Gradient	Initial speed Vmes	Stopping distance		**Brake duration [sec]**	File Identif Number
		Km/h	Smes[m]	S_c [m]		
M1C	0 %	118.3	470	483.61	26.40	97120M1a
M4C	1.33%	119.5	395	401.82	22.70	97120M4

Acceptance criteria			
speed	Average S_c	Criteria	Expected brake distance (f) Ø+5%
120	442.714	≤	496.65

Mode

Condurre il mezzo su di uno declivio (5‰) a velocità maggiore di 5 km/h e minore di 10 Km/h.
Porre il master controller in IDLE e verificare che il veicolo si arresti.
Settare il master controller in trazione e verificare che il veicolo riprenda la marcia senza dare luogo ad indietreggiamenti (no roll-back)

Move the vehicle up to a slope (5‰) at a speed higher than 5 km/h and lower than 10 Km/h.
Set the master controller to IDLE and check that the vehicle stops.
Set the master controller to traction and check that the vehicle starts moving forwards again, with no roll back.

Reference procedure	Master controller	Expected value	Actual Value
9.8.2	IDLE position	Stopping	OK
9.8.2	Traction position	No roll-back	OK

Software revision list

Train computer	**CCU**	DSCa-33h
	RIO	DSR2-20e

BCU	DK14 114

Power pack	**Engine controller**	Software	1.5.6
		Dataset	156br 08-01
	Trasmission	Software P1	V33_10
		Software P2	P2V33_7
		Dataset P1	1I43103 f.hex
		Dataset P2	2I433705.hex
	Intarder	Intarder ECU	/
		Data set	6009371088

IDU	23.39

Elenco strumenti di misura / Instruments of measure list

Tipo /Type	Serial number	End Validation of calibration

Notes

Annexes

-SEE ATTACHED GRAPHICS.
- CD-ROM WITH RECORDING DATA.

Open items list

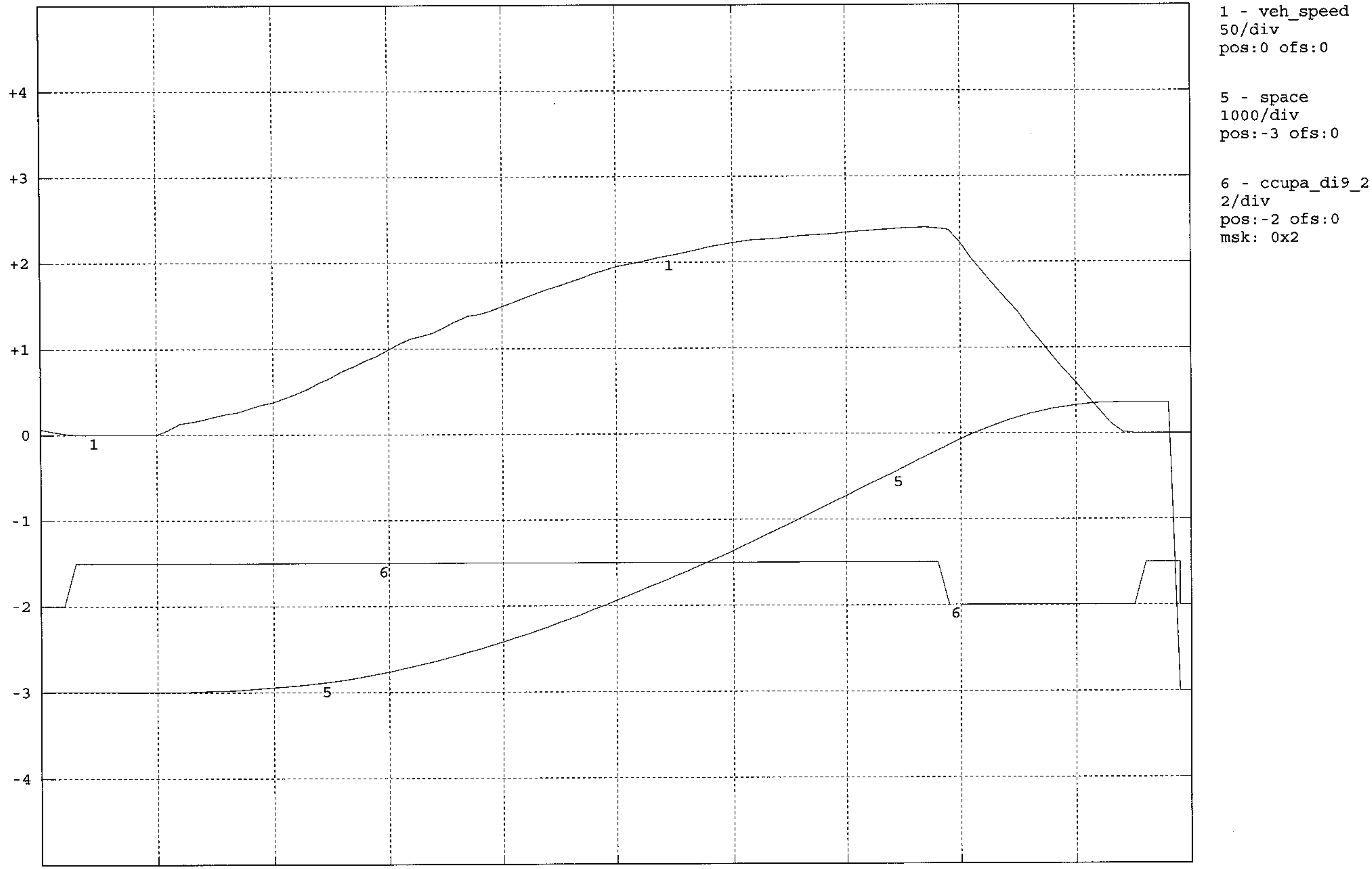
End results

Comply	Completely executed	Not comply	Not Completely executed
☒	☒	☐	☐

	Cognome e nome	Firma
AnsaldoBreda Checker	Heine Larsen	Heine Lar
Customer inspector	O. Kandrup	DSB
Data/ date	09 - 11 - 2010	

92120m1

ANSALDO

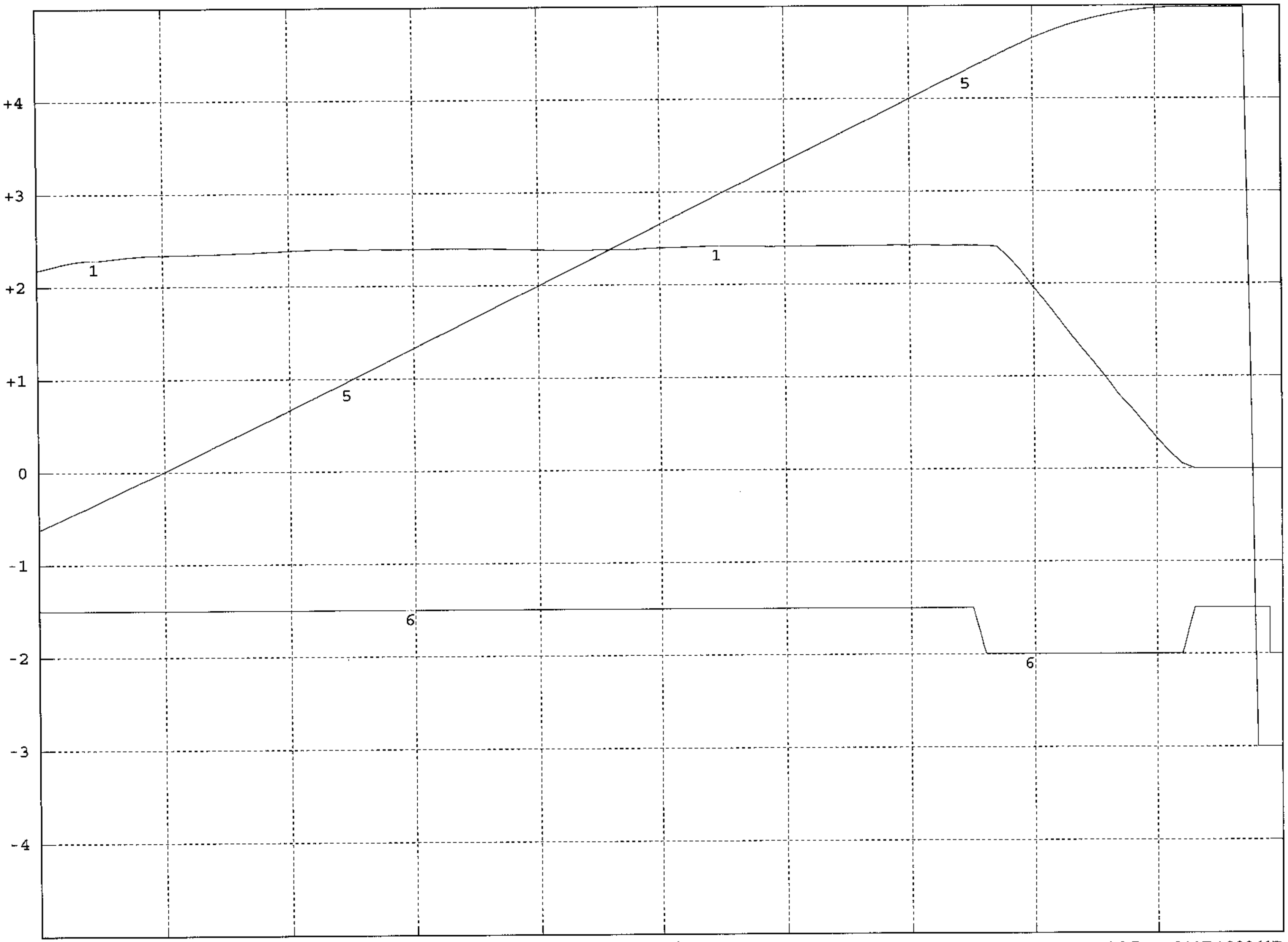


Acquisition date: 08 nov 2010 - 13:24:42
Printing date: 26 nov 2010 - 19.21.59

ATRterm 4.2 Pro - 211EA23061B

92120m4

ANSALDO



1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

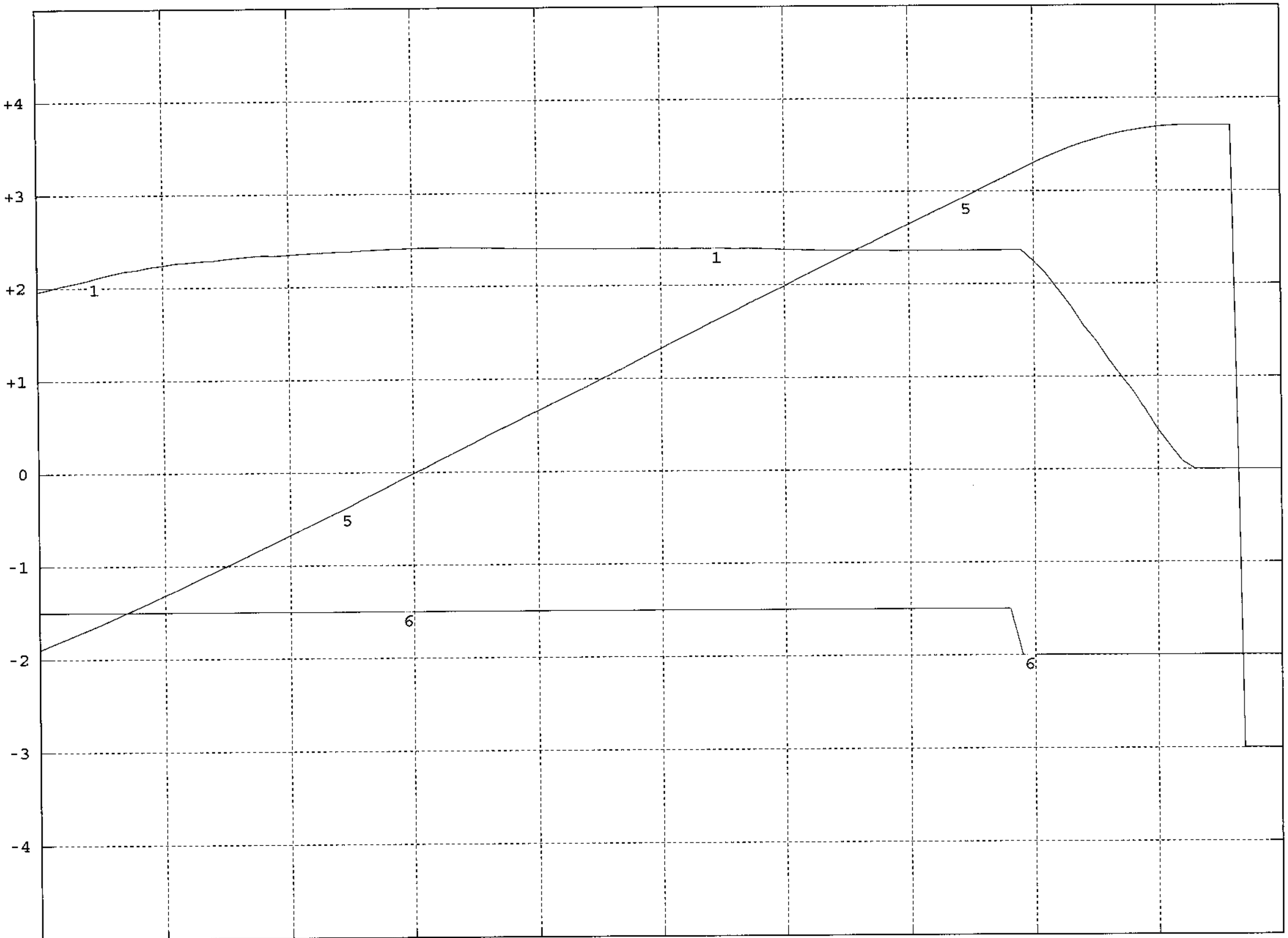
6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

Acquisition date: 08 nov 2010 - 17:10:44
Printing date: 26 nov 2010 - 19.22.30

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

93120m1



1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

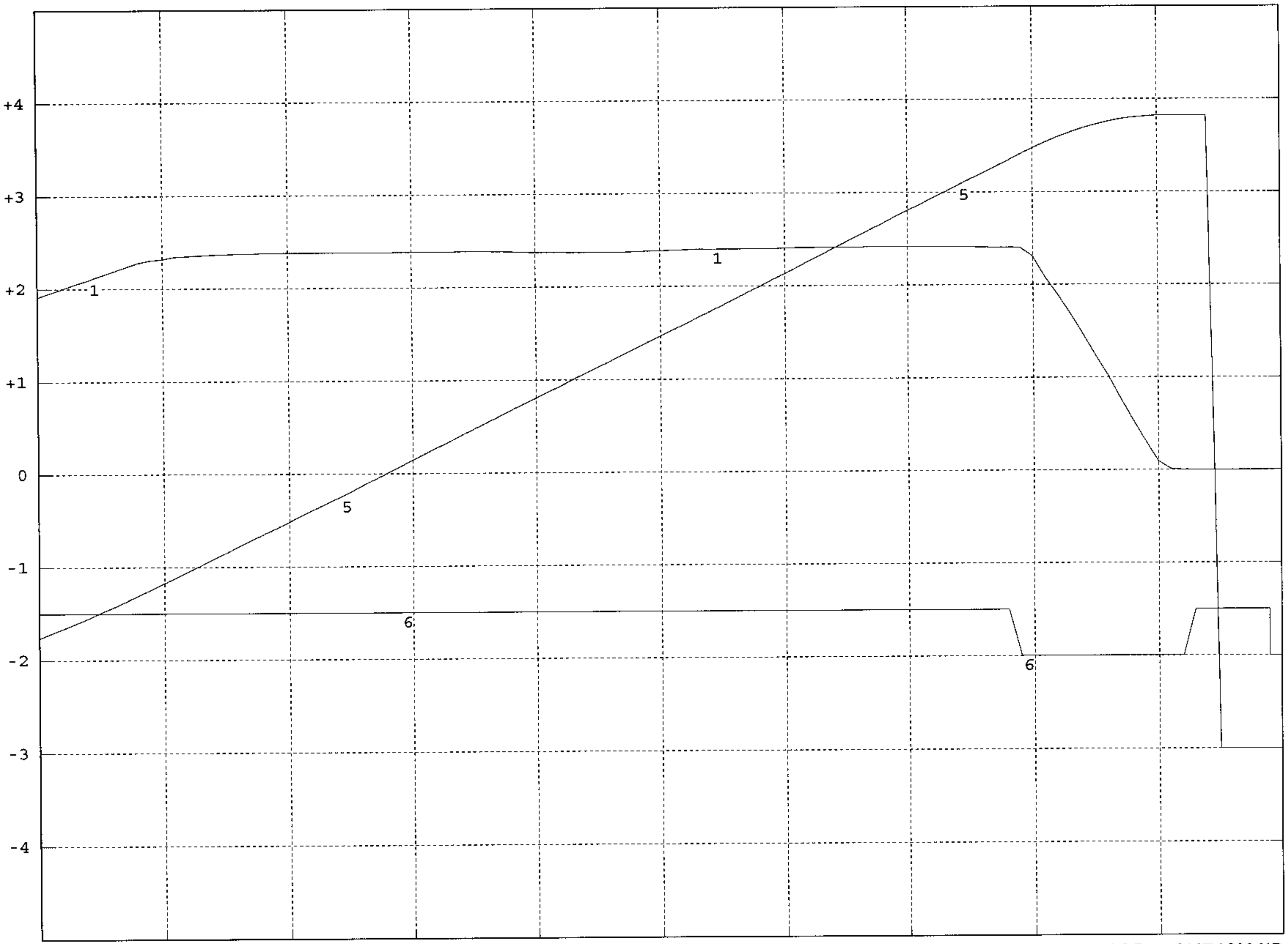
6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

Acquisition date: 08 nov 2010 - 13:29:31
Printing date: 26 nov 2010 - 19.23.00

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

93120m4



ANSALDO

1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

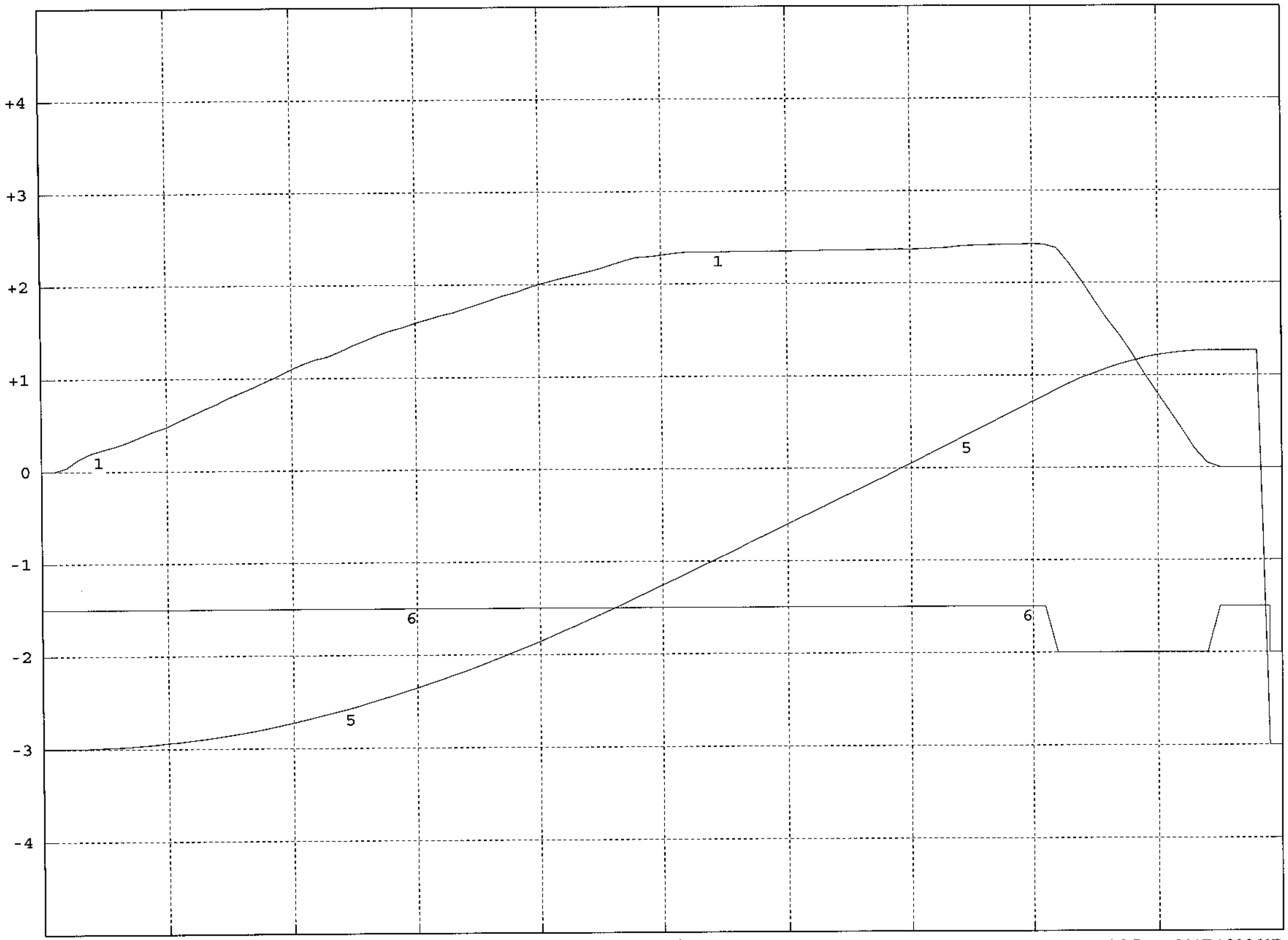
Acquisition date: 08 nov 2010 - 17:15:42
Printing date: 26 nov 2010 - 19.25.29

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

94120m1

ANSALDO



1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

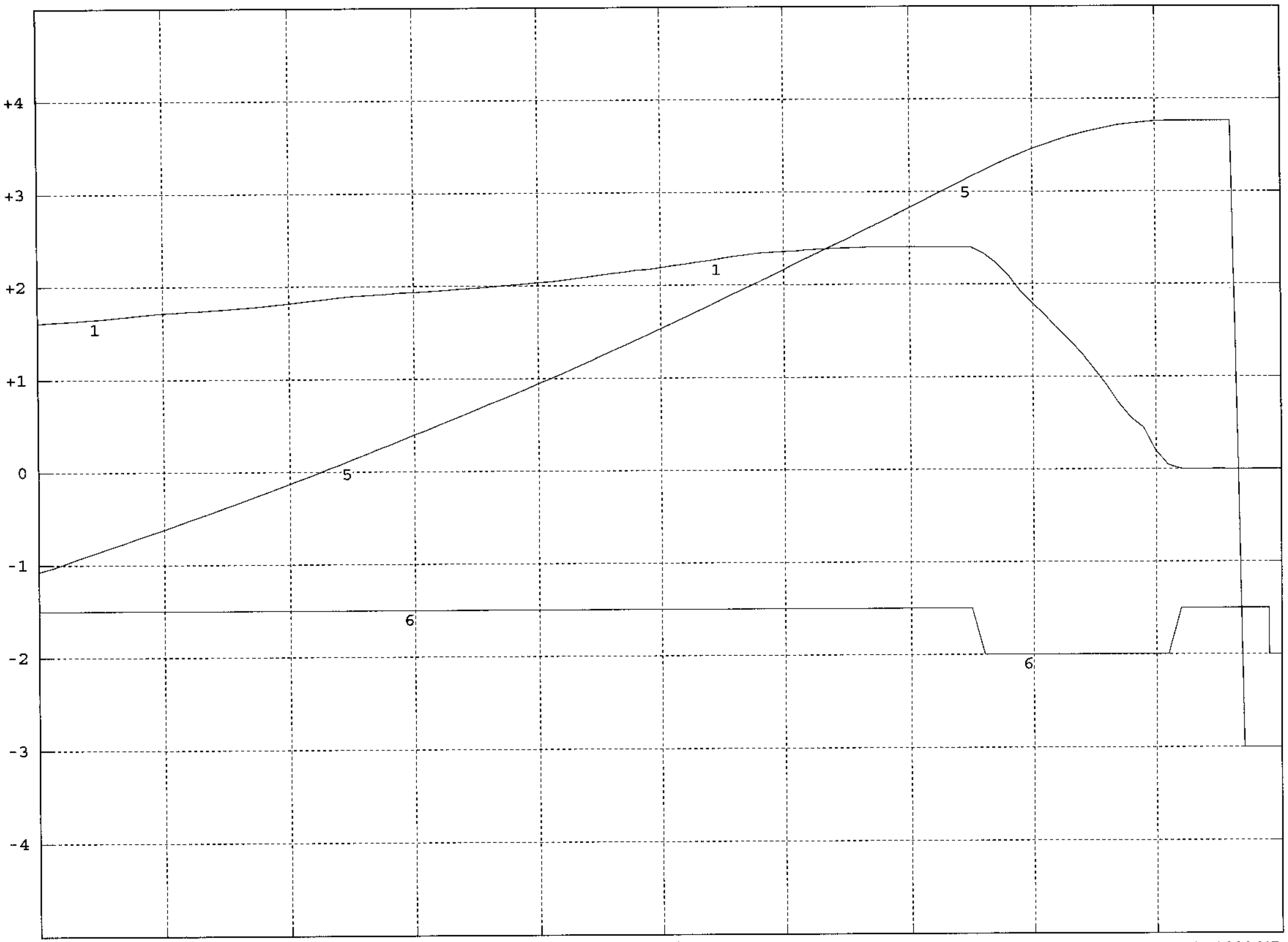
Acquisition date: 08 nov 2010 - 17:33:27
Printing date: 26 nov 2010 - 19.27.14

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

94120m4a

ANSALDO



1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

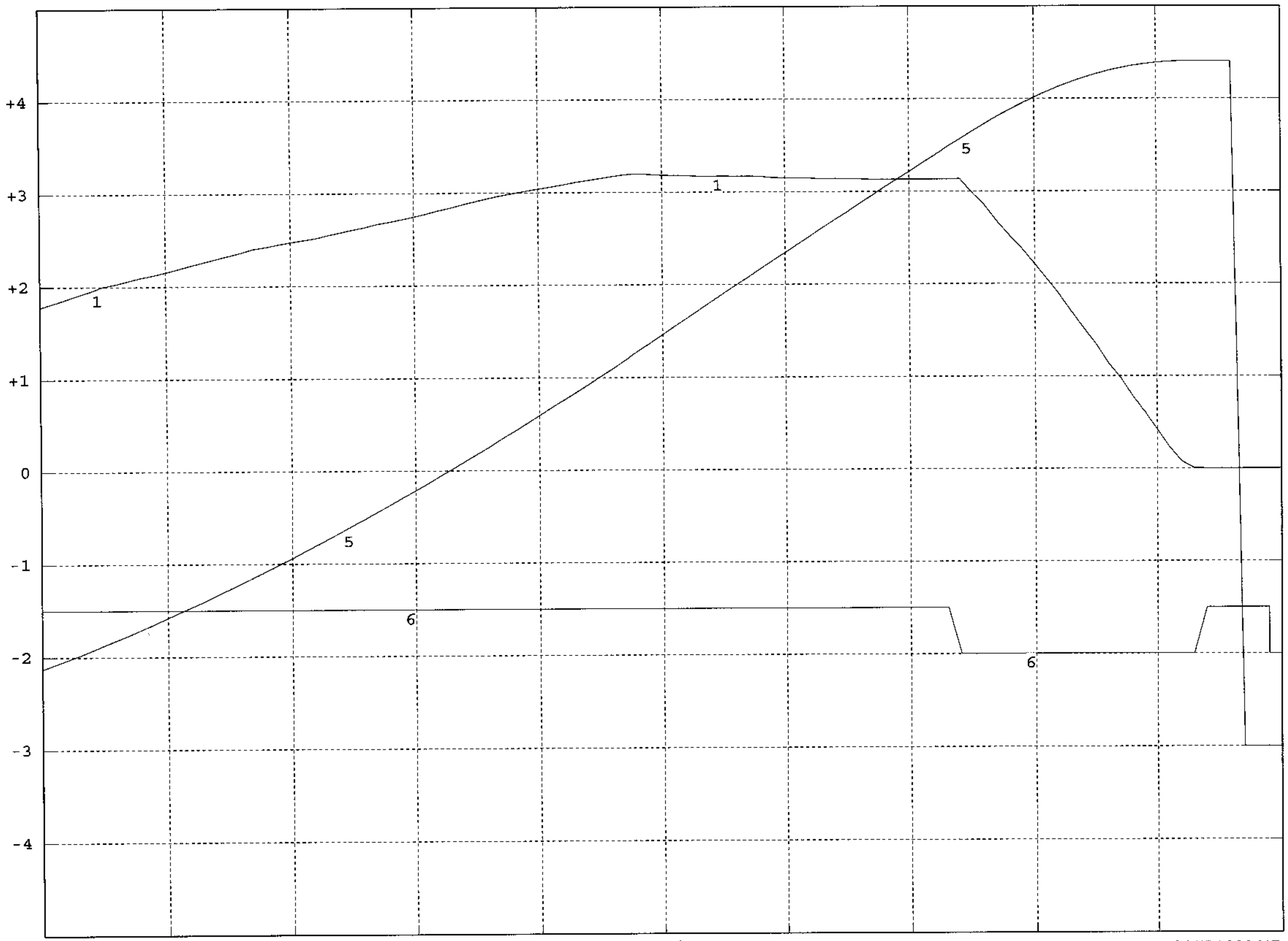
6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

Acquisition date: 08 nov 2010 - 18:17:54
Printing date: 26 nov 2010 - 19.30.02

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

94160m1



1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

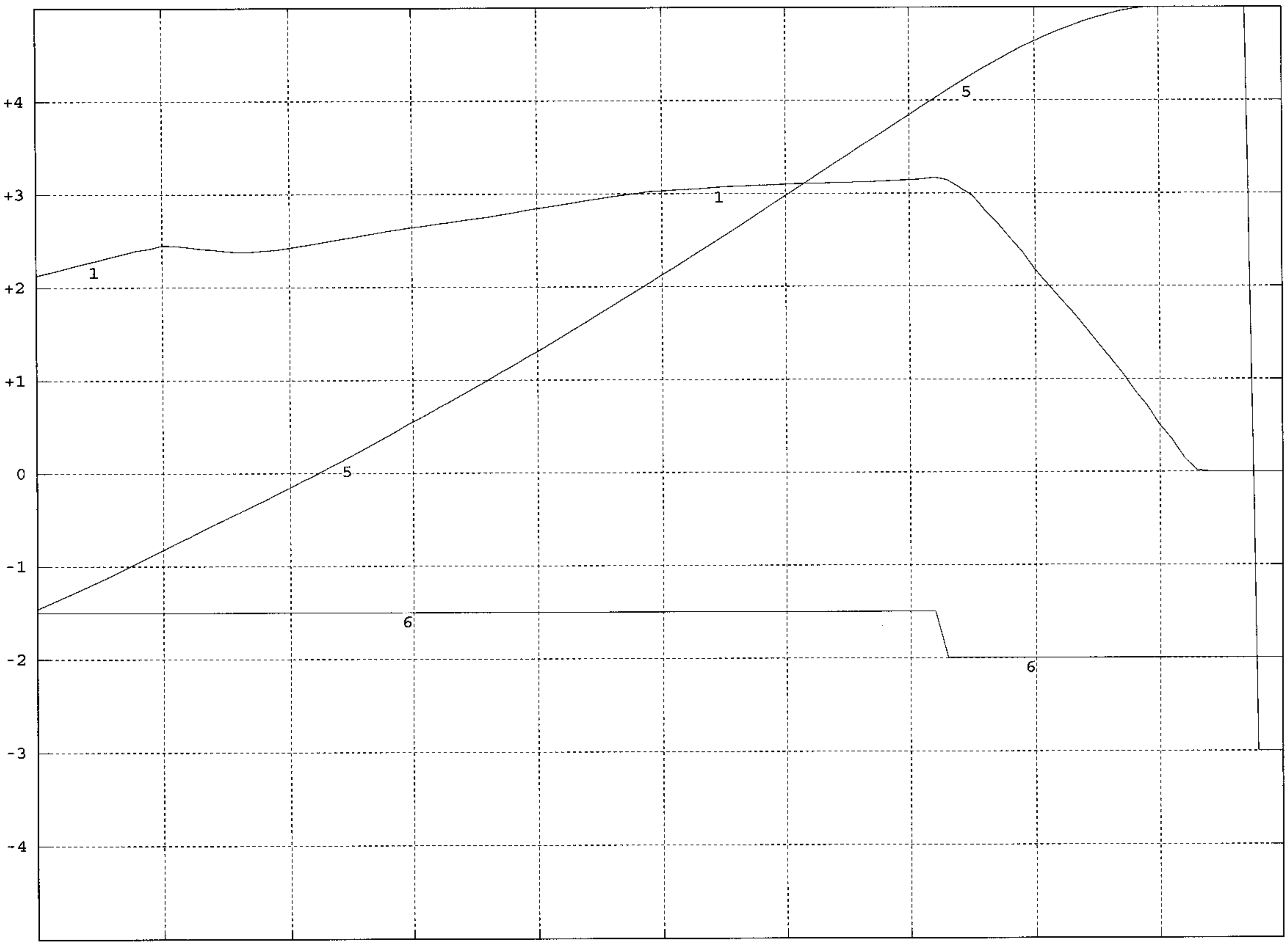
6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

Acquisition date: 08 nov 2010 - 17:38:08
Printing date: 26 nov 2010 - 19.57.00

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

94160m4



ANSALDO

1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

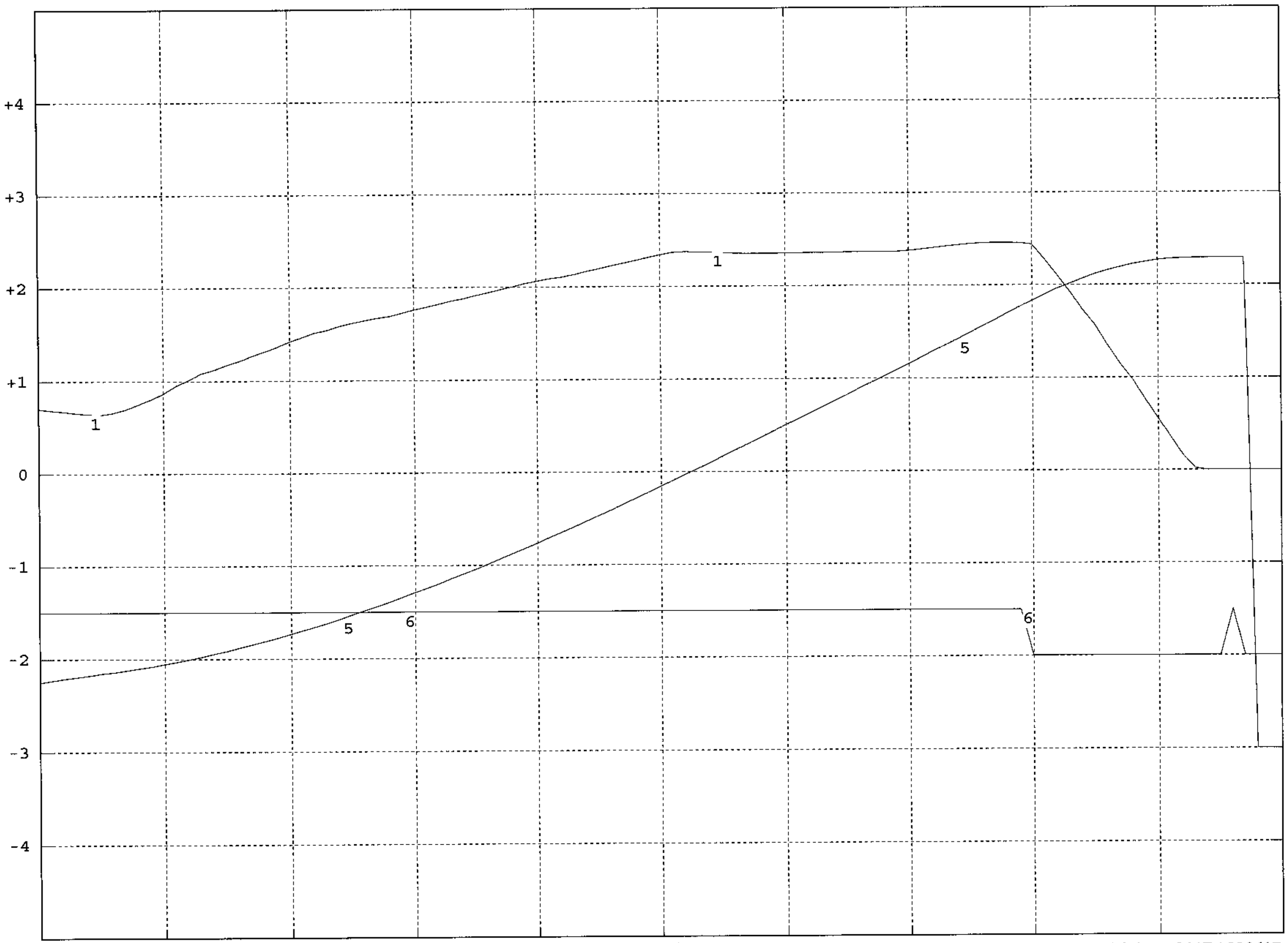
6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

Acquisition date: 09 nov 2010 - 14:32:01
Printing date: 26 nov 2010 - 19.57.32

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

95120m1



1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

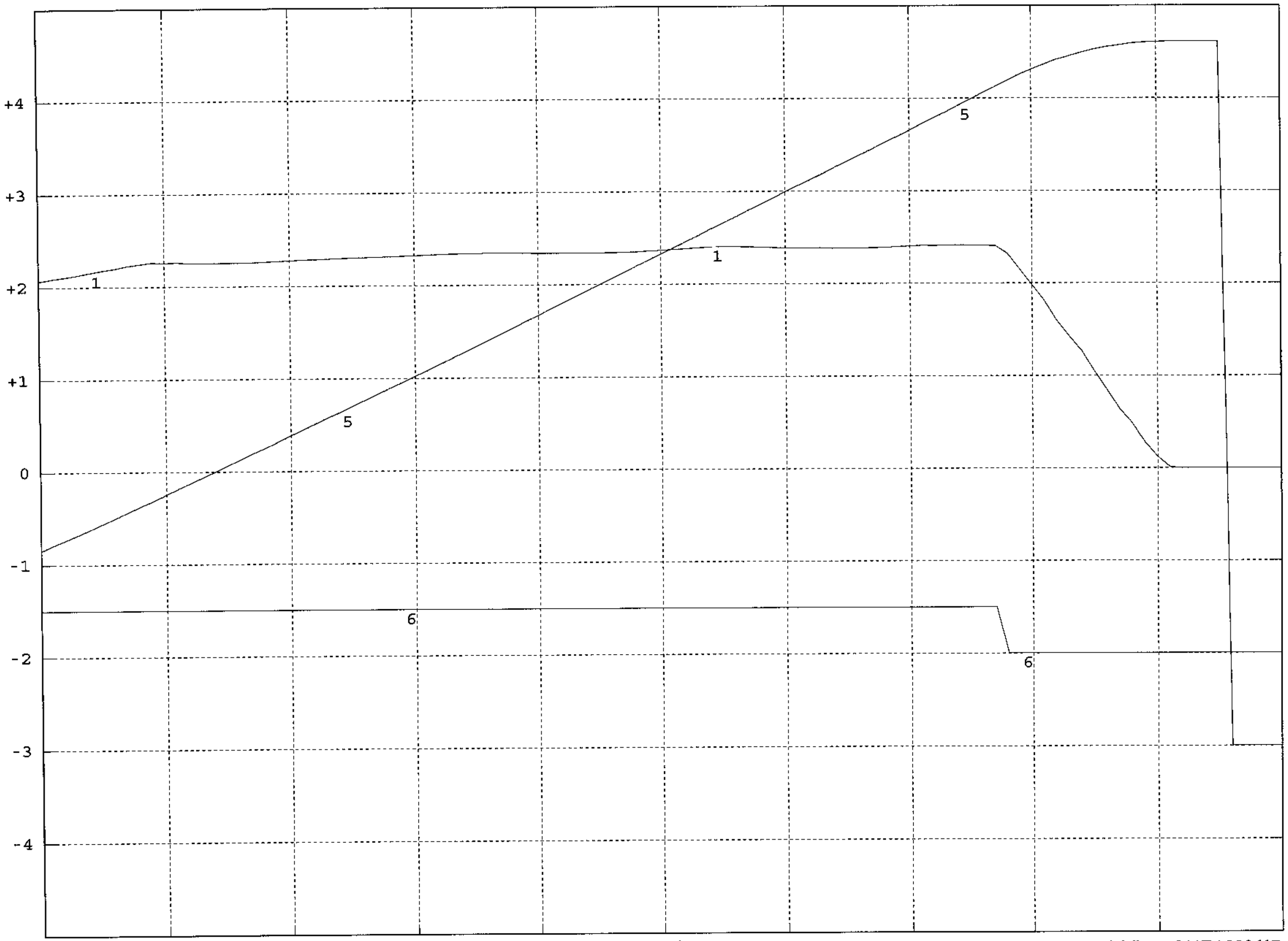
6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

Acquisition date: 08 nov 2010 - 20:16:20
Printing date: 26 nov 2010 - 19.58.06

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

95120m4



ANSALDO

1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

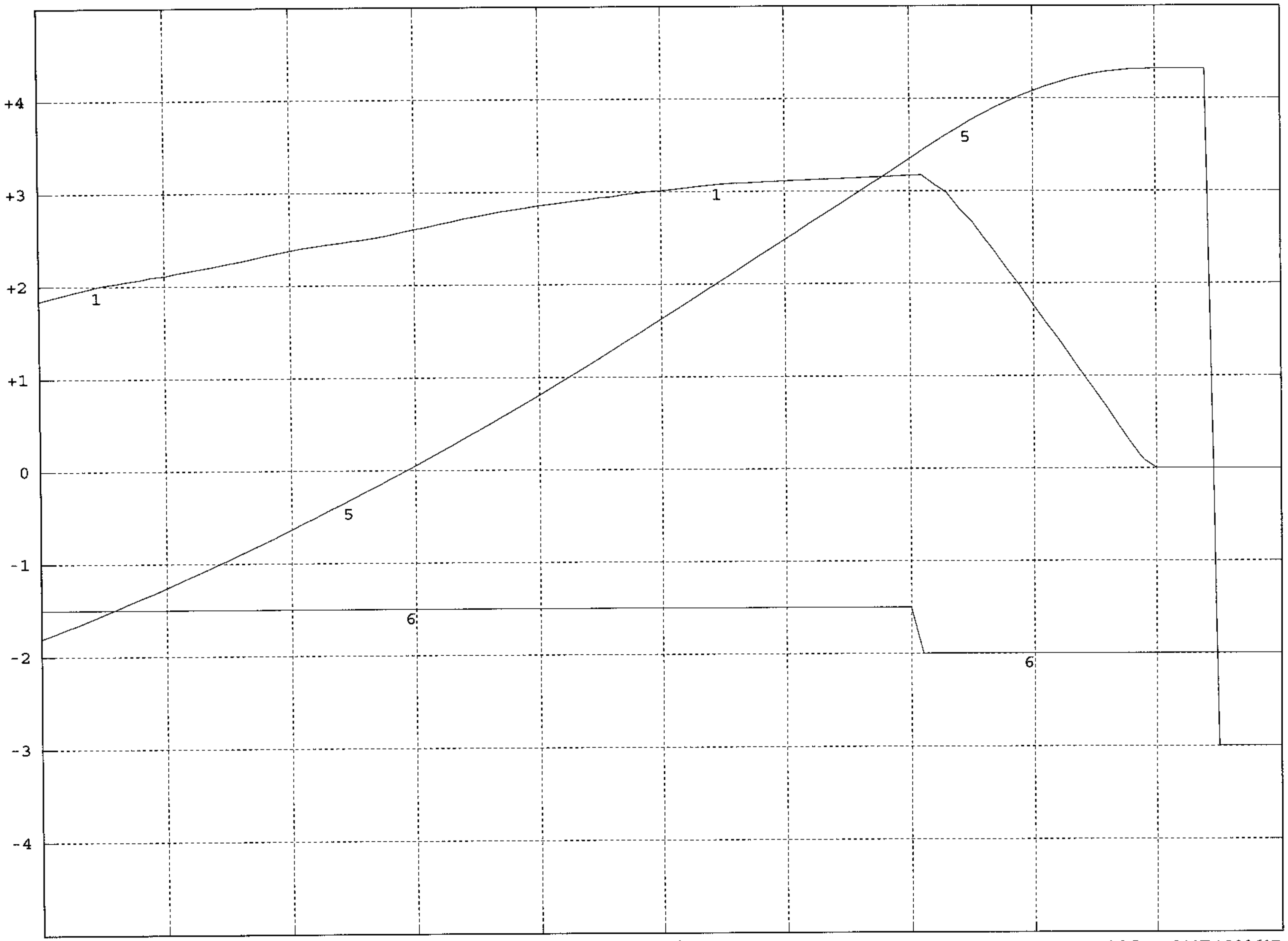
Acquisition date: 08 nov 2010 - 21:03:03
Printing date: 26 nov 2010 - 20.10.50

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

95160am1

ANSALDO



1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

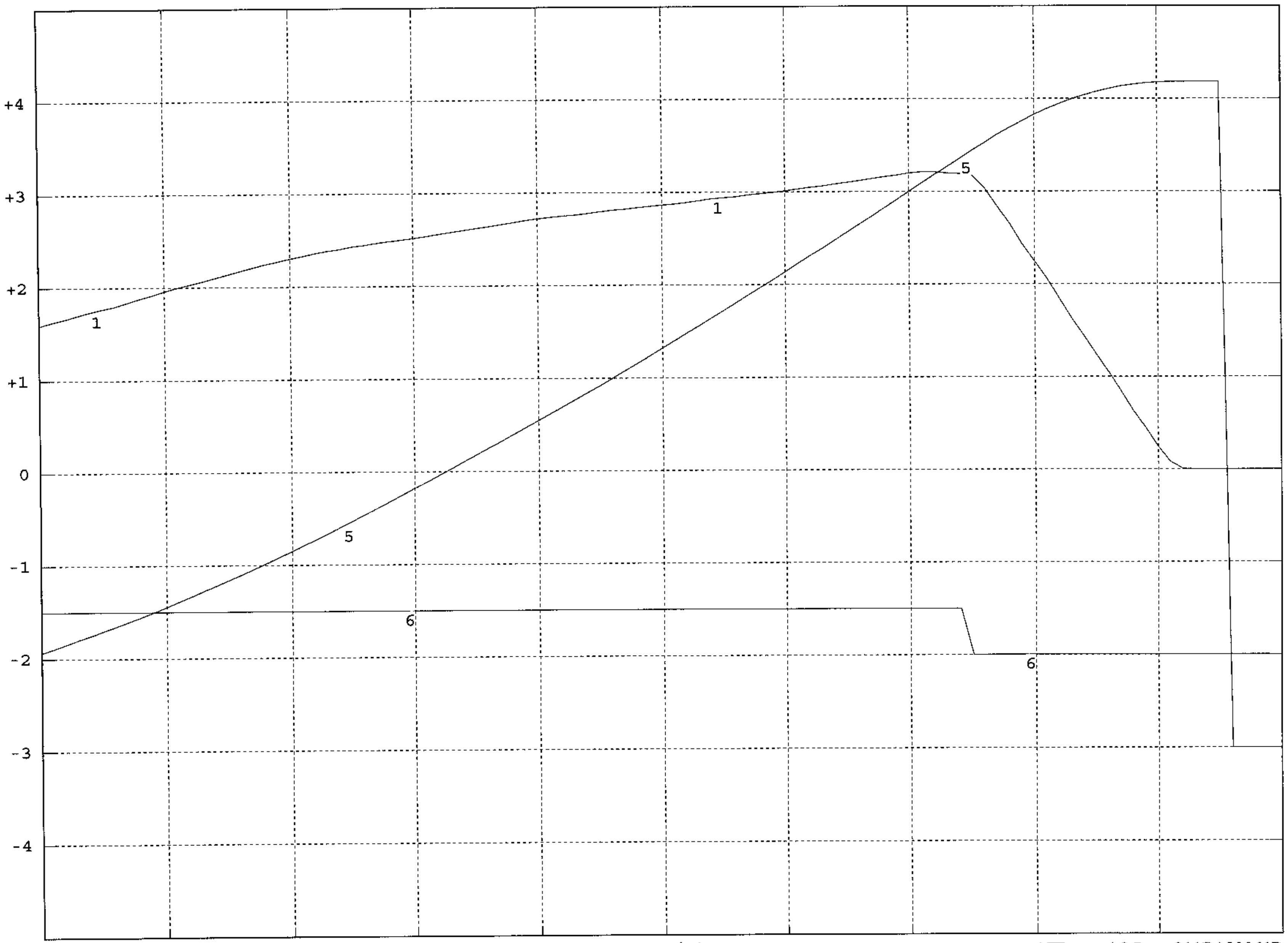
6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

Acquisition date: 08 nov 2010 - 20:23:50
Printing date: 26 nov 2010 - 20.11.13

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

95160am4



ANSALDO

1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

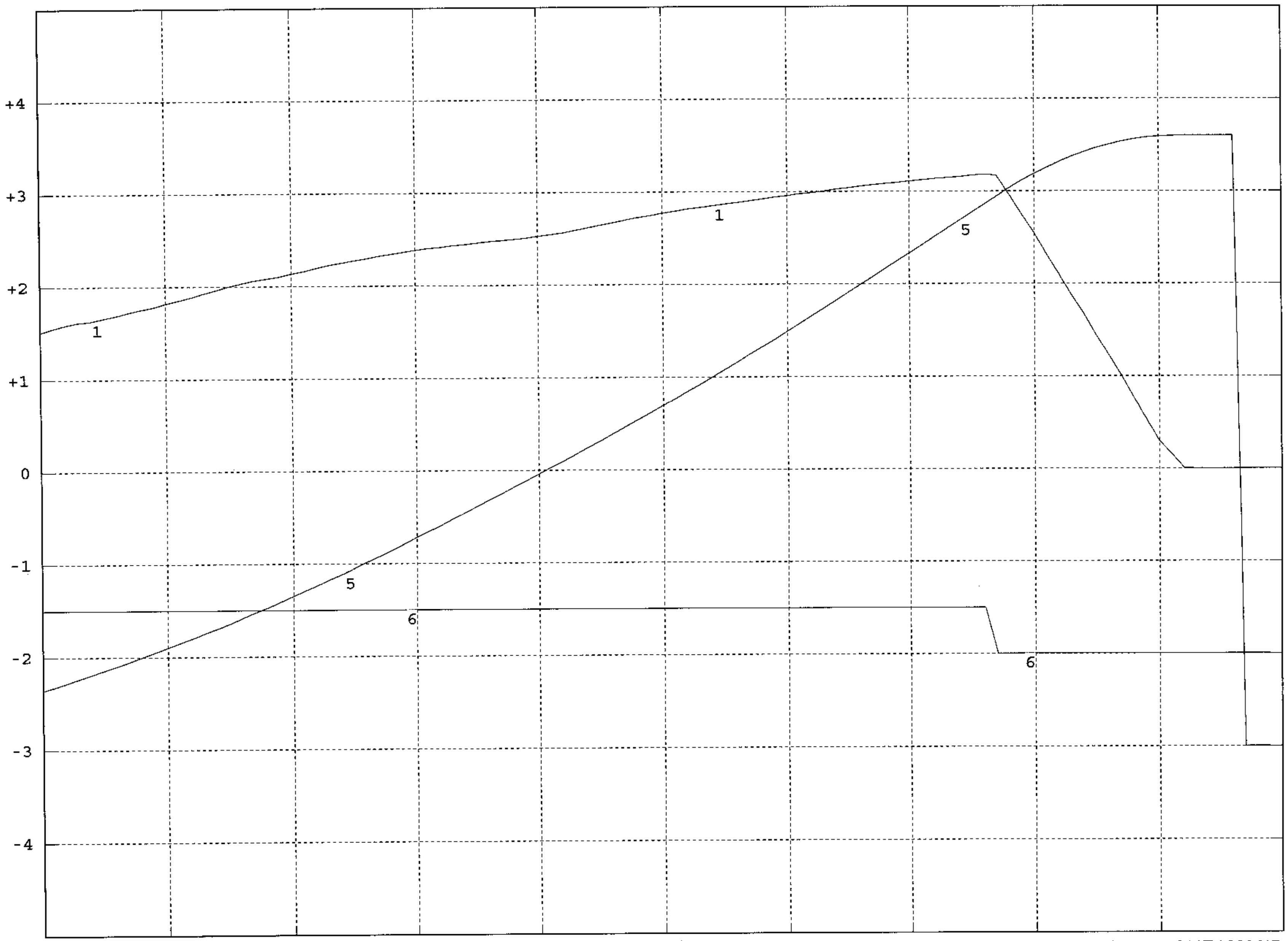
Acquisition date: 08 nov 2010 - 21:08:37
Printing date: 26 nov 2010 - 20.11.36

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

96160m1

ANSALDO



1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

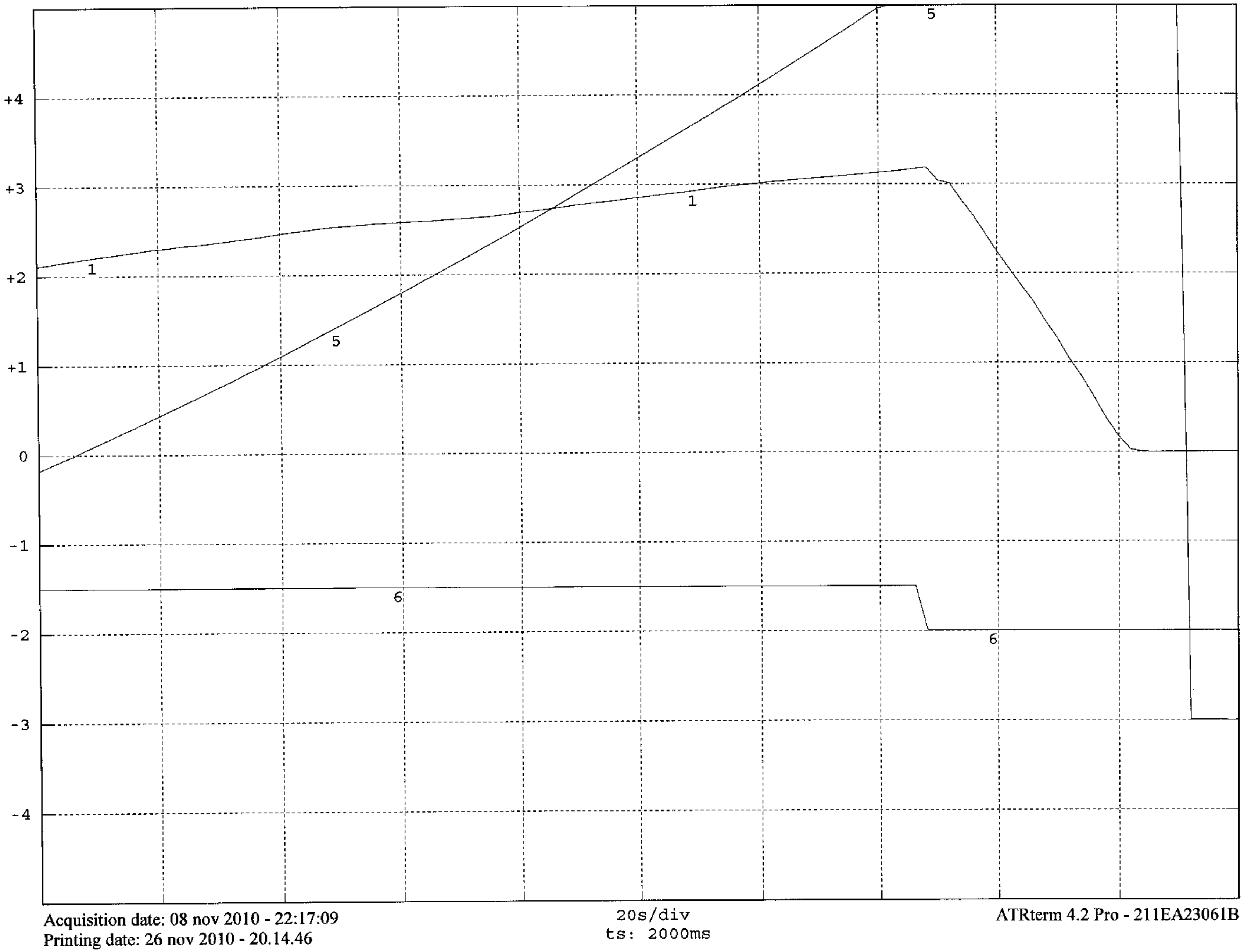
6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

Acquisition date: 08 nov 2010 - 21:32:22
Printing date: 26 nov 2010 - 20.14.25

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

96160m4



ANSALDO

1 - veh_speed
50/div
pos:0 ofs:0

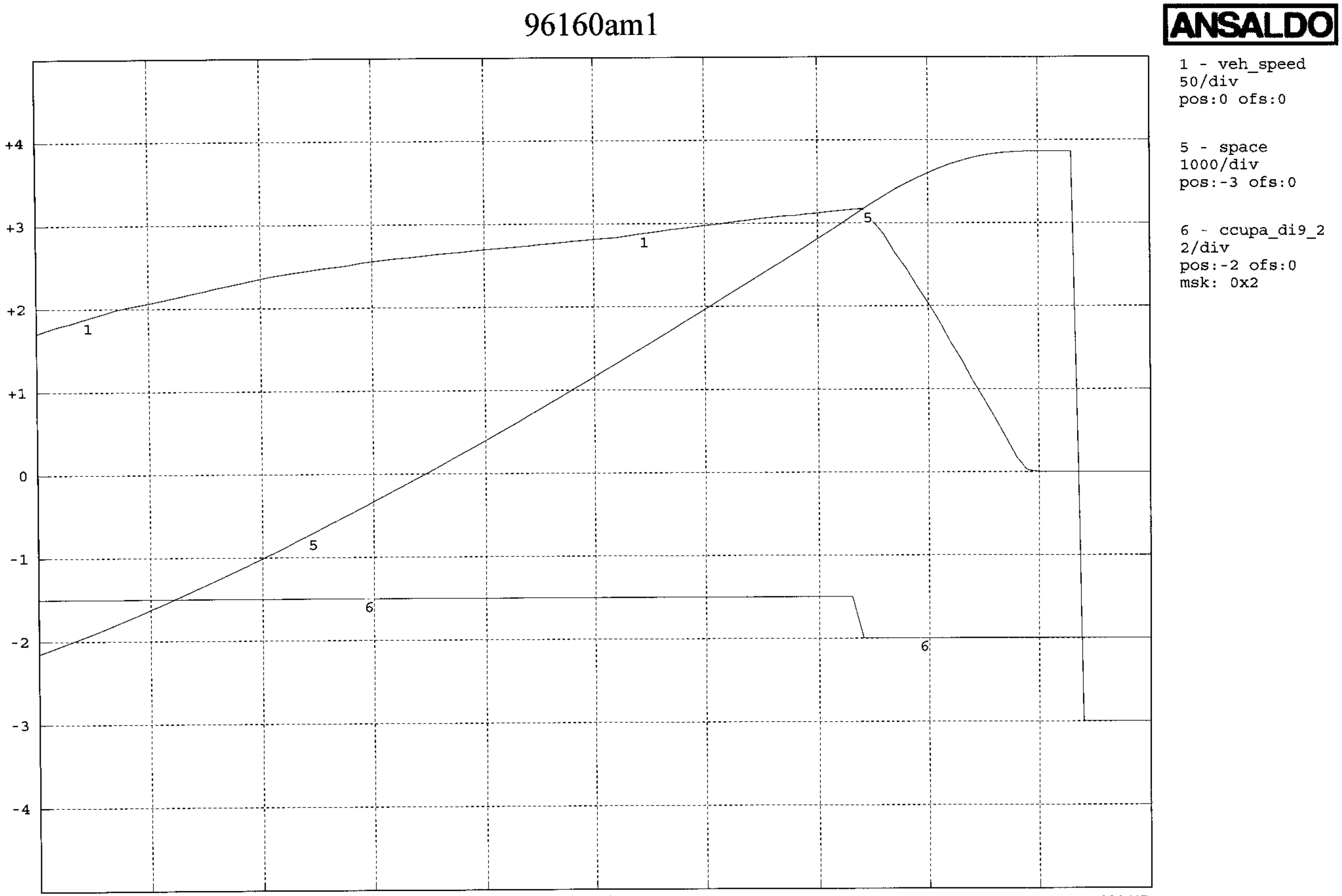
5 - space
1000/div
pos:-3 ofs:0

6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

Acquisition date: 08 nov 2010 - 22:17:09
Printing date: 26 nov 2010 - 20.14.46

ATRterm 4.2 Pro - 211EA23061B

96160am1

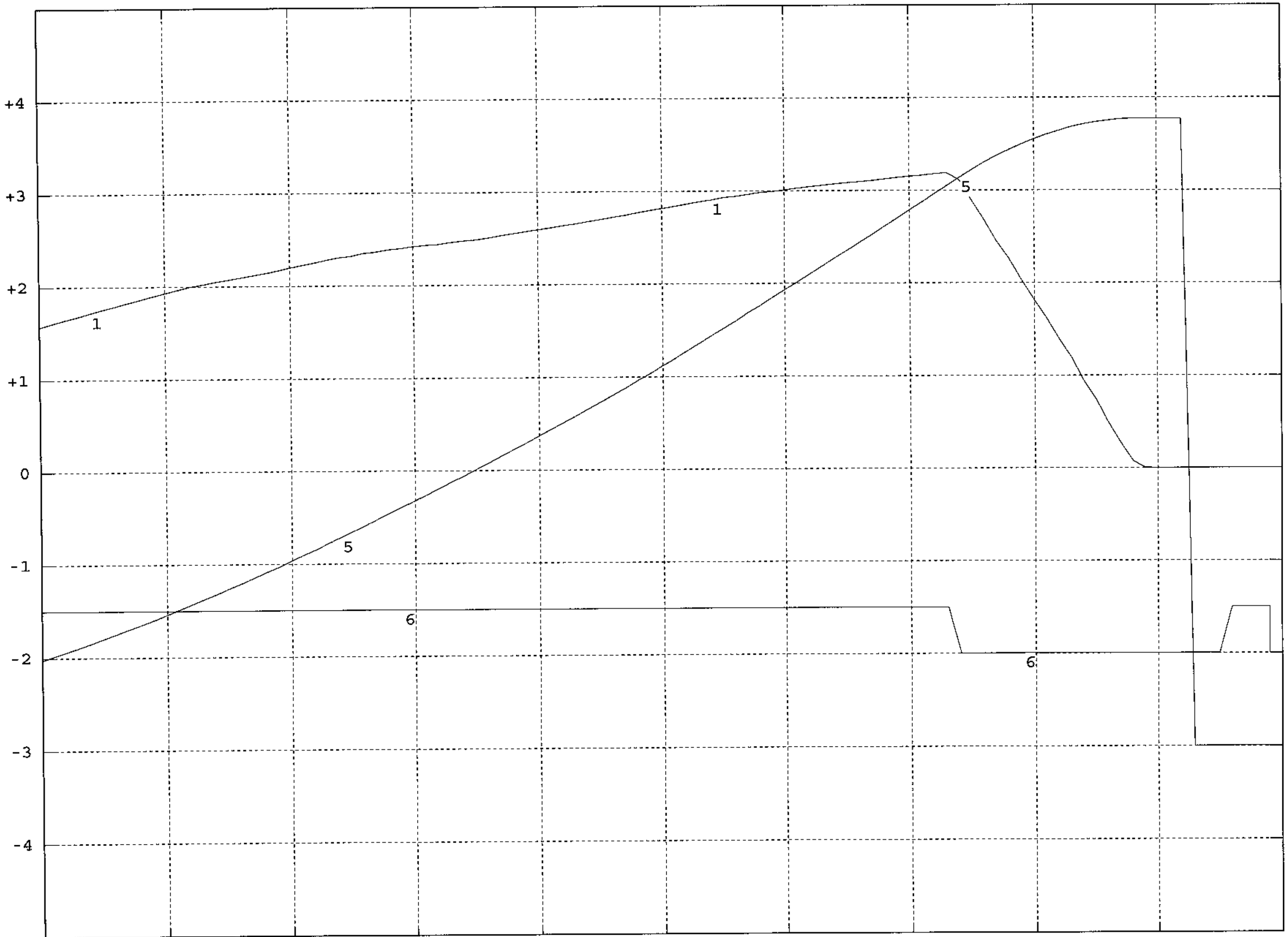


Acquisition date: 08 nov 2010 - 21:38:17
Printing date: 26 nov 2010 - 20.15.04

ATRterm 4.2 Pro - 211EA23061B

96160am4

ANSALDO



1 - veh_speed
50/div
pos:0 ofs:0

5 - space
1000/div
pos:-3 ofs:0

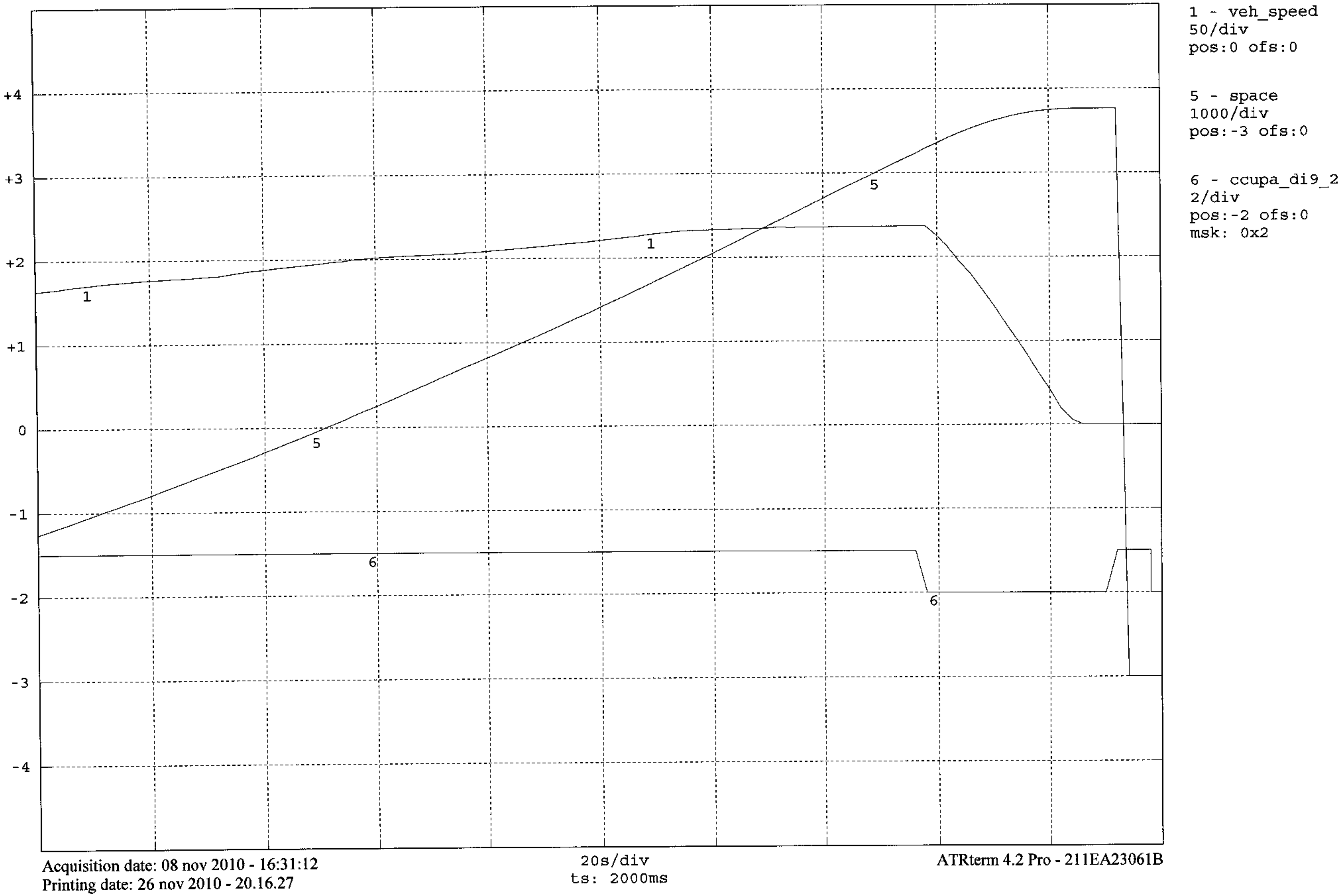
6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

Acquisition date: 08 nov 2010 - 22:29:17
Printing date: 26 nov 2010 - 20.15.50

20s/div
ts: 2000ms

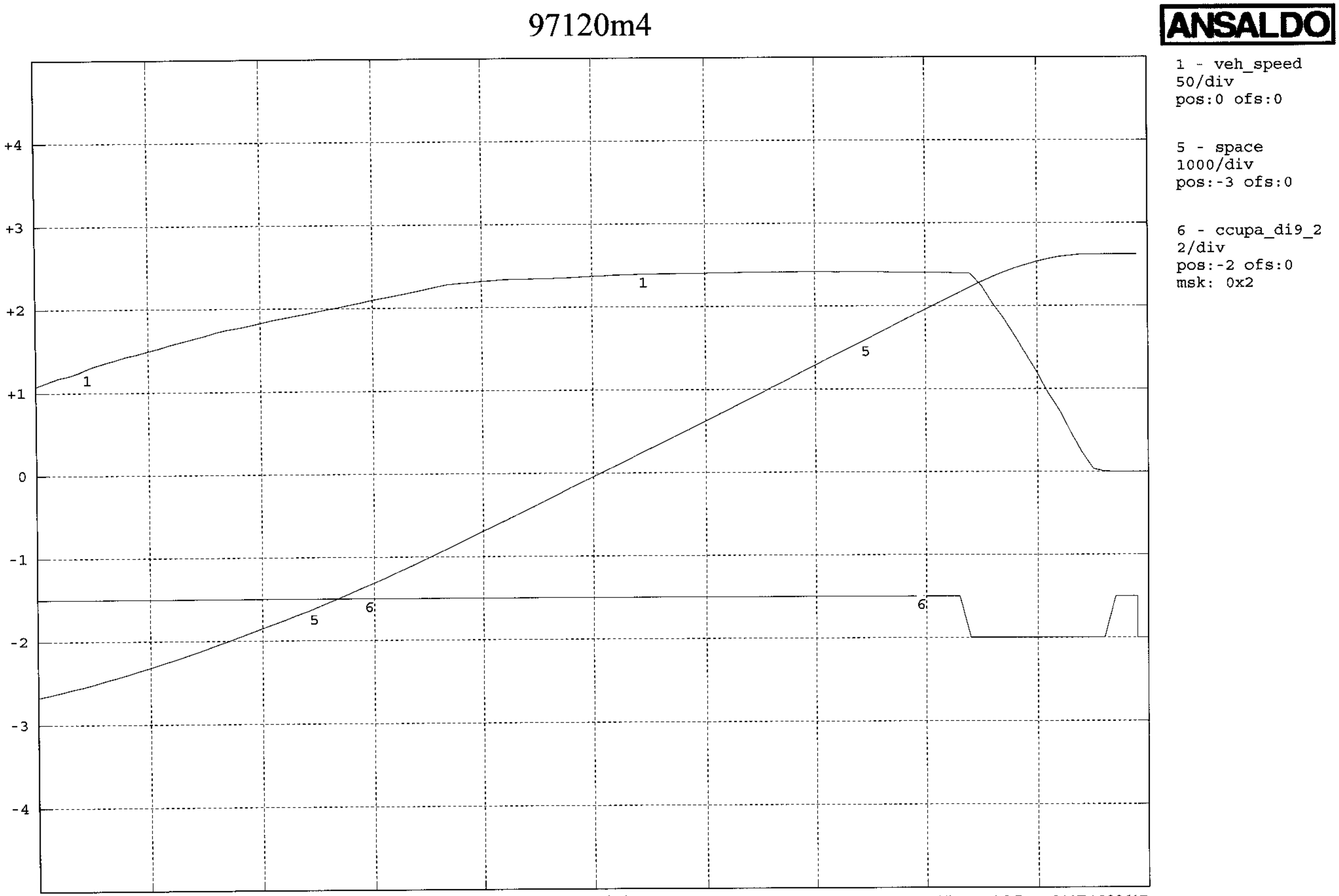
ATRterm 4.2 Pro - 211EA23061B

97120m1a



+4
+3
+2
+1
0
-1
-2
-3
-4
1
5
6
Acquisition date: 08 nov 2010 - 16:31:12
Printing date: 26 nov 2010 - 20.16.27
20s/div
ts: 2000ms
ATRterm 4.2 Pro - 211EA23061B
1 - veh_speed
50/div
pos:0 ofs:0
5 - space
1000/div
pos:-3 ofs:0
6 - ccupa_di9_2
2/div
pos:-2 ofs:0
msk: 0x2

97120m4



Acquisition date: 09 nov 2010 - 14:38:45
Printing date: 26 nov 2010 - 20.16.50

20s/div
ts: 2000ms

ATRterm 4.2 Pro - 211EA23061B

Bilag 2.11
Havarikommissionen
611-2011-23

DMU – IC4

DSAT 21

REPORT DI PROVA DI TIPO VEICOLO
VEHICLE TYPE TEST REPORT

DYNAMIC PERFORMANCE TEST:WHEEL SLIDE PROTECTION SYSTEM
TEST REPORT

PROCEDURA rev.3 PROCEDURE			
DATA/DATE	DATA/DATE	DATA/DATE	DATA/DATE
M1C	**T2HK**	**T3**	**M4C**
N°TELAIO AA01KVZ/01/B UNDERFRAME No.	N°TELAIO AA01KWZ/01/B UNDERFRAME No.	N°TELAIO AA01KW1/01/B UNDERFRAME No.	N°TELAIO AA01KVZ/02/B UNDERFRAME No.

<u>Train Set N°1</u>

According test procedure DSAT21 rev. 3

Data

Wheel diameter (Ø)	**840**
Weight=163042 kg	
Rotating mass=11708 kg	
Weather condition	**Changing**
Location of the test **Line from km 83,8 to km 93,0**	
Environmental temperature[°C]	**From -4°C to 1°C**
Wind speed	**Changing**

Brake distance

Braking Mode	Nominal brake distance [i=0; speed 120km/h]			
	Ø 860	Ø 840	Ø 820	Ø 800
Maximum service brake	728	715	701	688
Emergency w/o MTB	678	664	651	638
Safety (w/o MTB and w/o EP)	678	664	651	638

Table of results procedure reference 7.4

Manned cab.	Braking type	speed		7.4.1		7.4.2		7.4.3		7.4.4.1		7.4.5		7.4.6		File names and ID record
		Exp. value	Act. value	Exp. value	Act. value	Exp. value	Act. Value	Exp. value	Act. value	Tsd	Sc	Exp. value	Act. value	Exp. value	Act. value	
M1	Maximum service brake	120±3	119,91	$0{,}08 \geq \tau_a \geq 0{,}05$	0,046	≥35%	OK	OK	OK	715,0 ≥	665,06	≤2,5	OK	85%	93,9%	16mar08
M1	Maximum service brake	120±3	118,29	$0{,}08 \geq \tau_a \geq 0{,}05$	0,060	≥35%	OK	OK	OK	715,0 ≥	643,53	≤2,5	OK	85%	93,1%	16mar10
M4	Maximum service brake	120±3	113,73	$0{,}08 \geq \tau_a \geq 0{,}05$	0,069	≥35%	OK	OK	OK	715,0 ≥	654,61	≤2,5	OK	85%	89,9%	31mar02
M4	Maximum service brake	120±3	120,66	$0{,}08 \geq \tau_a \geq 0{,}05$	0,051	≥35%	OK	OK	OK	715,0 ≥	689,97	≤2,5	OK	85%	93,2%	31mar10
M1	Maximum service brake without HD	120±3	120,59	$0{,}08 \geq \tau_a \geq 0{,}05$	0,054	≥35%	OK	OK	OK	715,0 ≥	637,28	≤2,5	OK	85%	92,1%	16mar12
M1	Maximum service brake without HD	120±3	118,91	$0{,}08 \geq \tau_a \geq 0{,}05$	0,049	≥35%	OK	OK	OK	715,0 ≥	681,44	≤2,5	OK	85%	93,4%	16mar14
M4	Maximum service brake without HD	120±3	120,90	$0{,}08 \geq \tau_a \geq 0{,}05$	0,046	≥35%	OK	OK	OK	715,0 ≥	598,77	≤2,5	OK	85%	96,3%	16mar15
M4	Maximum service brake without HD	120±3	121,45	$0{,}08 \geq \tau_a \geq 0{,}05$	0,076	≥35%	OK	OK	OK	715,0 ≥	638,64	≤2,5	OK	85%	90,5%	16mar16
M1	Emergency brakeactivated by master controller	120±3	120,55	$0{,}08 \geq \tau_a \geq 0{,}05$	0,054	≥35%	OK	OK	OK	663,0 ≥	570,97	≤2,5	OK	85%	92,6%	16mar17

According test procedure DSAT21 rev. 3

Manned cab.	Braking type	speed		7.4.1		7.4.2		7.4.3		7.4.4.1		7.4.5		7.4.6		File names and ID record
		Exp. value	Act. value	Exp. value	Act. value	Exp. value	Act. Value	Exp. value	Act. value	Tsd	Sc	Exp. value	Act. value	Exp. value	Act. value	
M4	Emergency brakeactivated by master controller	120±3	121,25	$0{,}08\geq\tau_a\geq0{,}05$	0,077	≥35%	OK	OK	OK	663,0 ≥	562,90	≤2,5	OK	85%	94,4%	16mar18
M1	Emergency brakeactivated by master controller	120±3	120,09	$0{,}08\geq\tau_a\geq0{,}05$	0,064	≥35%	OK	OK	OK	663,0 ≥	554,90	≤2,5	OK	85%	95,6%	16mar19
M4	Emergency brakeactivated by master controller	120±3	121,76	$0{,}08\geq\tau_a\geq0{,}05$	0,058	≥35%	OK	OK	OK	663,0 ≥	587,47	≤2,5	OK	85%	92,0%	31mar08
M1	Safety brake	120±3	121,28	$0{,}08\geq\tau_a\geq0{,}05$	0,070	≥35%	OK	OK	OK	663,0 ≥	614,31	≤2,5	OK	85%	91,0%	01apr12
M1	Safety brake	120±3	117,33	$0{,}08\geq\tau_a\geq0{,}05$	0,078	≥35%	OK	OK	OK	663,0 ≥	572,87	≤2,5	OK	85%	95,1%	01apr16
M4	Safety brake	120±3	121,45	$0{,}08\geq\tau_a\geq0{,}05$	0,077	≥35%	OK	OK	OK	663,0 ≥	560,95	≤2,5	OK	85%	92,7%	01apr17
M4	Safety brake	120±3	119,59	$0{,}08\geq\tau_a\geq0{,}05$	0,076	≥35%	OK	OK	OK	663,0 ≥	614,81	≤2,5	OK	85%	93,0%	01apr18

Software revision list

Train computer	CCU	D1_C0_06v
	RIO	D1_R2_04f

BCU	B801

WSP	DK13

Power pack	Engine controller	Software	1.5.1
		Dataset	151br10
	Trasmission	Software P1	V31.13m
		Software P2	V31.13k
		Dataset P1	1l413m19.hex
		Dataset P2	2l413k18.hex
	Intarder	Intarder ECU	031205.eol
		Data set	031205.eol

IDU	RIL06

HVAC pas. Area	1.8

HVAC Driver's cab	2.1

Equipment List		
Type	S/N	Calibration

Track condition		
Dry ☑	Wet ☐	Iced ☐

END RESULT	
Comply ☑	Not Comply ☐

According test procedure DSAT21 rev. 3

NOTE

OPEN ITEMS LIST

Annexes List

- 1 chart showing conditions, results and data filename of all the runs;
- 3 charts showing the daily test activities, signed by the DSB representative;
- 1 chart for each run showing the train deceleration curve as measured by the inertial accelerometer, the speed and distance curves as measured by the optical sensor, the brake line and the slide flags (18 pages);
- 1 chart for each run reproducing the pipe pressures as measured by the DASH18 recorder (18 pages);
- 1 chart for each run reproducing the significant data measured by the BCU (18 pages);
- 1 chart for each run showing the deceleration curve and the peak deceleration, for the antislide efficiency calculation (18 pages);
- for each run at least 5 charts showing the train speed, BCU reference speed and single axle speed. These charts show that the minimum sliding requirement is met for each run (97 pages).

	NAME	SIGNATURE
AnsaldoBreda Tester	PROCIDA GIANCARMINE	[signature] ANSALDOBREDA C.Q. VISTO
Customer's inspector		

DATE

According test procedure DSAT21 rev. 3

Table of results Procedure reference chapter 9

Manned cab.	Braking type	speed		Adhesion		Minimum slide	Max. speed dfference	Stopping distance	Pressure drop	Utlisation of available adhesion	File names and ID record
		Exp. value	Act. value	Exp. value	Act. value						
M1	Emergency brake with magnetic trake brake	120±3	119,39	$0,08 \geq \tau_a \geq 0,05$	0,069	OK	OK	486,52	OK	96,6	16mar21
M4	Emergency brake with magnetic trake brake	120±3	119,05	$0,08 \geq \tau_a \geq 0,05$	0,058	OK	OK	544,51	OK	92,1	31mar11

WSP performance runs for DSAT21 on 16 March 2005										
Filename (.txt)	Test type	Track condition	Manned cabin	V_{mes} Initial measured speed (km/h)	S_{mes} Measured stopping distance (m)	S_c Stopping distance correction (m)	Stopping distance target (m)	Distance increase (%)	T_a Adhesion	Average deceleration (m/s^2)
16mar08	Max Service Brake	soap	M1	119,91	664,06	665,06	*572,00*	16,27	0,046	0,84
16mar10	Max Service Brake	soap	M1	118,29	625,32	643,53	*572,00*	12,51	0,060	0,86
16mar12	Max Service no HD	soap	M1	120,59	643,56	637,28	*572,00*	11,41	0,054	0,87
16mar14	Max Service no HD	soap	M1	118,91	669,12	681,44	*572,00*	19,13	0,049	0,82
16mar15	Max Service no HD	soap	M1	120,90	607,79	598,77	*572,00*	4,68	0,046	0,93
16mar16	Max Service no HD	soap	M4	121,45	654,17	638,64	*572,00*	11,65	0,076	0,87
16mar17	Emergency by MC no MTB	soap	M1	120,55	576,22	570,97	*531,00*	7,53	0,054	0,97
16mar18	Emergency by MC no MTB	soap	M4	121,25	574,69	562,90	*531,00*	6,01	0,077	0,99
16mar19	Emergency by MC no MTB	soap	M1	120,09	555,74	554,90	*531,00*	4,50	0,064	1,00

Ole Mårtensen, DSB
Vojens

Brake tests for DSAT21 on 31 March 2005										
Filename (.txt)	Test type	Track condition	Manned cabin	V_{mes} Initial measured speed (km/h)	S_{mes} Measured stopping distance (m)	S_c Stopping distance correction (m)	Stopping distance target (m)	Distance increase (%)	T_a Adhesion	Average deceleration (m/s²)
31mar02	Max Service Brake	soap	M4	113,73	587,99	654,61	*572,00*	14,44	0,069	0,85
31mar08	Emergency by MC no MTB	soap	M4	121,76	604,83	587,47	*531,00*	10,63	0,058	0,95
31mar10	Max Service Brake	soap	M4	120,66	697,58	689,97	*572,00*	20,62	0,051	0,81
31mar11	Emergency by mushroom	soap	M4	119,05	535,92	544,51	*466,00*	16,85	0,058	1,02

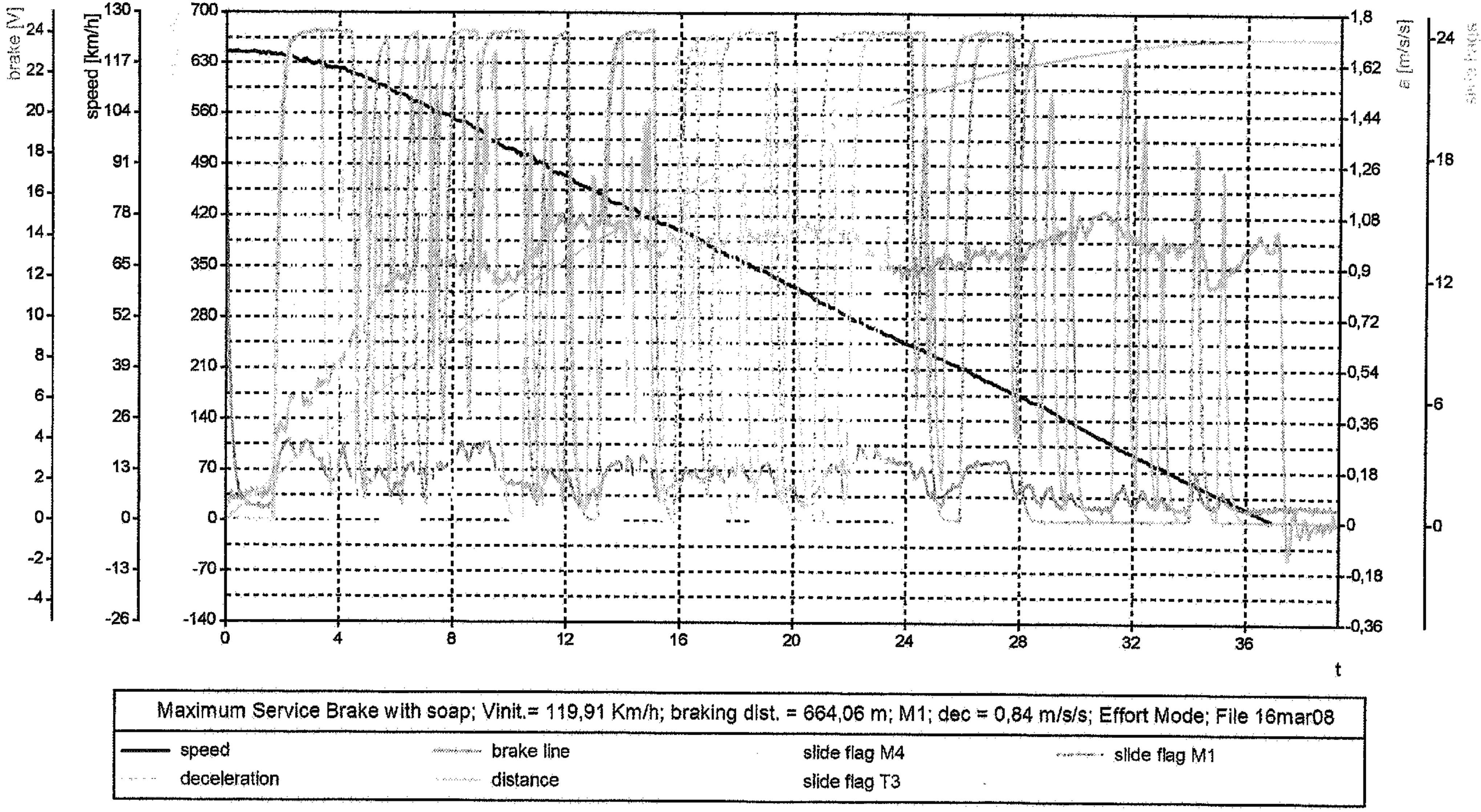
Ole Mårtensen, DSB

Vojens 7/4 05

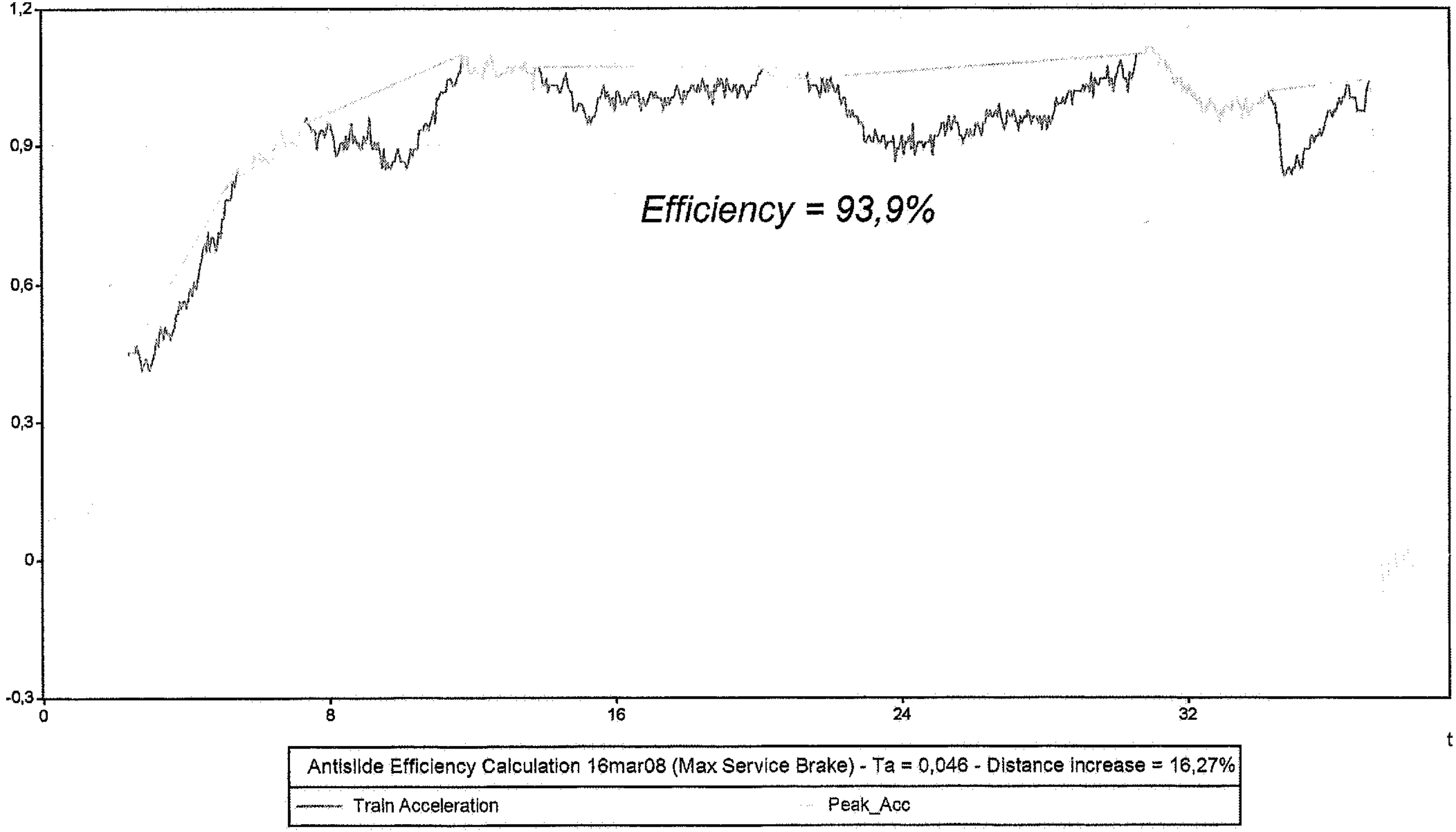
Brake tests for DSAT21 on 1 April 2005										
Filename (.txt)	Test type	Track condition	Manned cabin	V_{mes} Initial measured speed (km/h)	S_{mes} Measured stopping distance (m)	S_c Stopping distance correction (m)	Stopping distance target (m)	Distance increase (%)	T_a Adhesion	Average deceleration (m/s^2)
01apr12	Safety (Purely pneumatic) without MTB	soap	M1	121,28	627,49	614,31	*531,00*	15,69	0,070	0,90
01apr16	Safety (Purely pneumatic) without MTB	soap	M1	117,33	547,66	572,87	*531,00*	7,89	0,078	0,97
01apr17	Safety (Purely pneumatic) without MTB	soap	M4	121,45	574,59	560,95	*531,00*	5,64	0,077	0,99
01apr18	Safety (Purely pneumatic) without MTB	soap	M1	119,59	610,62	614,81	*531,00*	15,78	0,076	0,9

Ole Mortensen DSB
Vojens 7/4 05

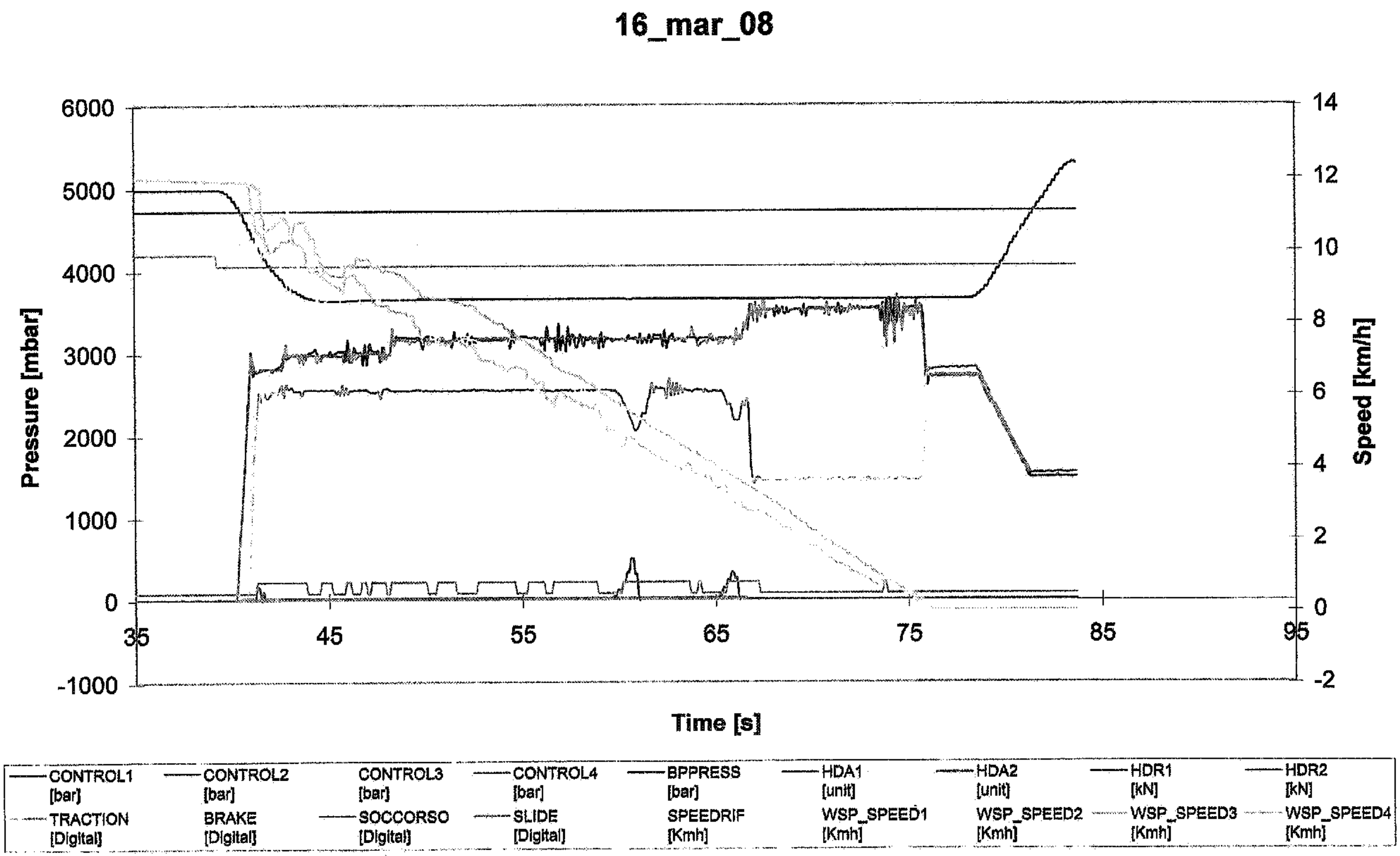
WSP performance runs for DSAT21											
Filename (.txt)	Test type	Track condition	Manned cabin	V_{mes} Initial measured speed (km/h)	S_{mes} Measured stopping distance (m)	S_c Stopping distance correction (m)	Stopping distance target (m)	Distance increase to dry target (%)	T_a Adhesion	Average deceleration (m/s^2)
16mar08	Max Service Brake	soap	M1	119,91	664,06	665,06	*715,00*	16,27	0,046	0,84
16mar10	Max Service Brake	soap	M1	118,29	625,32	643,53	*715,00*	12,51	0,060	0,86
31mar02	Max Service Brake	soap	M4	113,73	587,99	654,61	*715,00*	14,44	0,069	0,85
31mar10	Max Service Brake	soap	M4	120,66	697,58	689,97	*715,00*	20,62	0,051	0,81
16mar12	Max Service without HD	soap	M1	120,59	643,56	637,28	*715,00*	11,41	0,054	0,87
16mar14	Max Service without HD	soap	M1	118,91	669,12	681,44	*715,00*	19,13	0,049	0,82
16mar15	Max Service without HD	soap	M4	120,90	607,79	598,77	*715,00*	4,68	0,046	0,93
16mar16	Max Service without HD	soap	M4	121,45	654,17	638,64	*715,00*	11,65	0,076	0,87
16mar17	Emergency by MC without MTB	soap	M1	120,55	576,22	570,97	*663,00*	7,53	0,054	0,97
16mar18	Emergency by MC without MTB	soap	M4	121,25	574,69	562,90	*663,00*	6,01	0,077	0,99
16mar19	Emergency by MC without MTB	soap	M1	120,09	555,74	554,90	*663,00*	4,50	0,064	1,00
31mar08	Emergency by MC without MTB	soap	M4	121,76	604,83	587,47	*663,00*	10,63	0,058	0,95
01apr12	Safety (Purely IP) without MTB	soap	M1	121,28	627,49	614,31	*663,00*	15,69	0,070	0,90
01apr16	Safety (Purely IP) without MTB	soap	M1	117,33	547,66	572,87	*663,00*	7,89	0,078	0,97
01apr17	Safety (Purely IP) without MTB	soap	M4	121,45	574,59	560,95	*663,00*	5,64	0,077	0,99
01apr18	Safety (Purely IP) without MTB	soap	M4	119,59	610,62	614,81	*663,00*	15,78	0,076	0,9
31mar11	Emergency by mushroom	soap	M4	119,05	535,92	544,51	*582,00*	16,85	0,058	1,02
16mar21	Emergency by mushroom	soap	M1	119,39	481,59	486,52	*582,00*	4,40	0,069	1,14

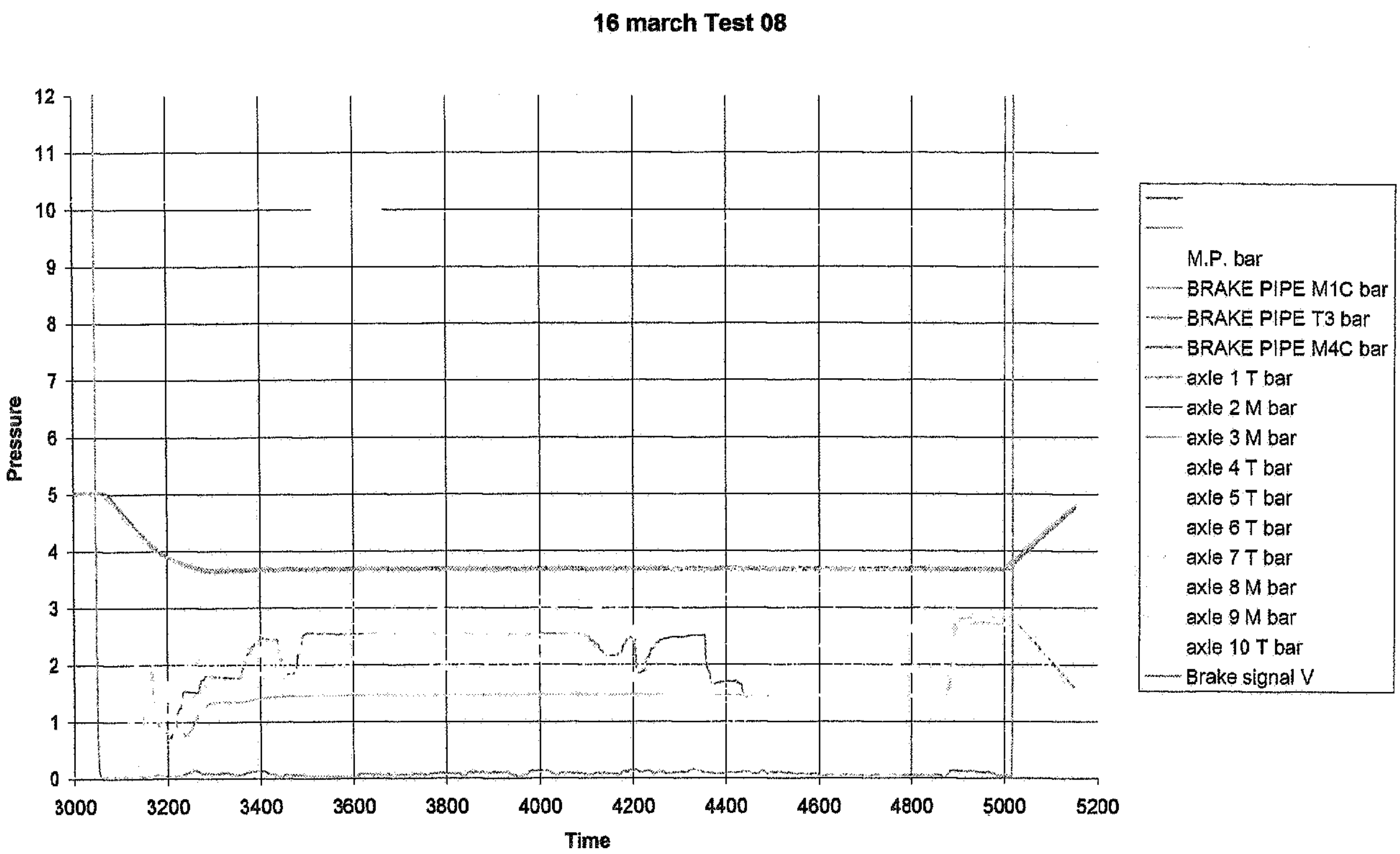


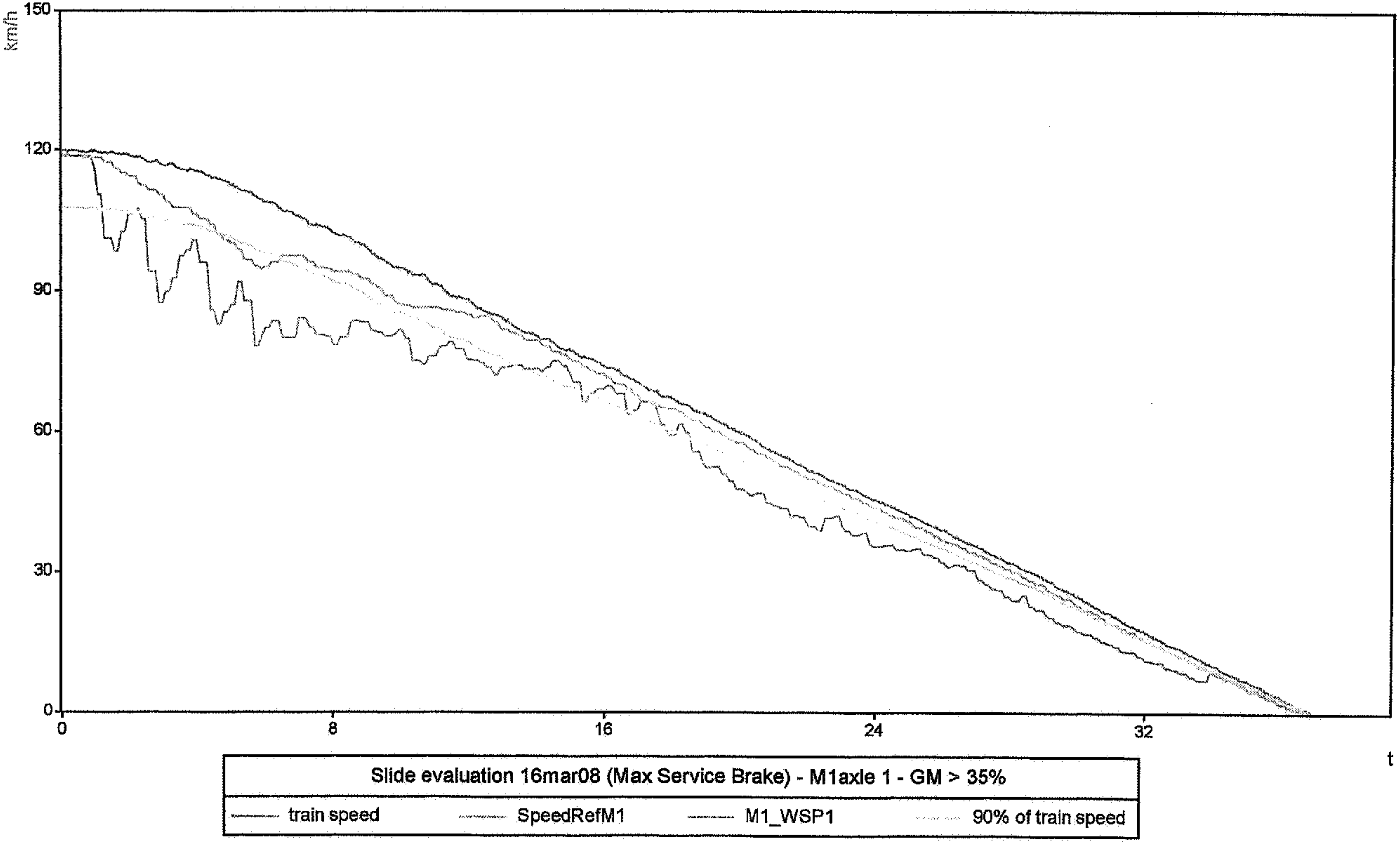
Maximum Service Brake with soap; Vinit.= 119,91 Km/h; braking dist. = 664,06 m; M1; dec = 0,84 m/s/s; Effort Mode; File 16mar08

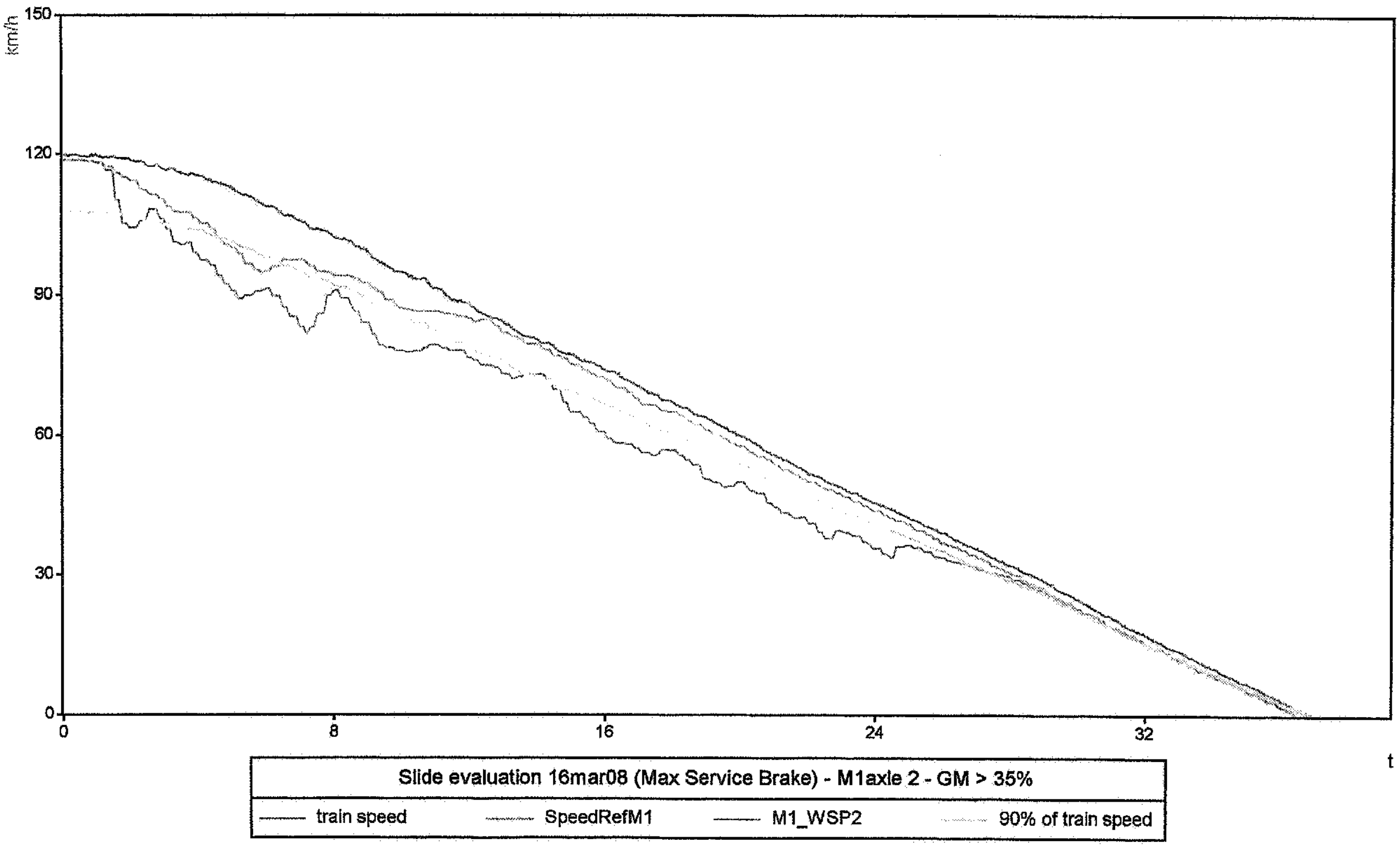


1,2
0,9
0,6
0,3
0
-0,3
0
8
16
24
32
t
Efficiency = 93,9%
Antislide Efficiency Calculation 16mar08 (Max Service Brake) - Ta = 0,046 - Distance increase = 16,27%
Train Acceleration
Peak_Acc

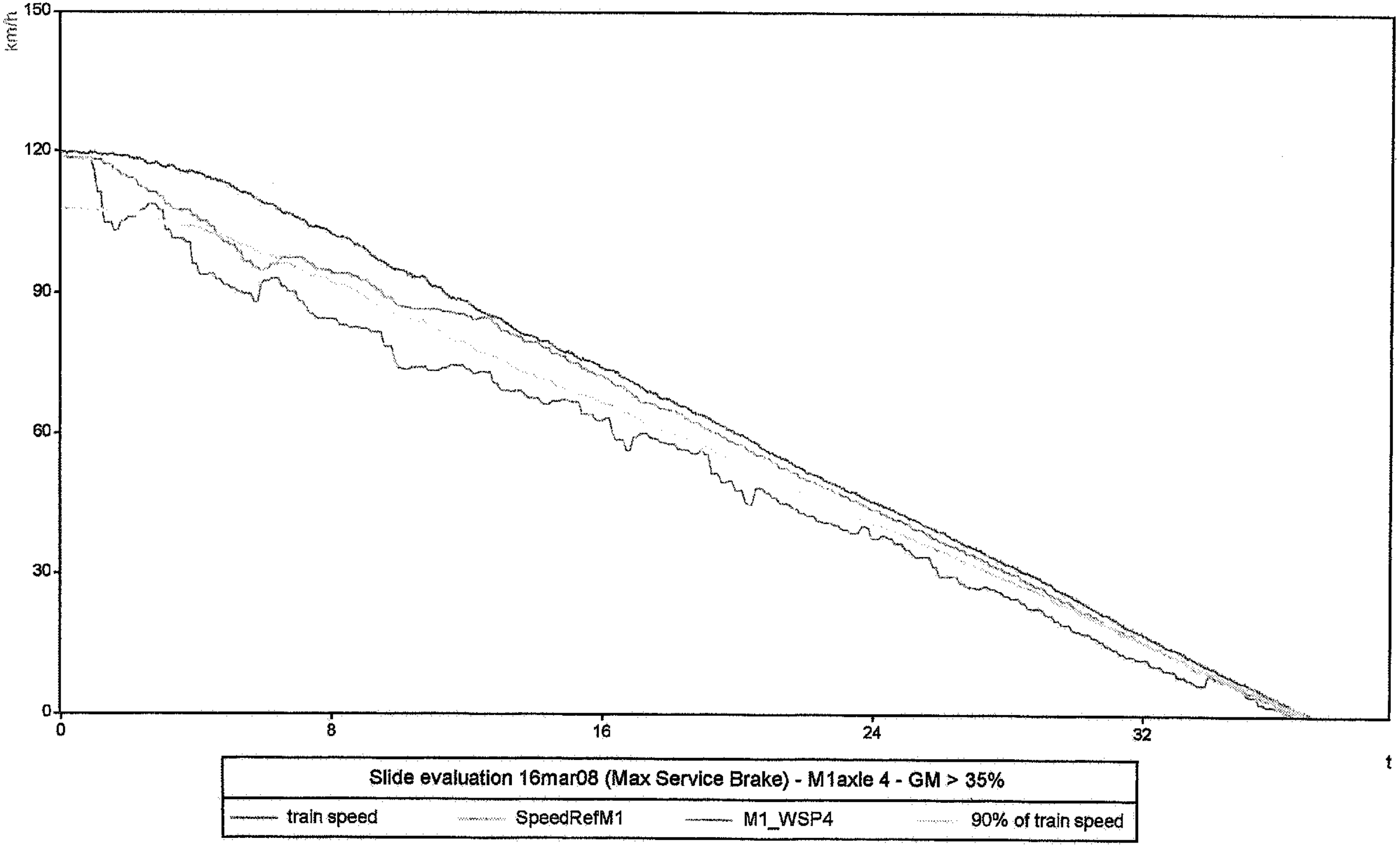

16_mar_08
Pressure [mbar]
6000
5000
4000
3000
2000
1000
0
-1000
Speed [km/h]
14
12
10
8
6
4
2
0
-2
35
45
55
65
75
85
95
Time [s]
CONTROL1 [bar]
CONTROL2 [bar]
CONTROL3 [bar]
CONTROL4 [bar]
BPPRESS [bar]
HDA1 [unit]
HDA2 [unit]
HDR1 [kN]
HDR2 [kN]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]


16 march Test 08
Pressure
Time
12
11
10
9
8
7
6
5
4
3
2
1
0
3000
3200
3400
3600
3800
4000
4200
4400
4600
4800
5000
5200
M.P. bar
BRAKE PIPE M1C bar
BRAKE PIPE T3 bar
BRAKE PIPE M4C bar
axle 1 T bar
axle 2 M bar
axle 3 M bar
axle 4 T bar
axle 5 T bar
axle 6 T bar
axle 7 T bar
axle 8 M bar
axle 9 M bar
axle 10 T bar
Brake signal V

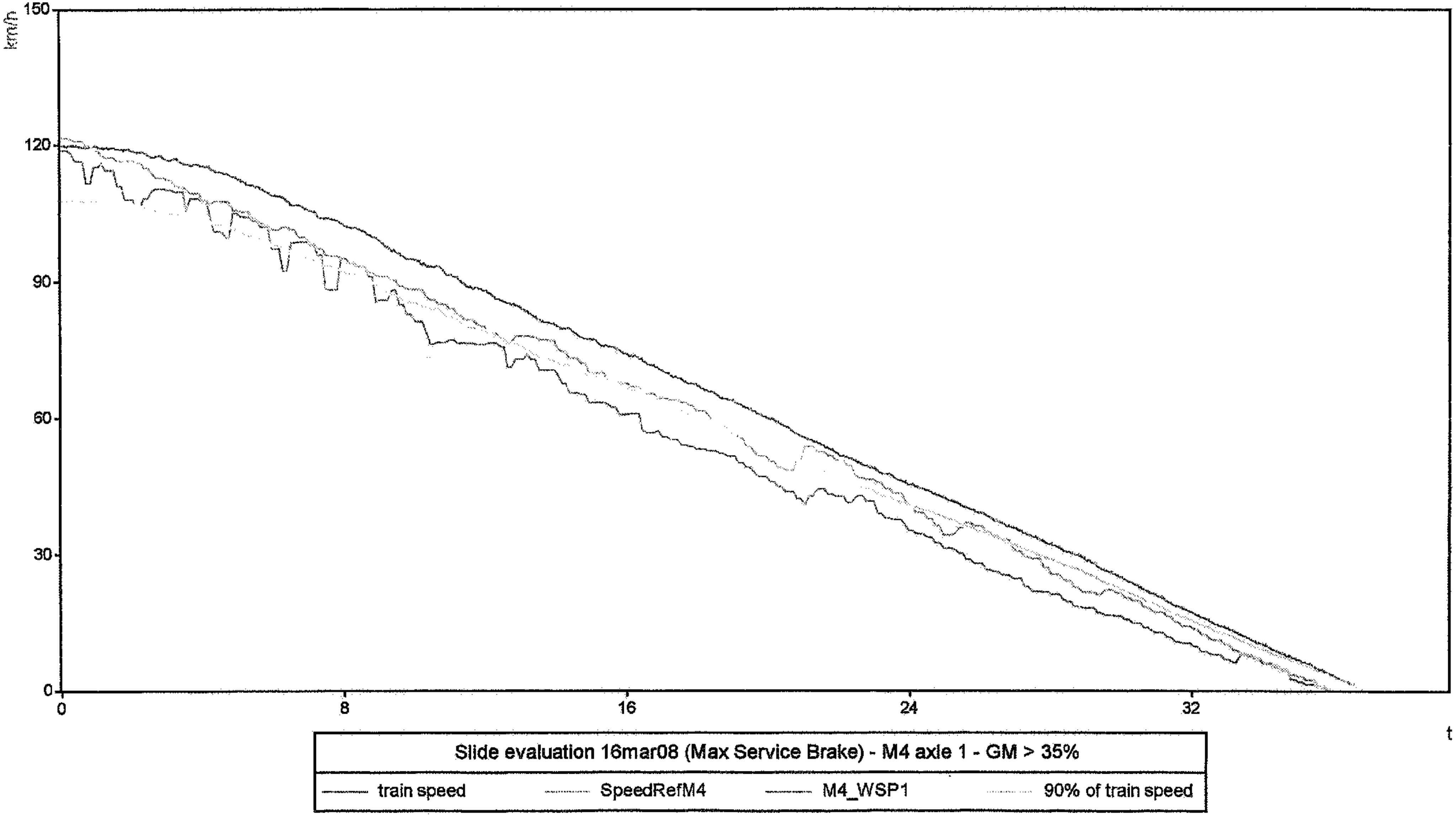

km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar08 (Max Service Brake) - M1axle 1 - GM > 35%
train speed
SpeedRefM1
M1_WSP1
90% of train speed

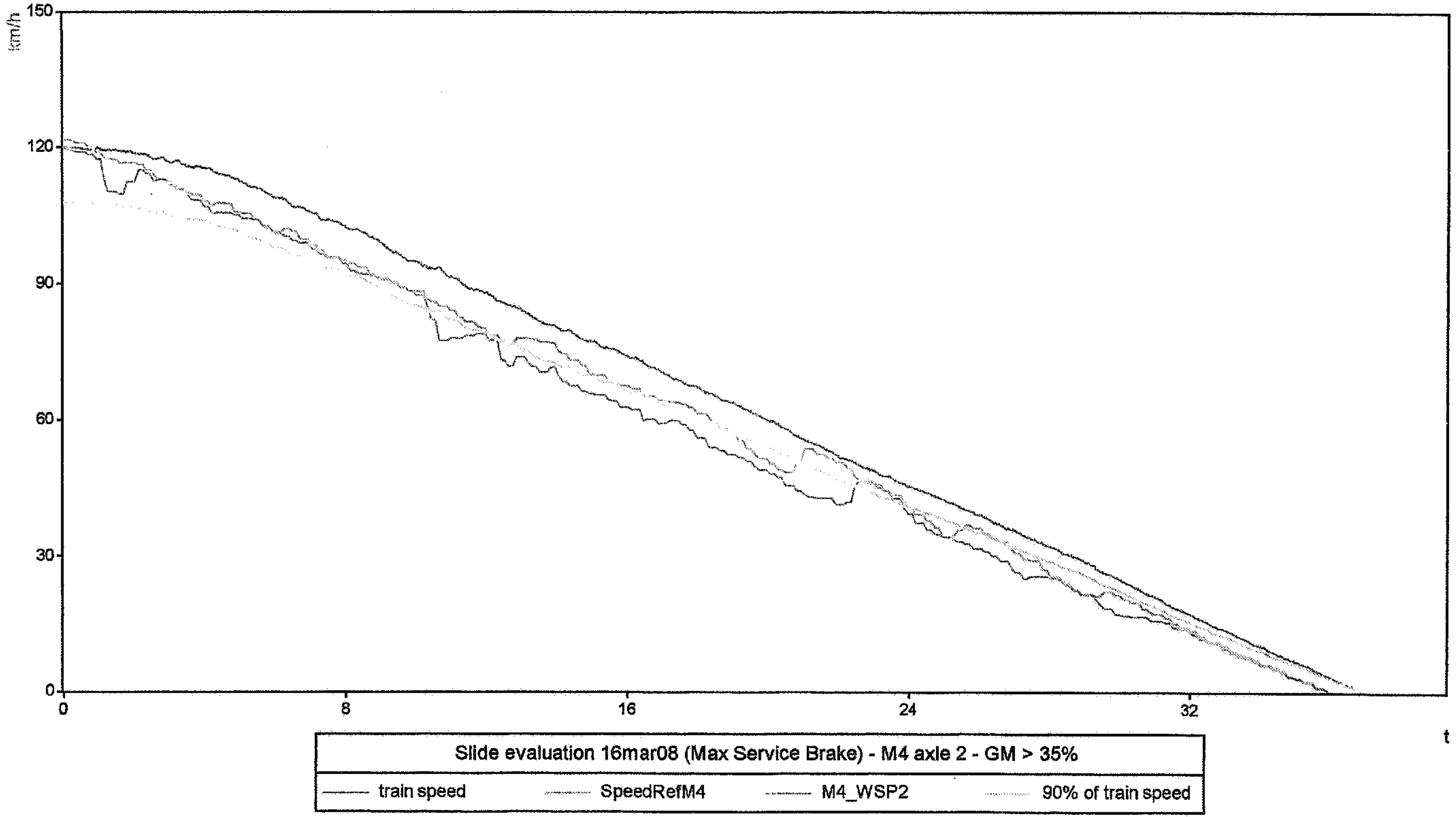


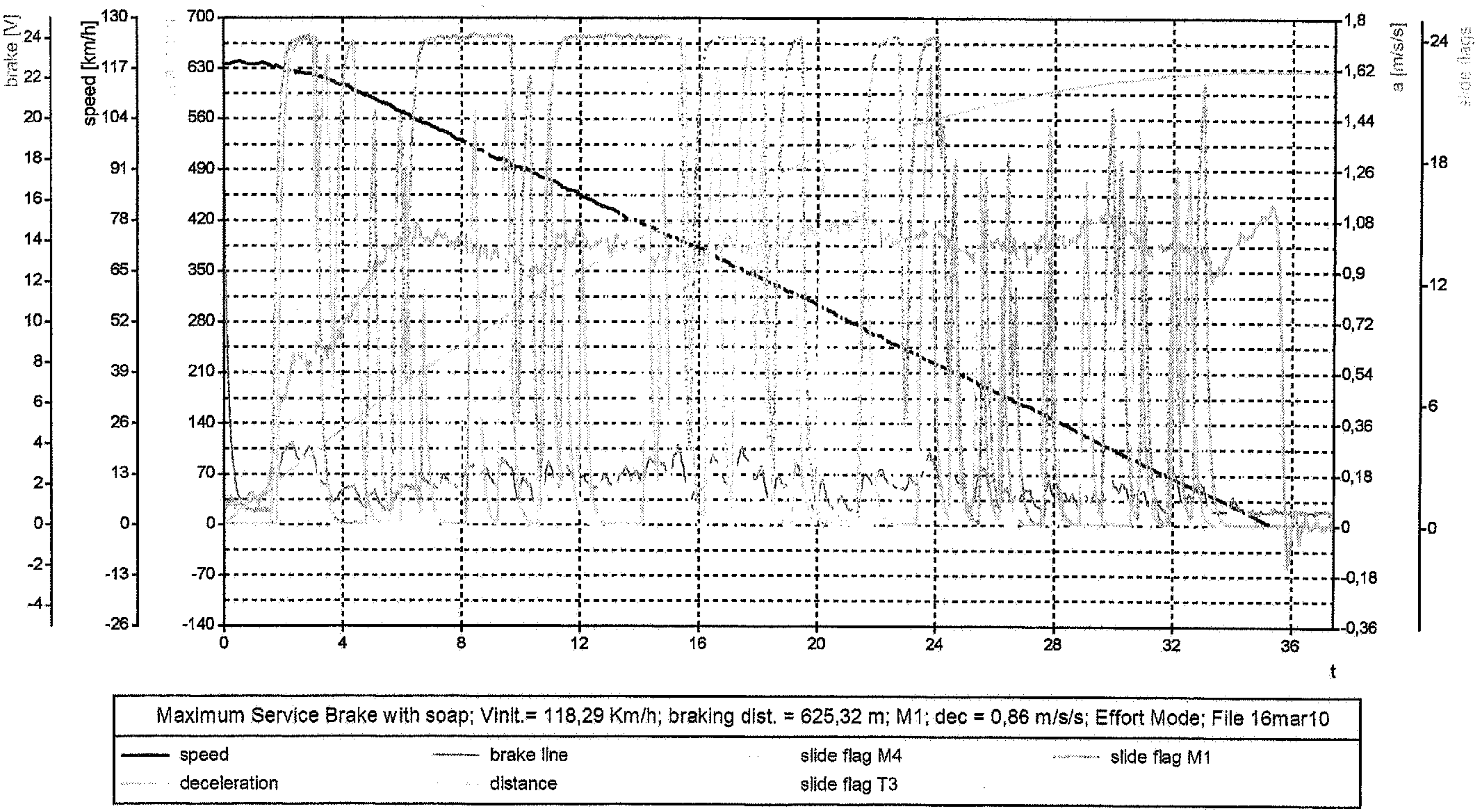
km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar08 (Max Service Brake) - M1axle 2 - GM > 35%
train speed
SpeedRefM1
M1_WSP2
90% of train speed

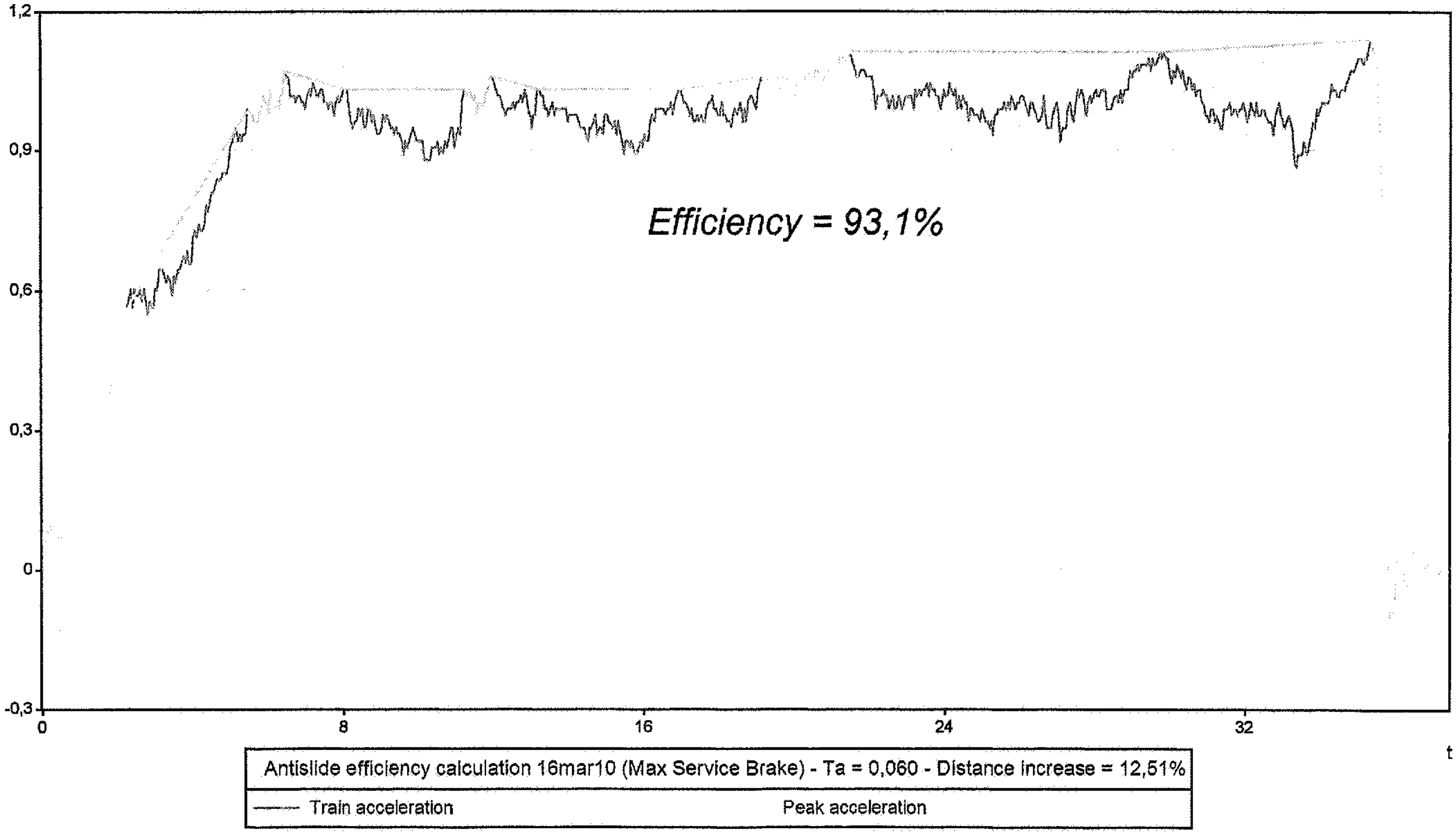


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar08 (Max Service Brake) - M1axle 4 - GM > 35%
train speed
SpeedRefM1
M1_WSP4
90% of train speed

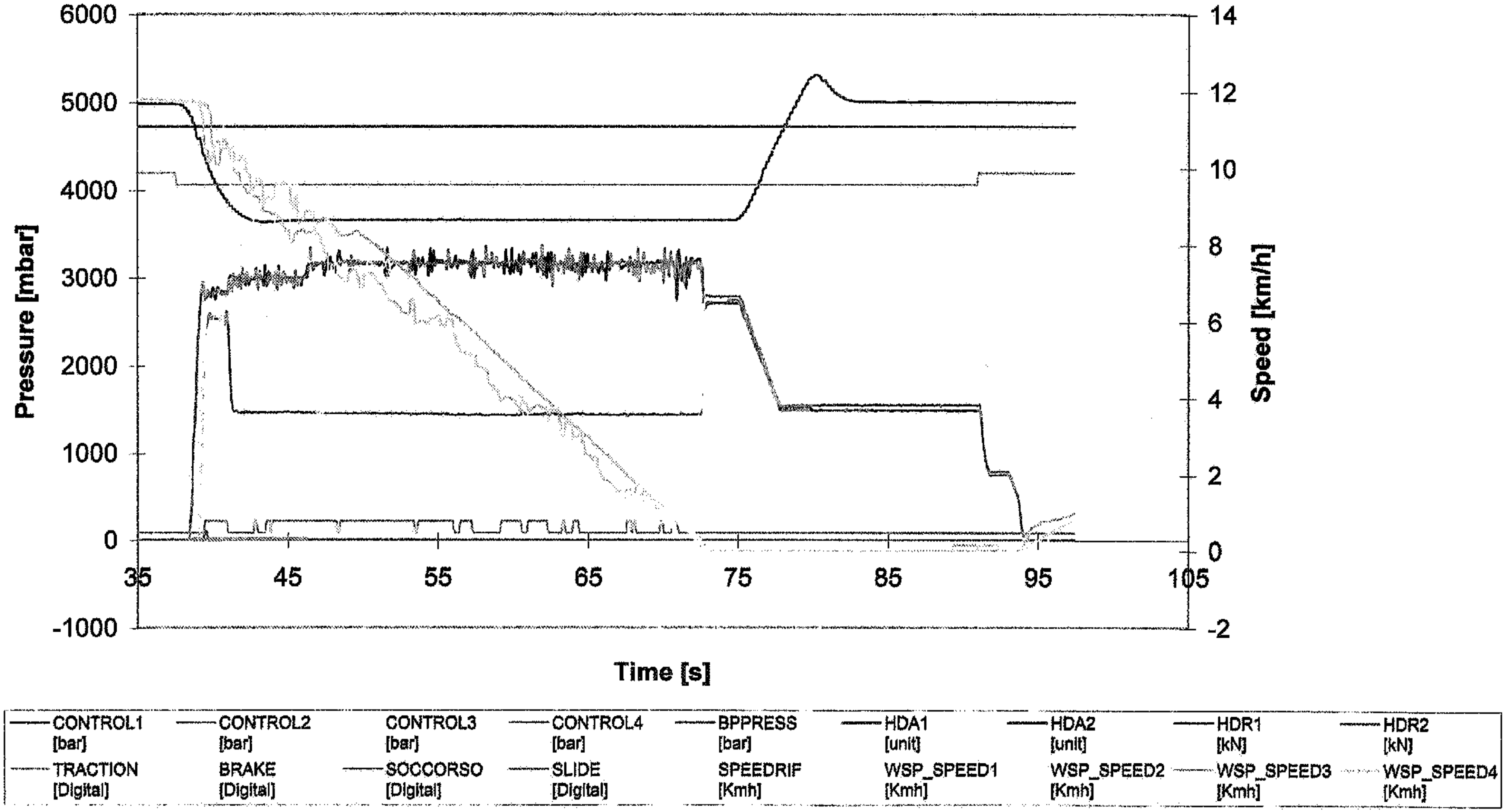

km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar08 (Max Service Brake) - M4 axle 1 - GM > 35%
train speed
SpeedRefM4
M4_WSP1
90% of train speed


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar08 (Max Service Brake) - M4 axle 2 - GM > 35%
train speed
SpeedRefM4
M4_WSP2
90% of train speed

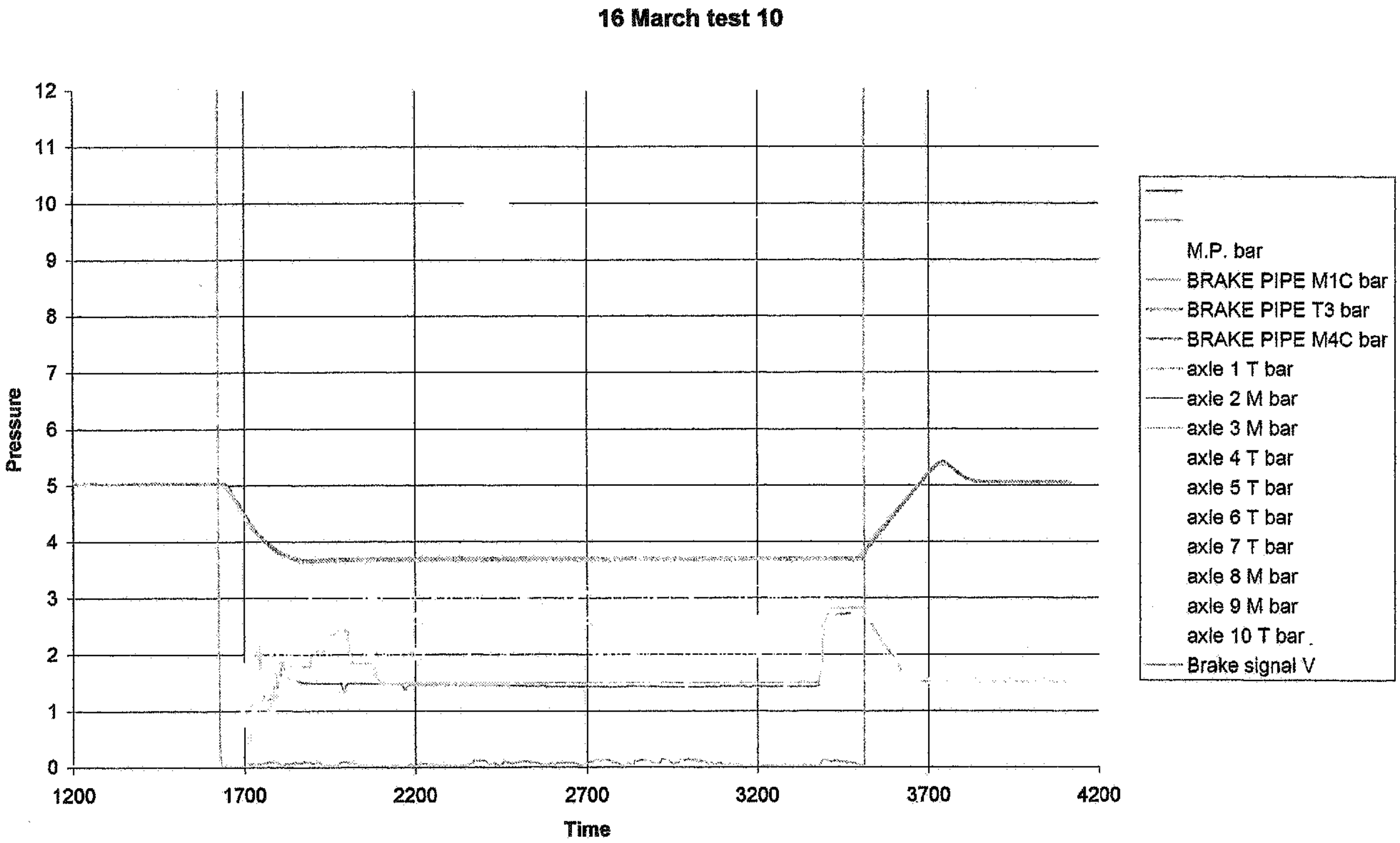

brake [V]
speed [km/h]
a [m/s/s]
slide flags
t
Maximum Service Brake with soap; Vinit.= 118,29 Km/h; braking dist. = 625,32 m; M1; dec = 0,86 m/s/s; Effort Mode; File 16mar10
speed
brake line
slide flag M4
slide flag M1
deceleration
distance
slide flag T3

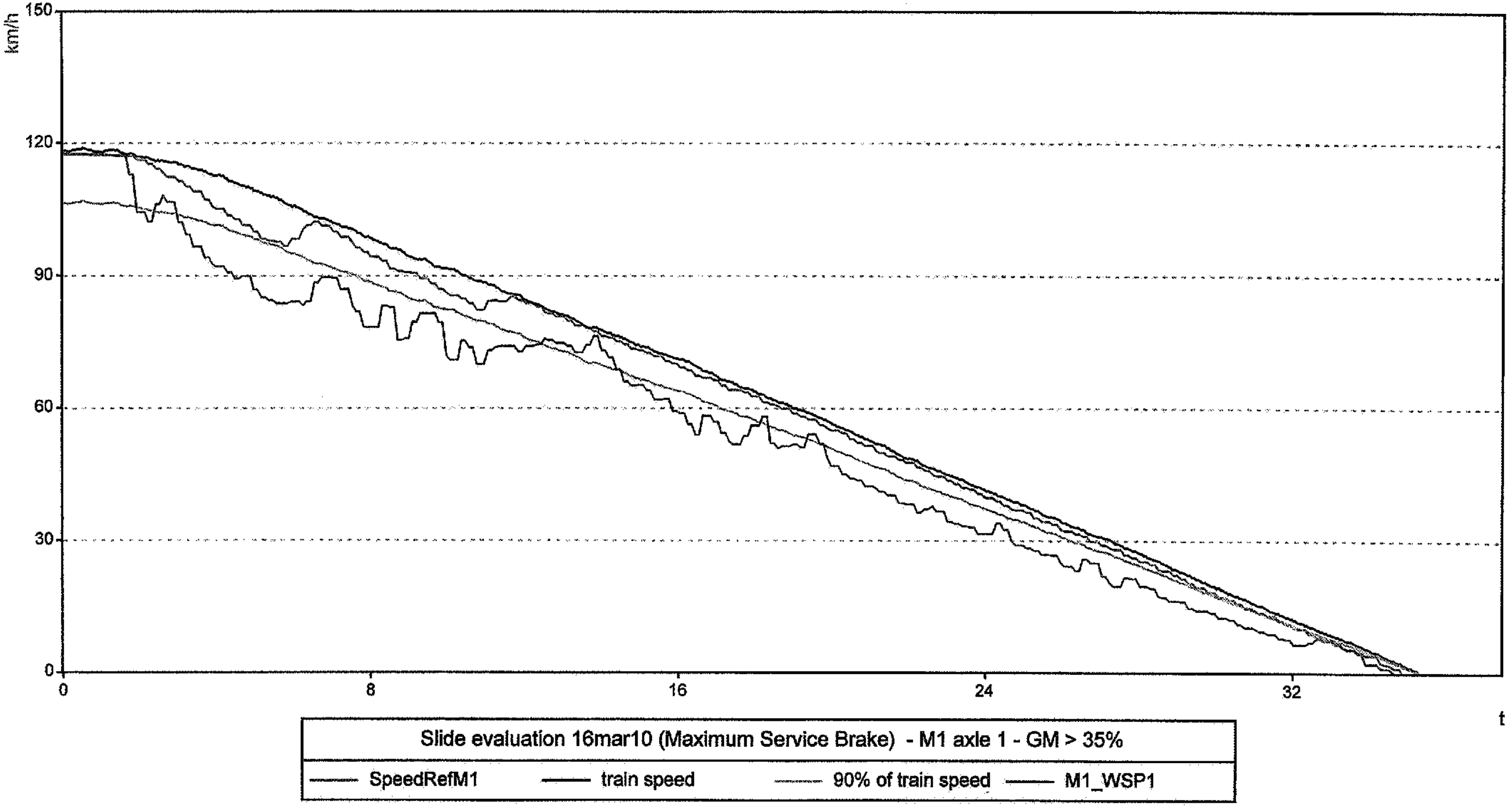

1,2
0,9
0,6
0,3
0
-0,3
0
8
16
24
32
t
Efficiency = 93,1%
Antislide efficiency calculation 16mar10 (Max Service Brake) - Ta = 0,060 - Distance increase = 12,51%
Train acceleration
Peak acceleration

16_mar_10

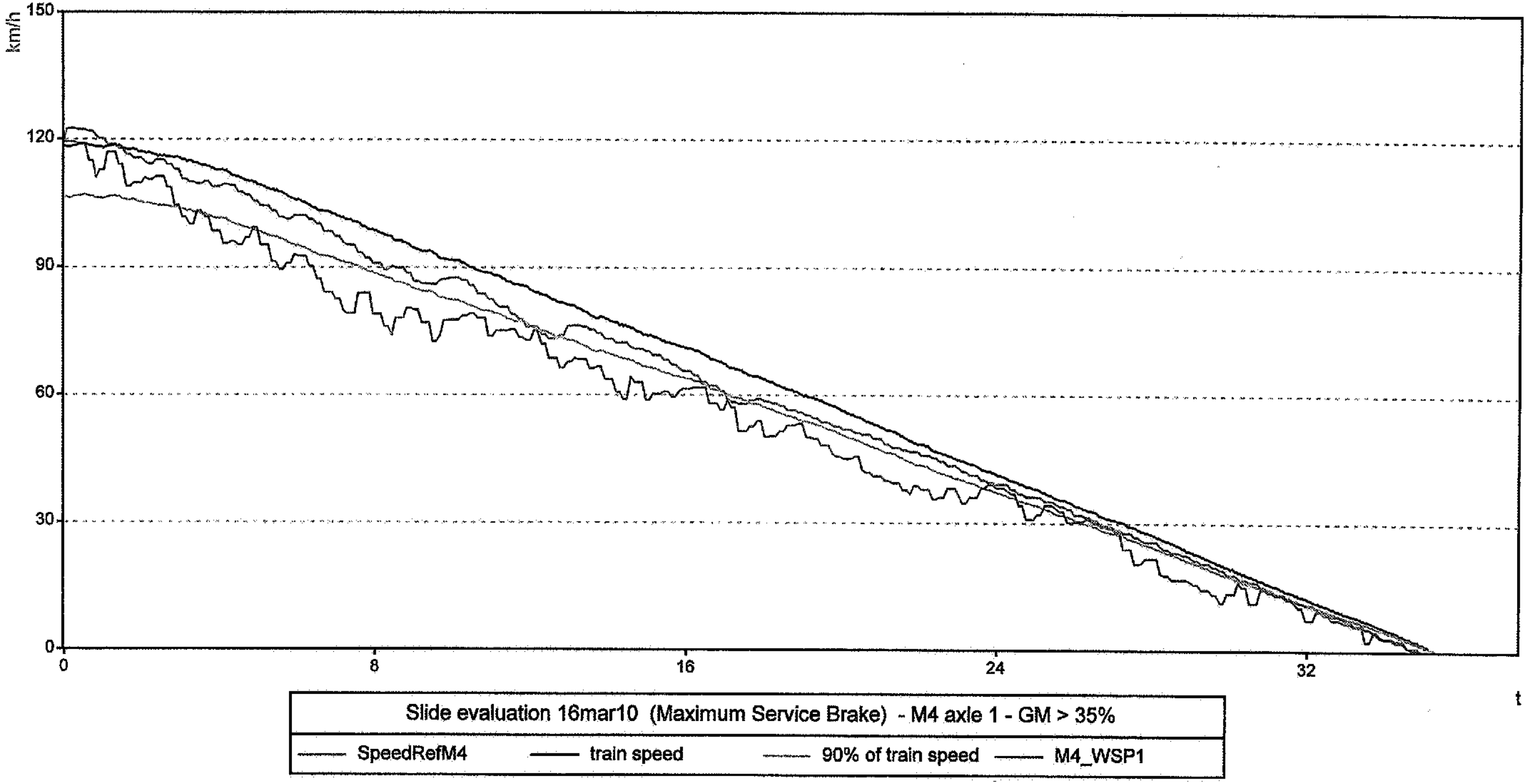


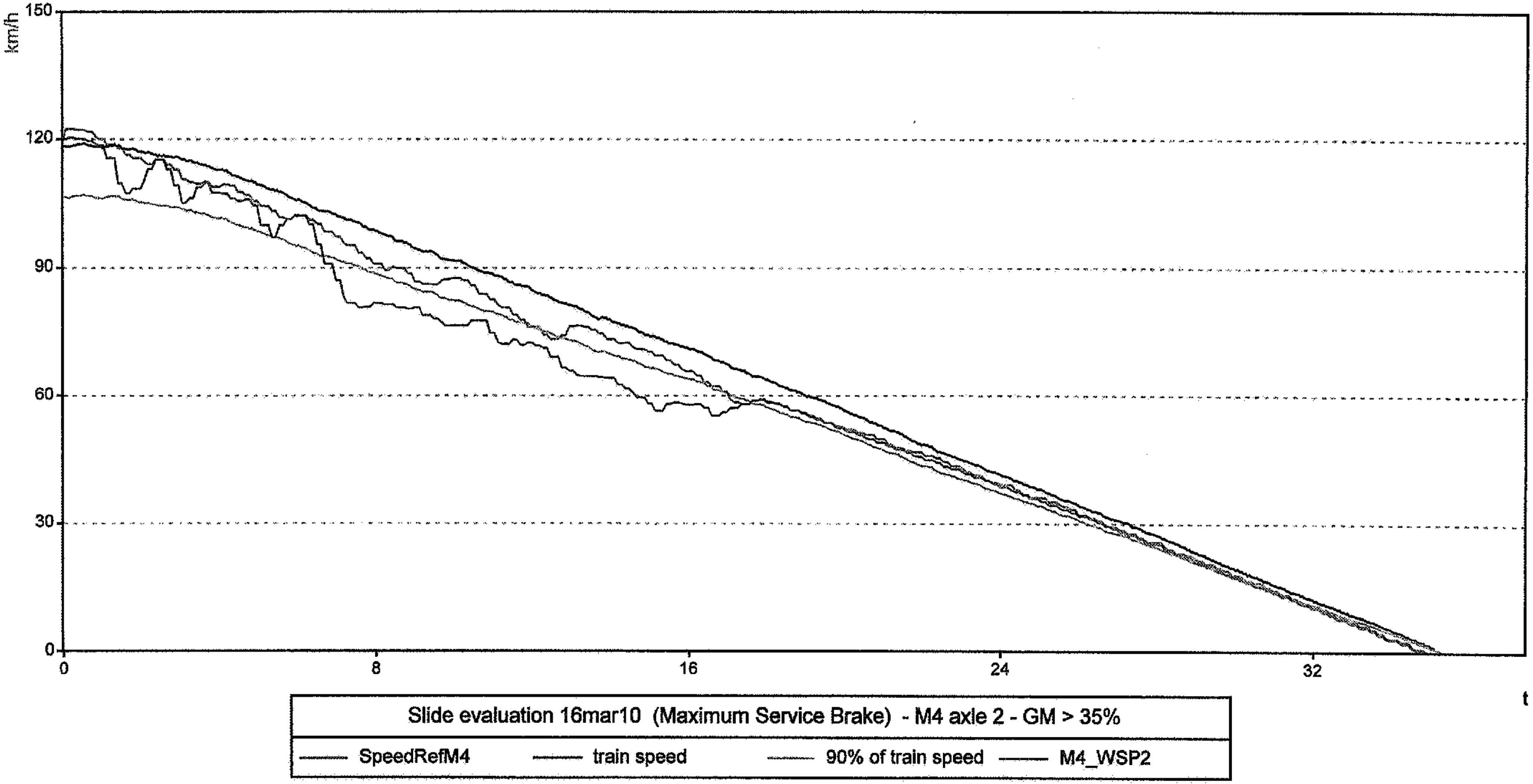
Pressure [mbar]
6000
5000
4000
3000
2000
1000
0
-1000
Speed [km/h]
14
12
10
8
6
4
2
0
-2
35
45
55
65
75
85
95
105
Time [s]
CONTROL1 [bar]
CONTROL2 [bar]
CONTROL3 [bar]
CONTROL4 [bar]
BPPRESS [bar]
HDA1 [unit]
HDA2 [unit]
HDR1 [kN]
HDR2 [kN]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]

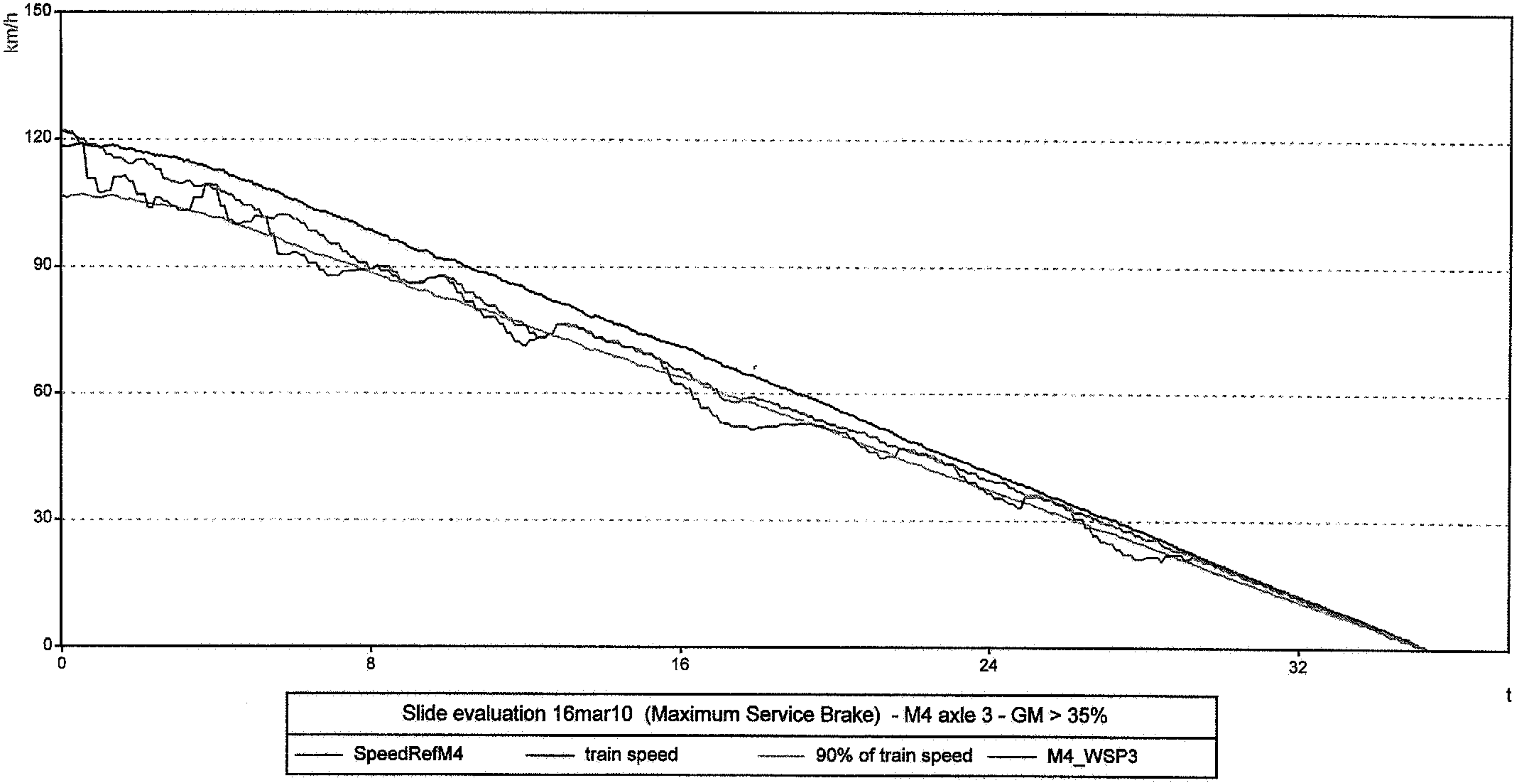

16 March test 10
Pressure
Time
12
11
10
9
8
7
6
5
4
3
2
1
0
1200
1700
2200
2700
3200
3700
4200
M.P. bar
BRAKE PIPE M1C bar
BRAKE PIPE T3 bar
BRAKE PIPE M4C bar
axle 1 T bar
axle 2 M bar
axle 3 M bar
axle 4 T bar
axle 5 T bar
axle 6 T bar
axle 7 T bar
axle 8 M bar
axle 9 M bar
axle 10 T bar
Brake signal V

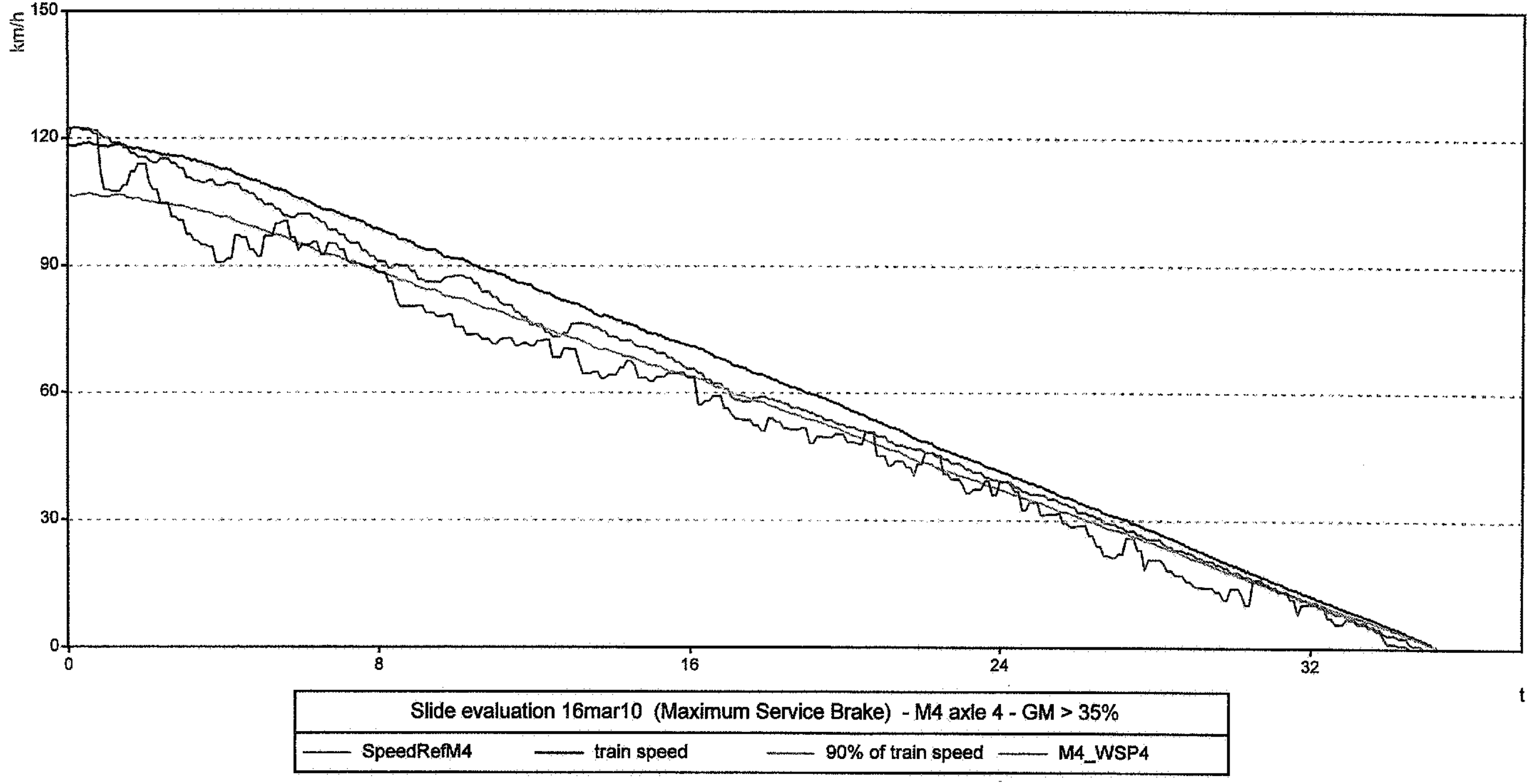


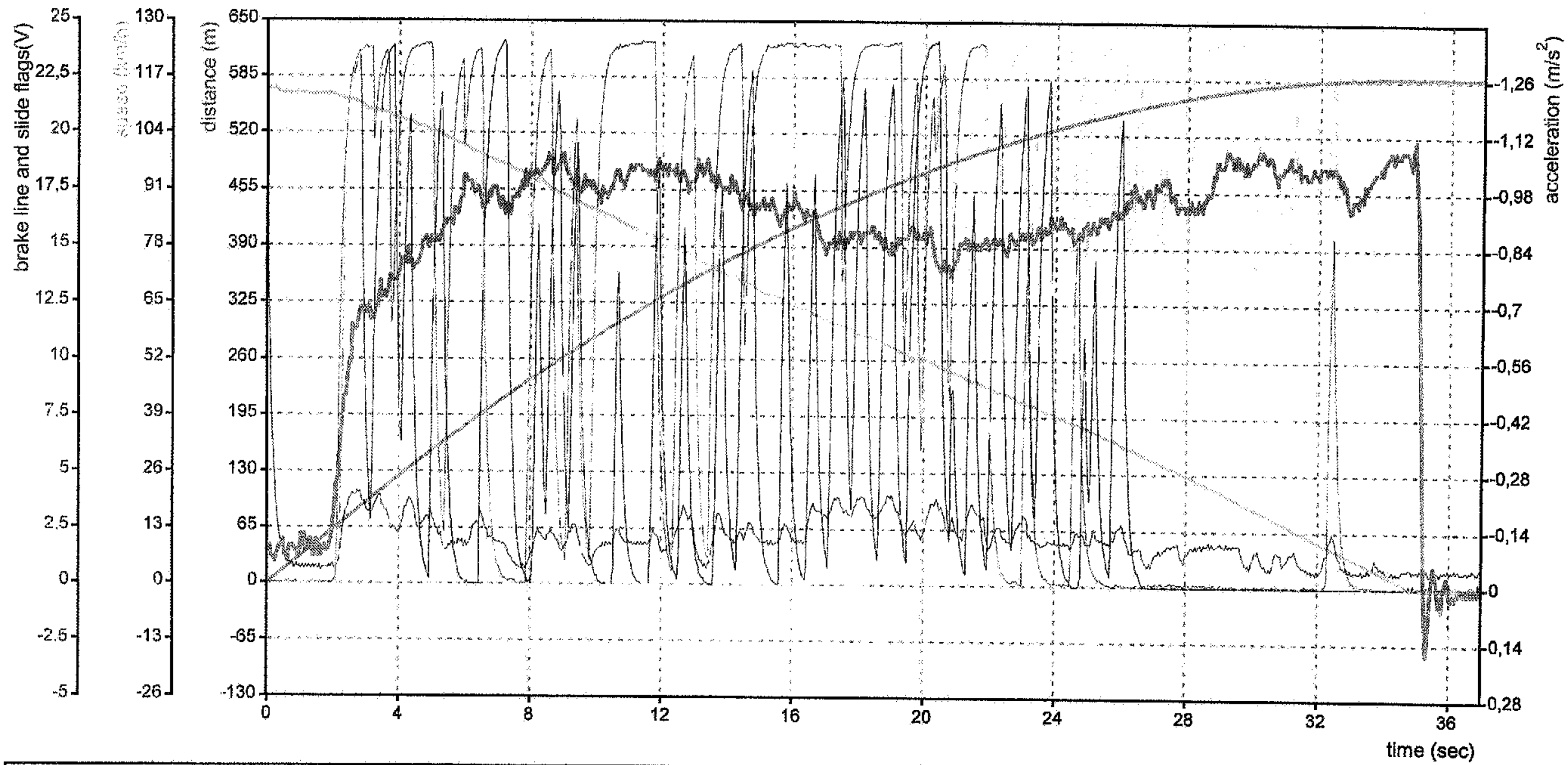
km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar10 (Maximum Service Brake) - M1 axle 1 - GM > 35%
SpeedRefM1
train speed
90% of train speed
M1_WSP1


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar10 (Maximum Service Brake) - M4 axle 1 - GM > 35%
SpeedRefM4
train speed
90% of train speed
M4_WSP1


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar10 (Maximum Service Brake) - M4 axle 2 - GM > 35%
SpeedRefM4
train speed
90% of train speed
M4_WSP2

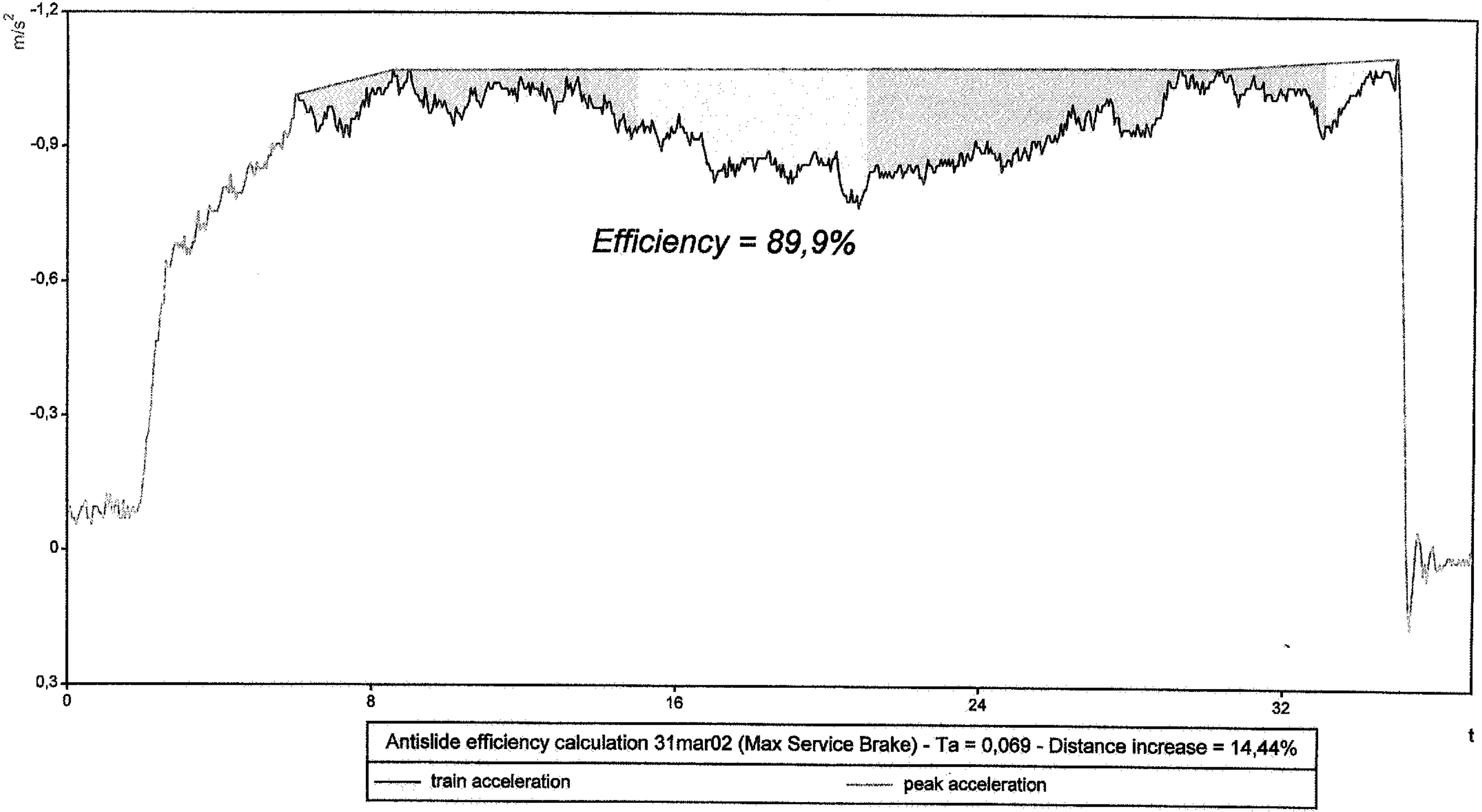

km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar10 (Maximum Service Brake) - M4 axle 3 - GM > 35%
SpeedRefM4
train speed
90% of train speed
M4_WSP3

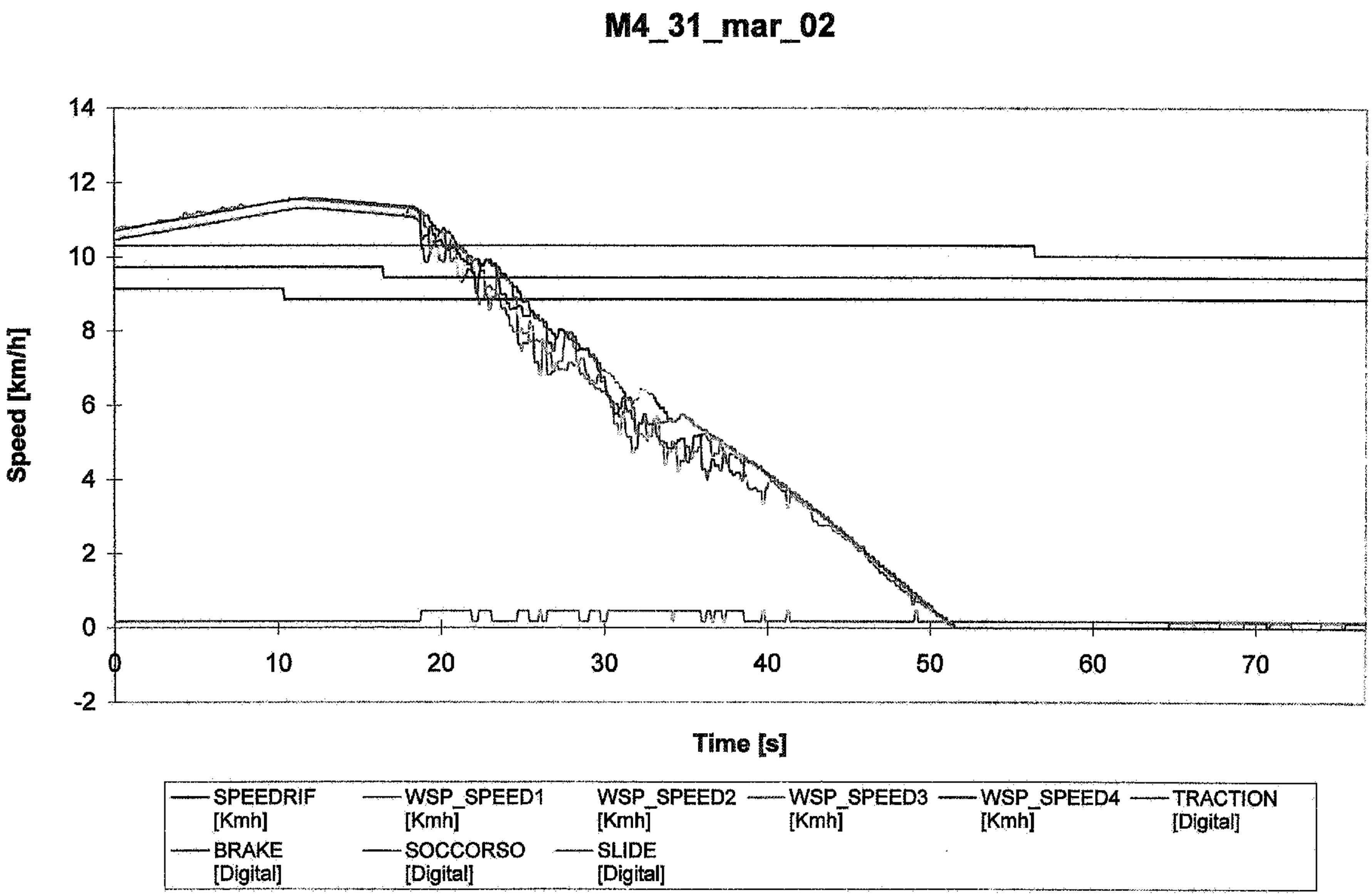

km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar10 (Maximum Service Brake) - M4 axle 4 - GM > 35%
SpeedRefM4
train speed
90% of train speed
M4_WSP4



Max Service Brake with soap from M4; dry rail; initial speed = 113,73 km/h; stopp. distance = 587,99 m; mean deceleration = 0,85 m/s^2; File: 31mar02

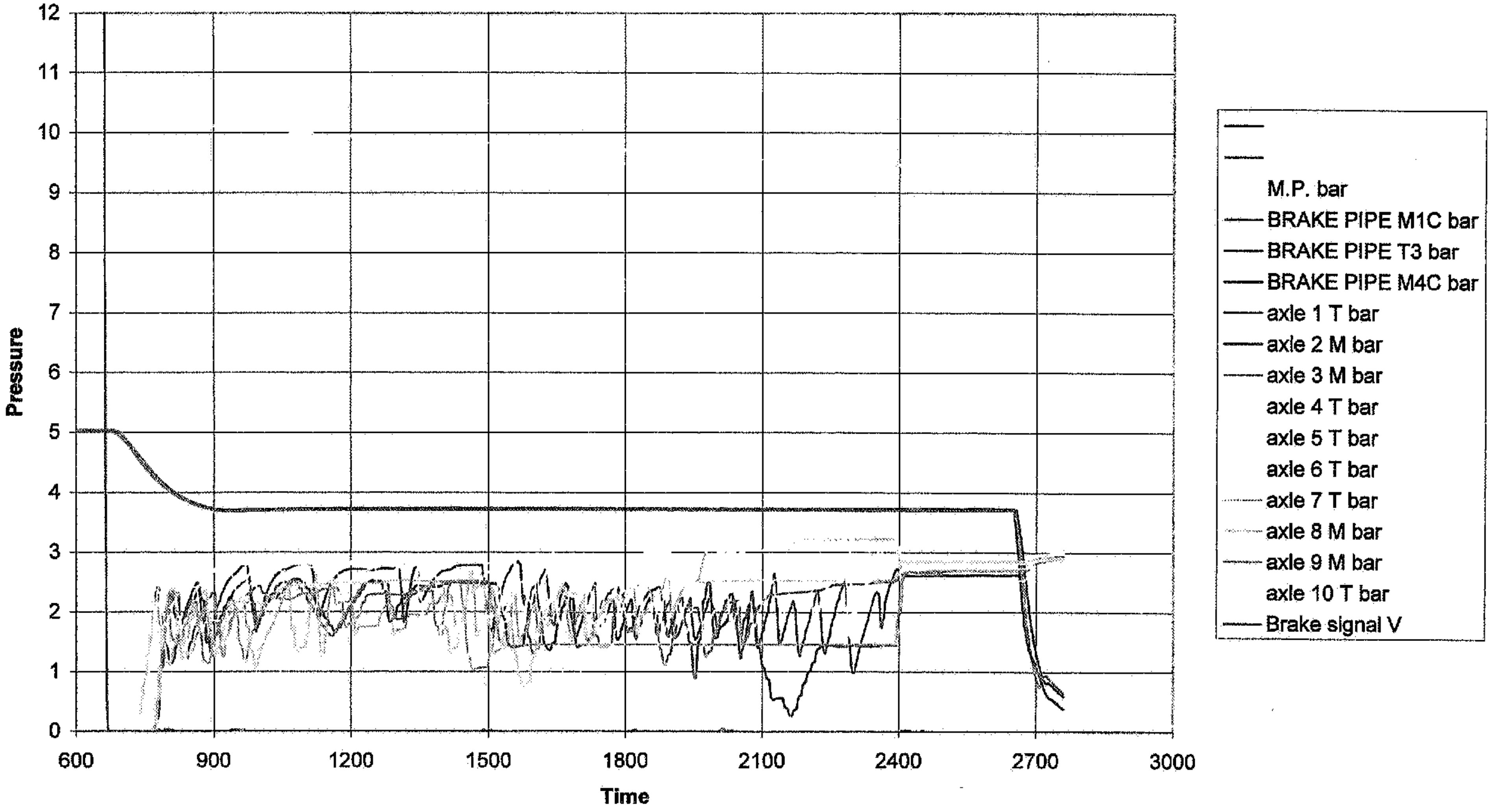
speed — distance — brake line — acceleration — Slide flag T3 — slide flag M4 — Slide flag M1

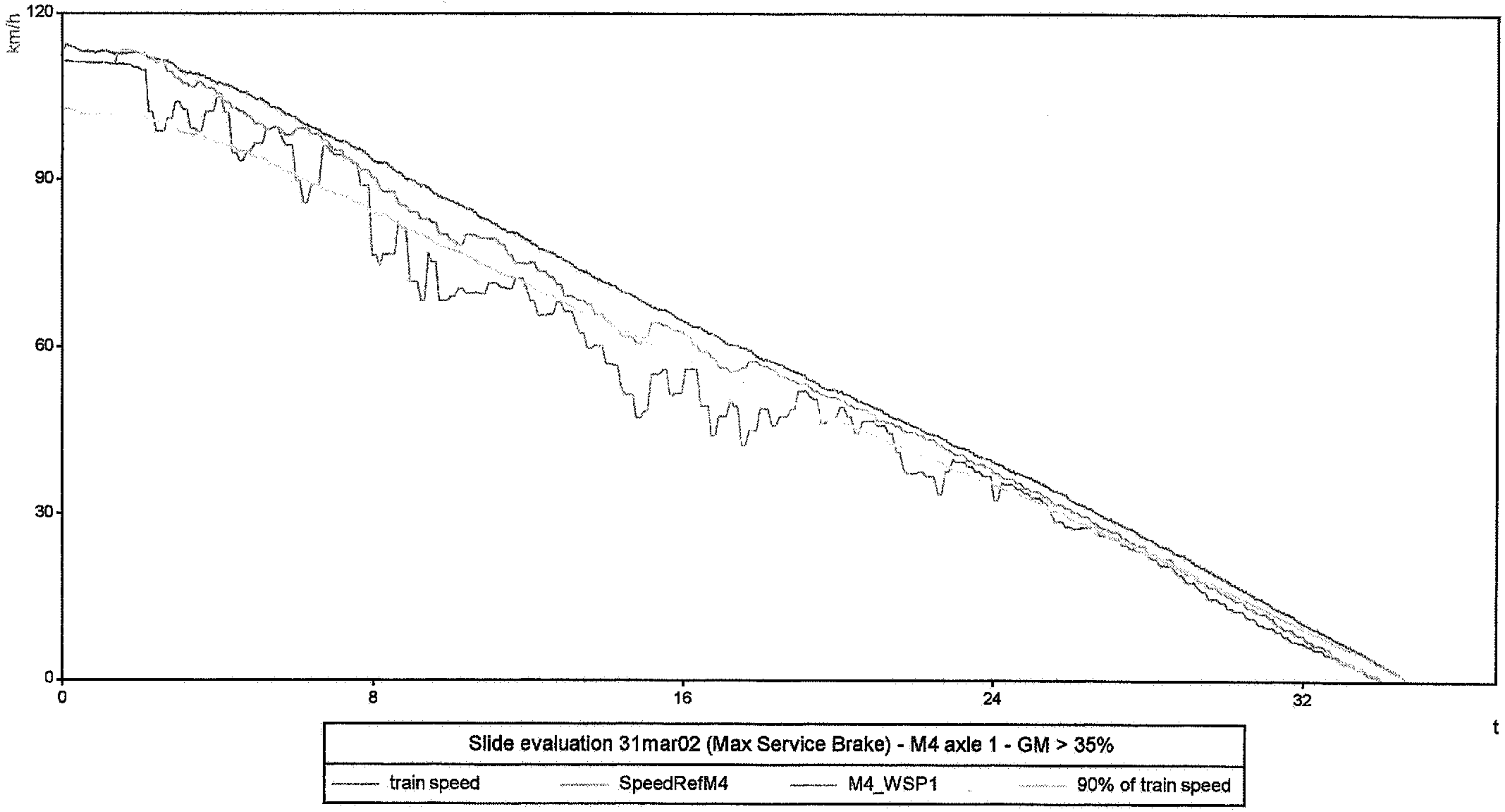

m/s2
-1,2
-0,9
-0,6
-0,3
0
0,3
0
8
16
24
32
t
Efficiency = 89,9%
Antislide efficiency calculation 31mar02 (Max Service Brake) - Ta = 0,069 - Distance increase = 14,44%
train acceleration
peak acceleration

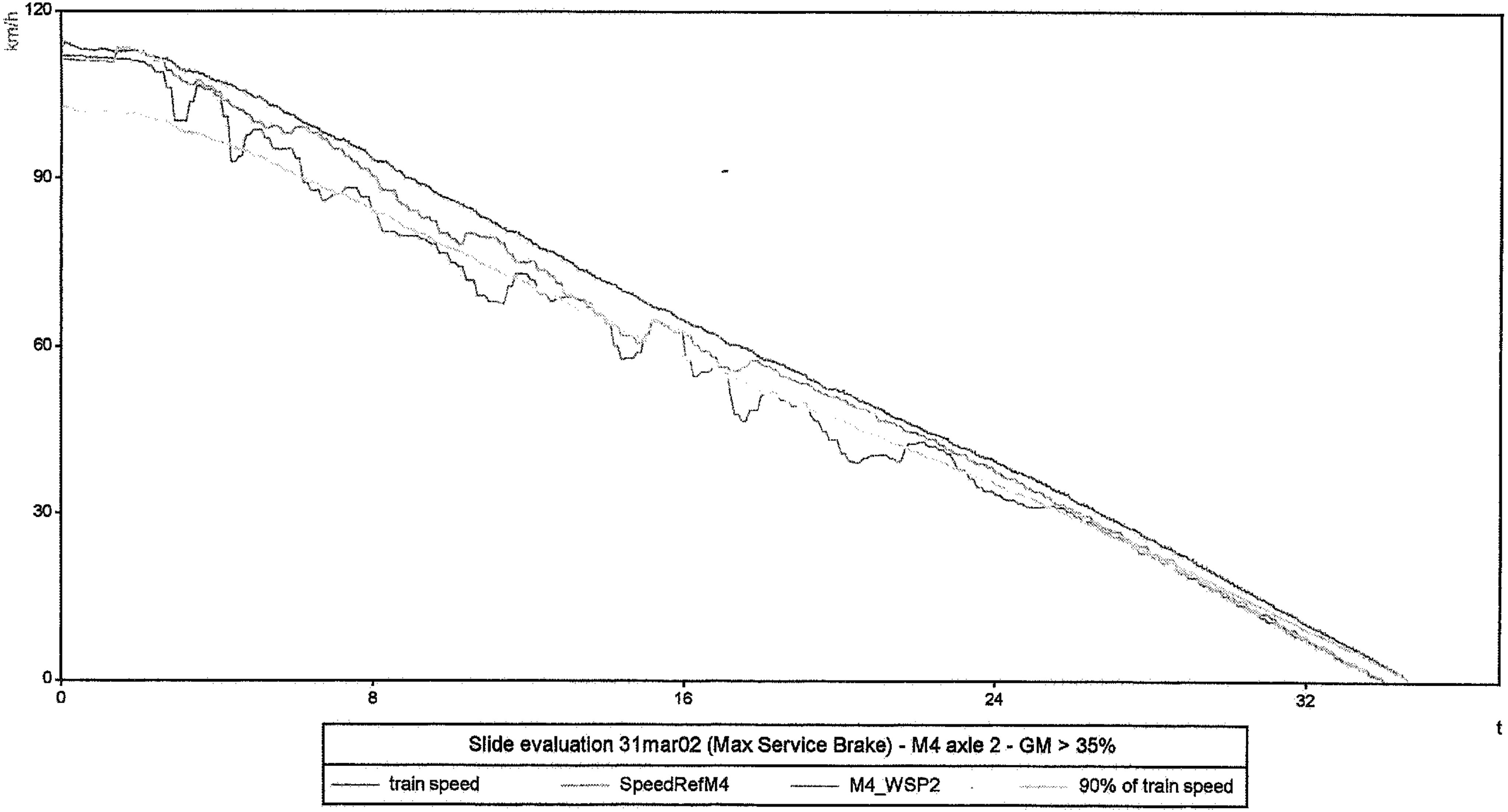


M4_31_mar_02
Speed [km/h]
14
12
10
8
6
4
2
0
-2
0
10
20
30
40
50
60
70
Time [s]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]

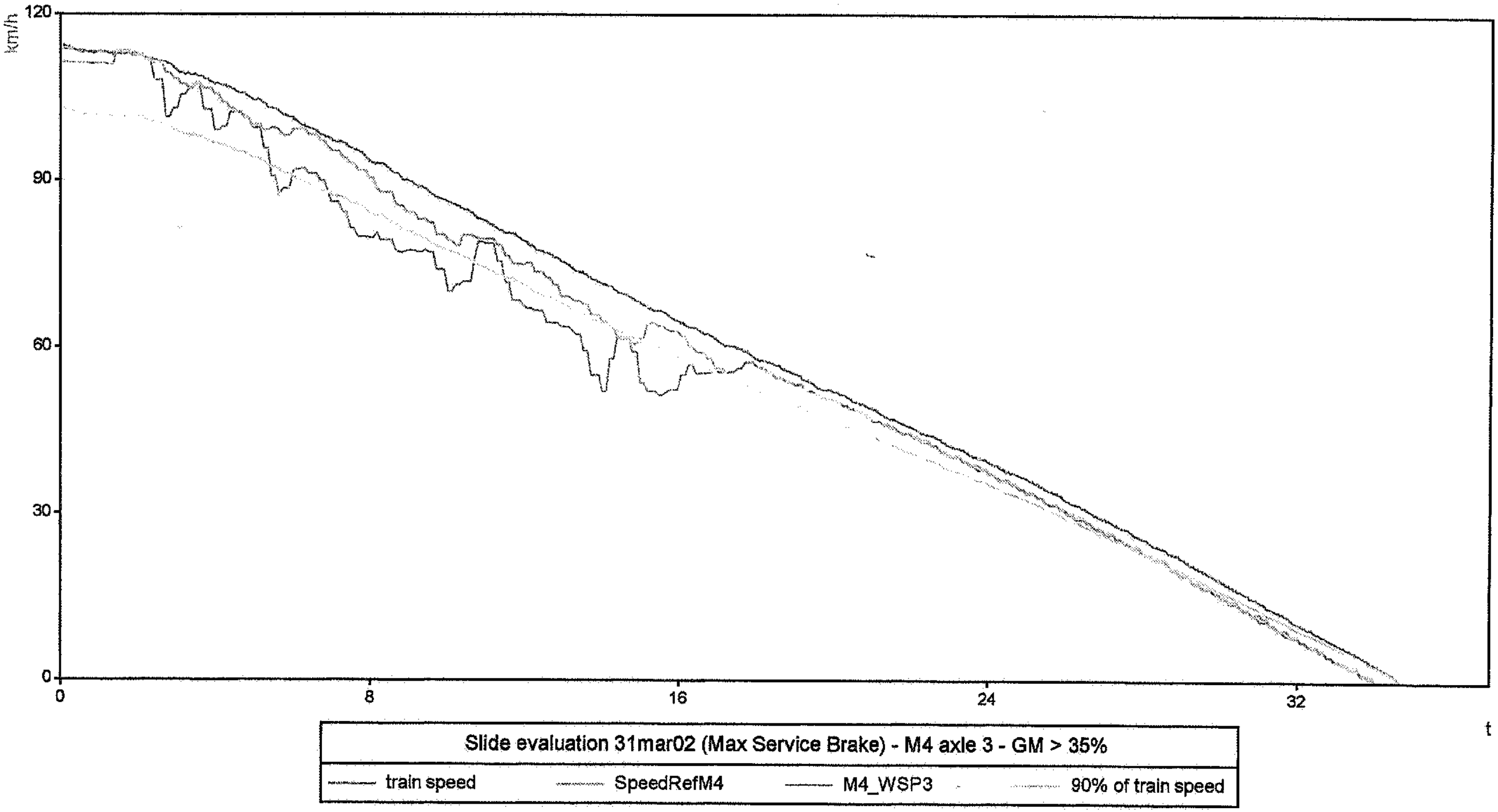
31 March Test 02



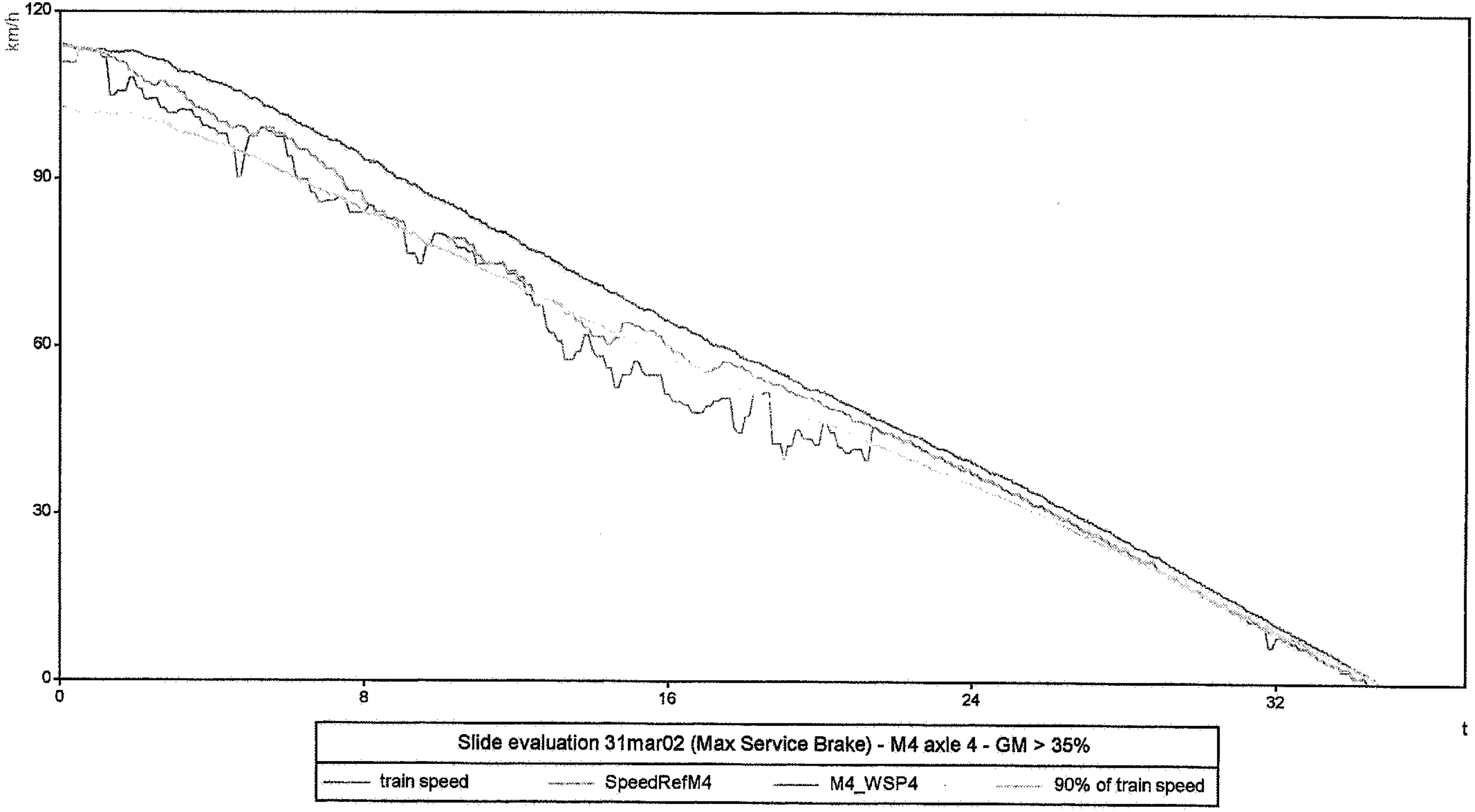

km/h
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 31mar02 (Max Service Brake) - M4 axle 1 - GM > 35%
train speed
SpeedRefM4
M4_WSP1
90% of train speed



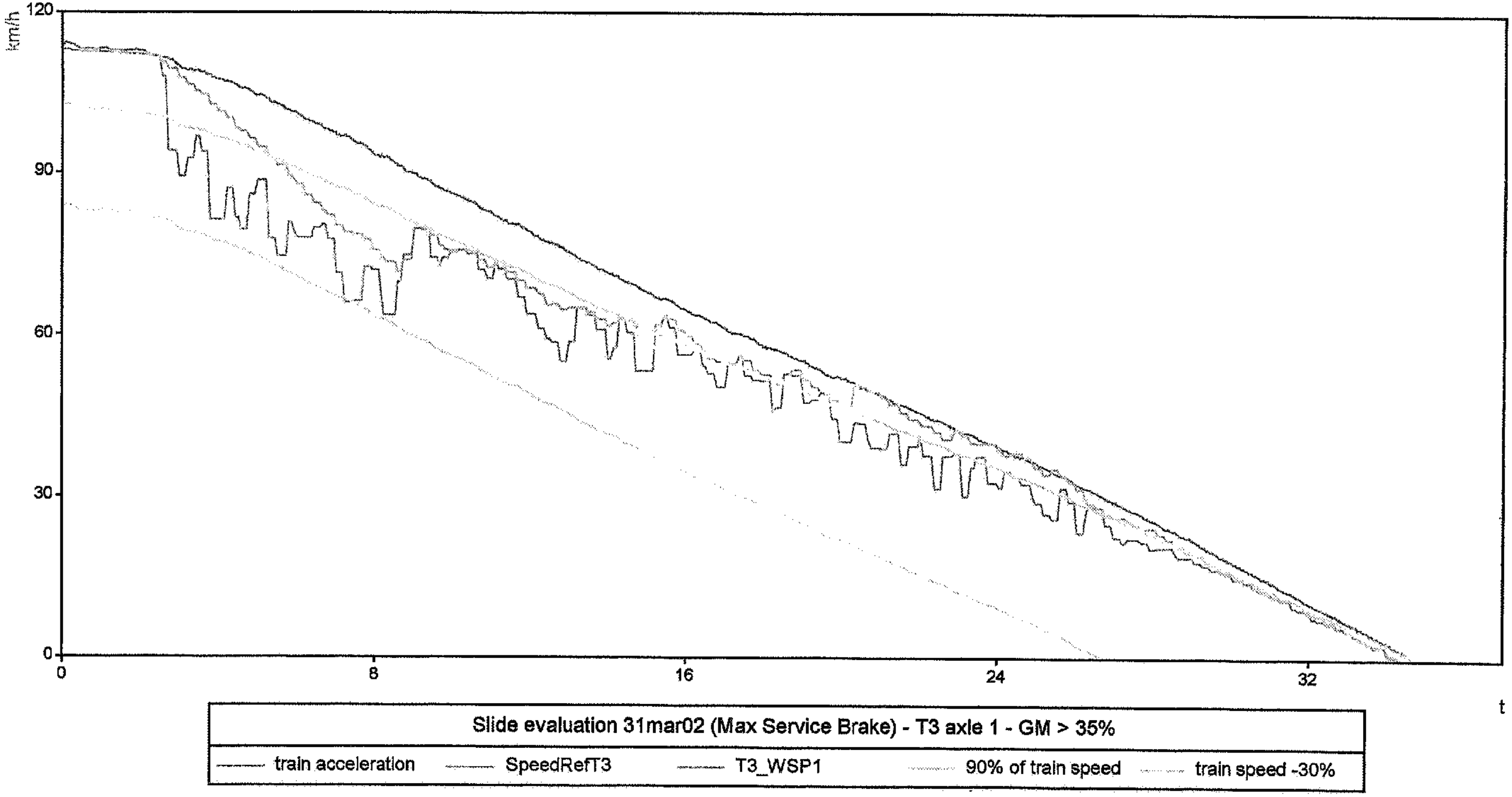
km/h
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 31mar02 (Max Service Brake) - M4 axle 2 - GM > 35%
train speed
SpeedRefM4
M4_WSP2
90% of train speed

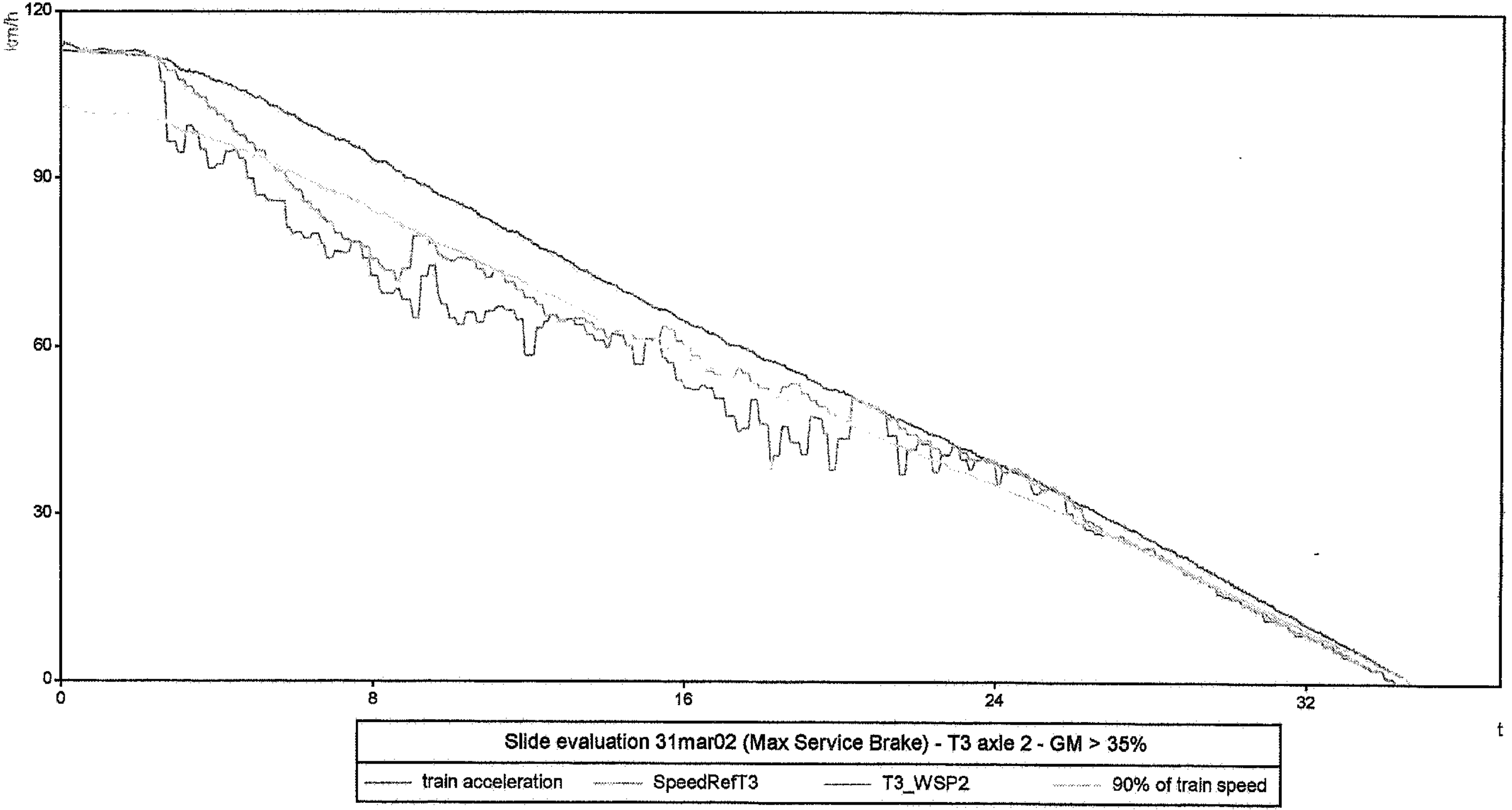


km/h
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 31mar02 (Max Service Brake) - M4 axle 3 - GM > 35%
train speed
SpeedRefM4
M4_WSP3
90% of train speed

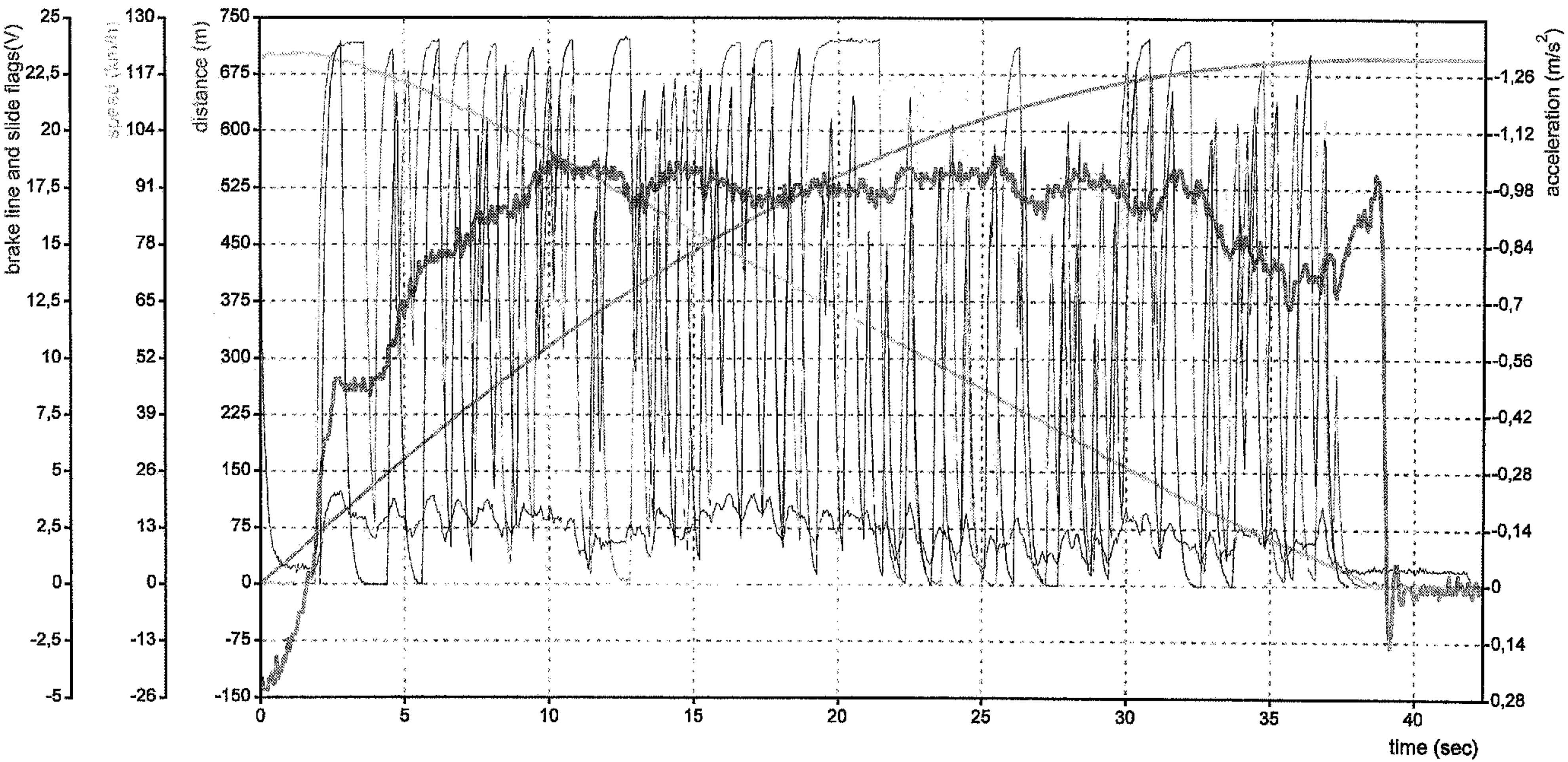


km/h
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 31mar02 (Max Service Brake) - M4 axle 4 - GM > 35%
train speed
SpeedRefM4
M4_WSP4
90% of train speed


km/h
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 31mar02 (Max Service Brake) - T3 axle 1 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP1
90% of train speed
train speed -30%

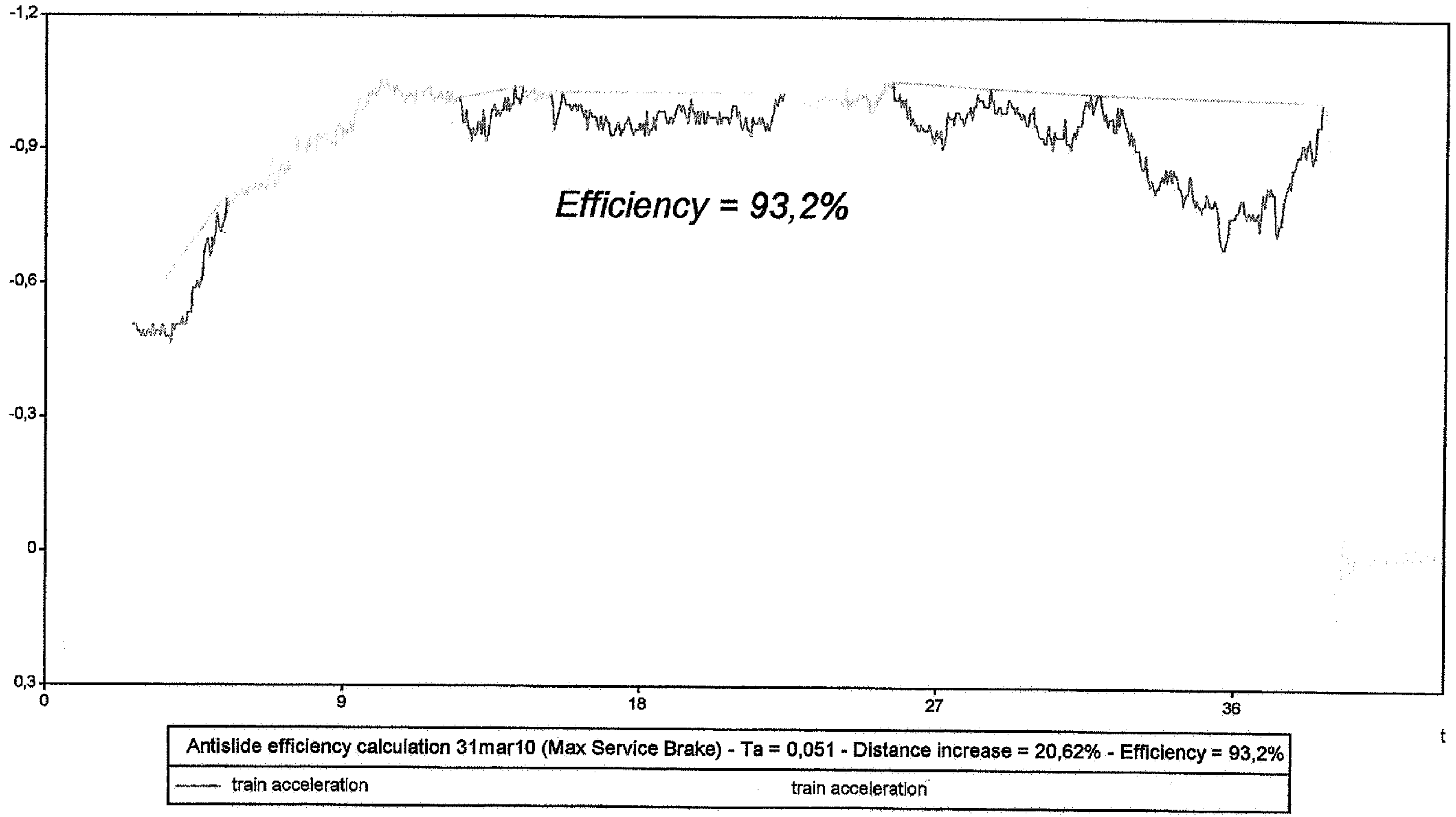


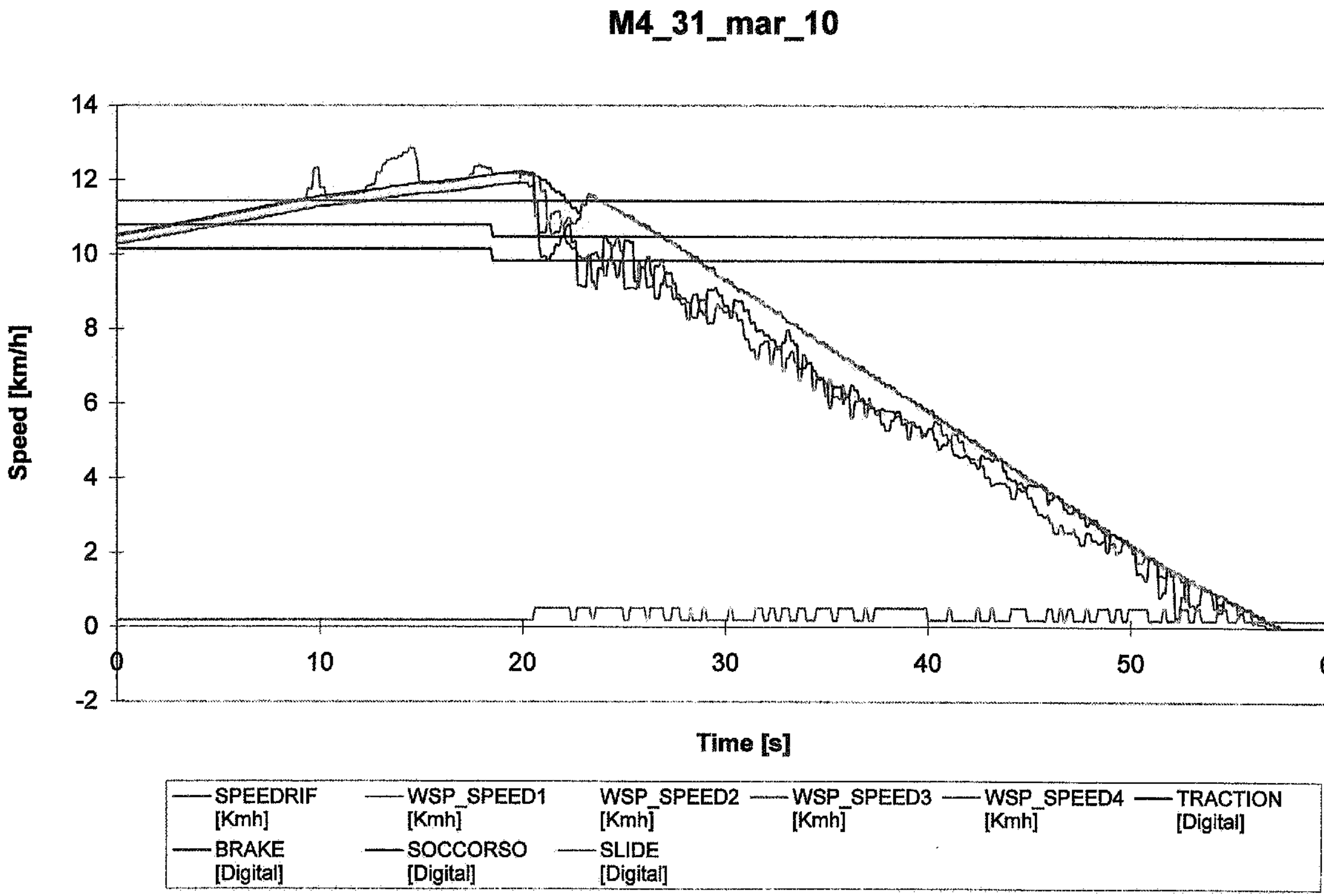
km/h
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 31mar02 (Max Service Brake) - T3 axle 2 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP2
90% of train speed

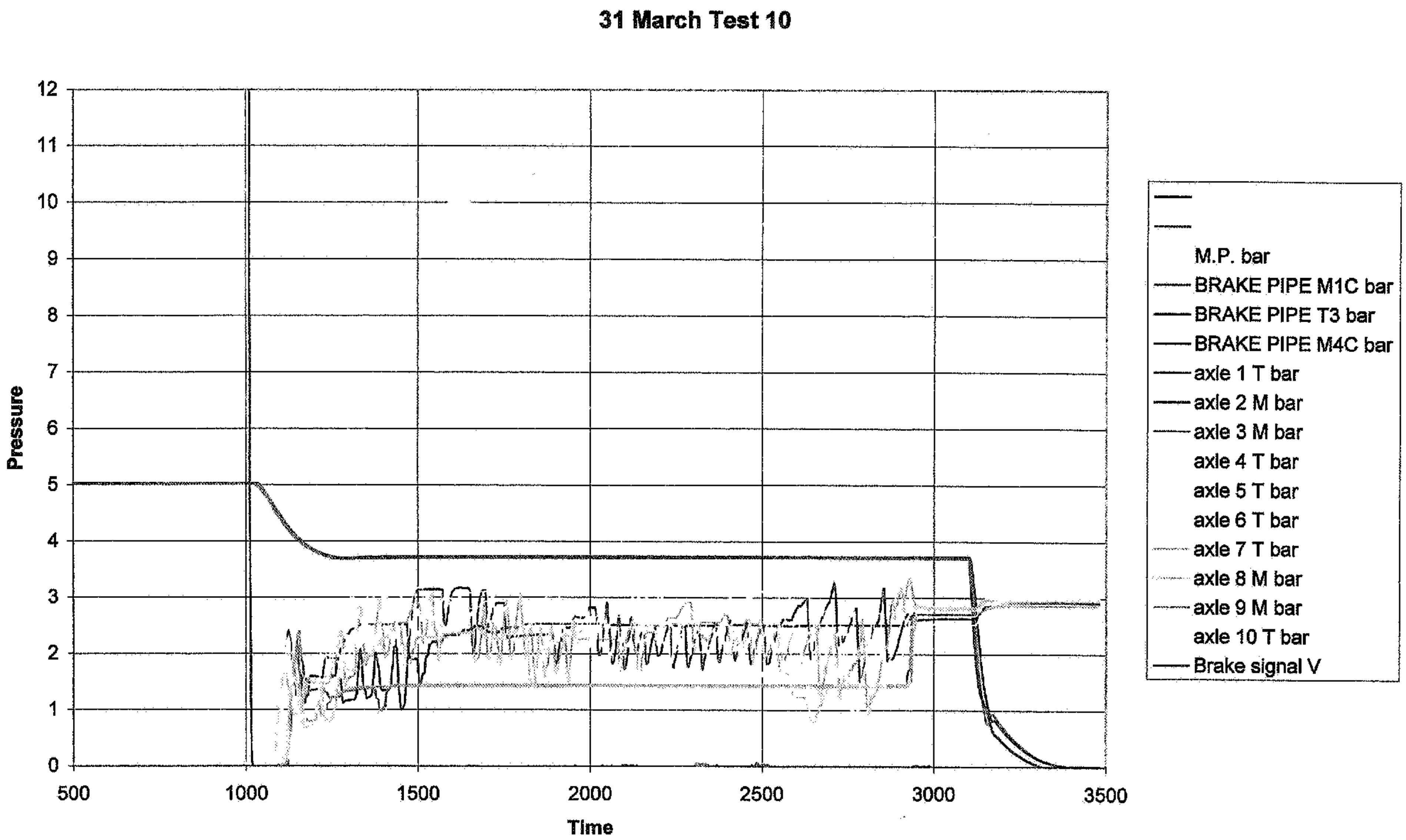


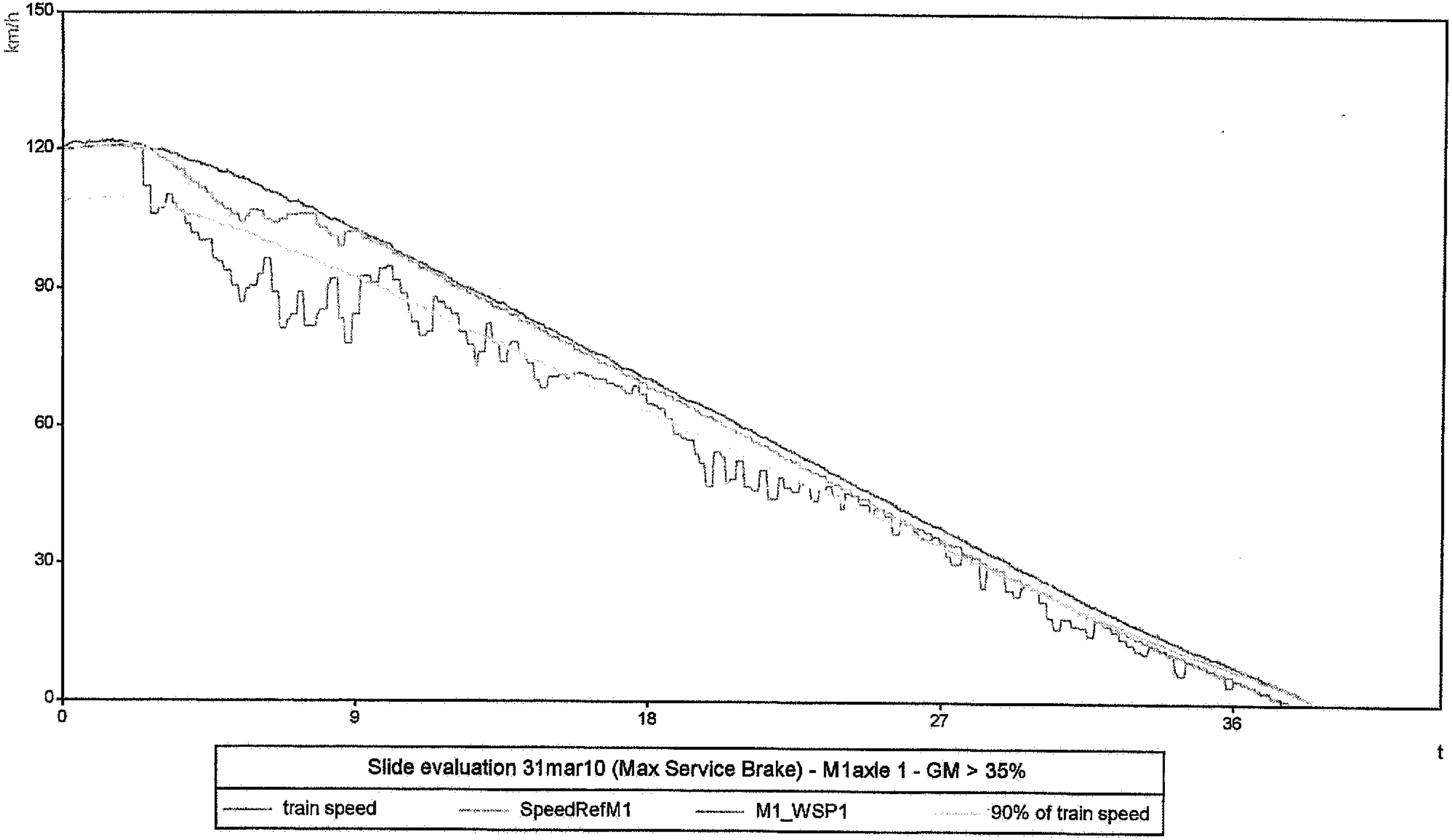
Max Service Brake with soap from M4; dry rail; initial speed = 120,66 km/h; stopp. distance = 697,58 m; mean deceleration = 0,81 m/s^2; File: 31mar10

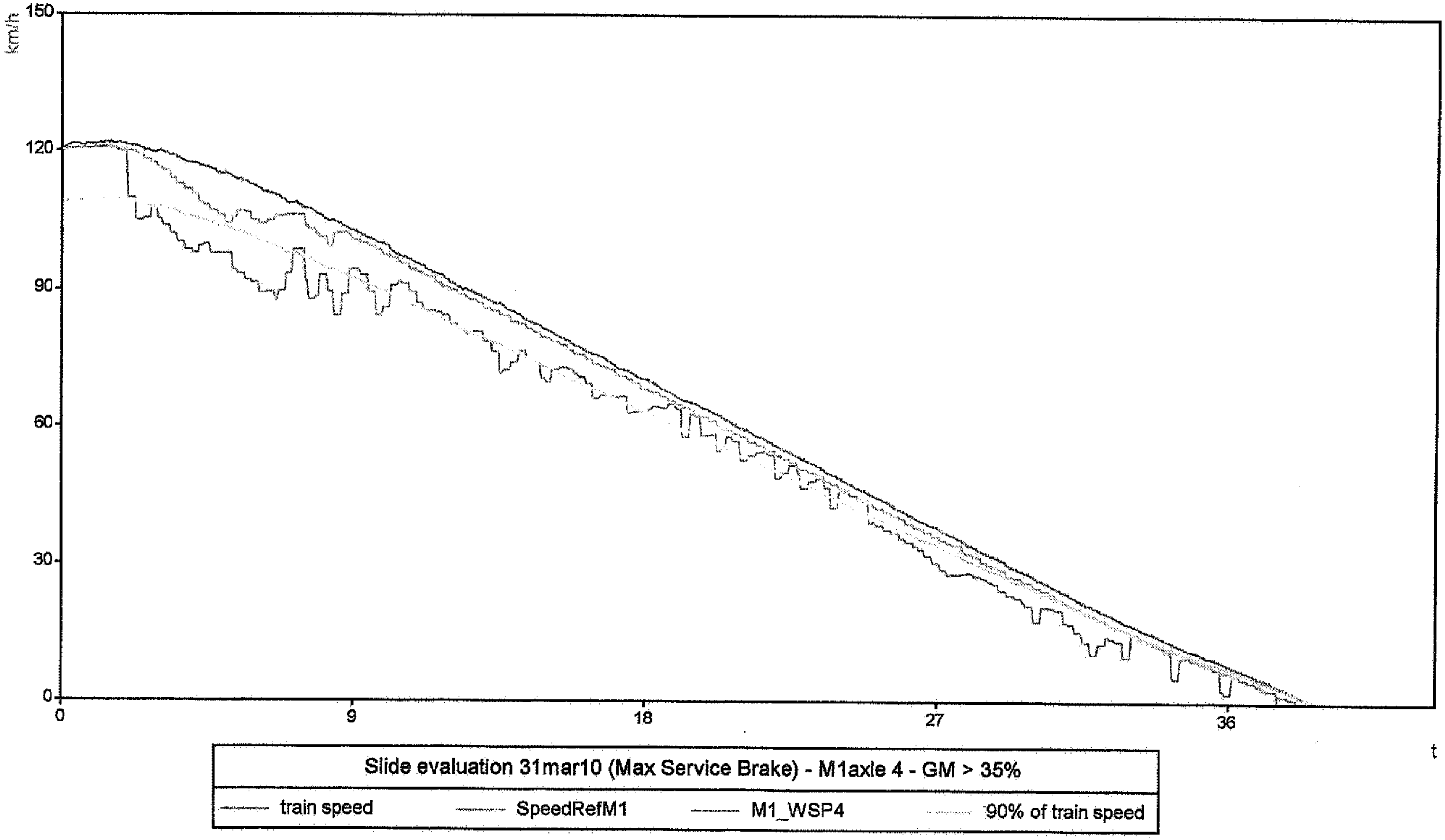
speed	brake line	Slide flag T3	Slide flag M1
distance	acceleration	slide flag M4	

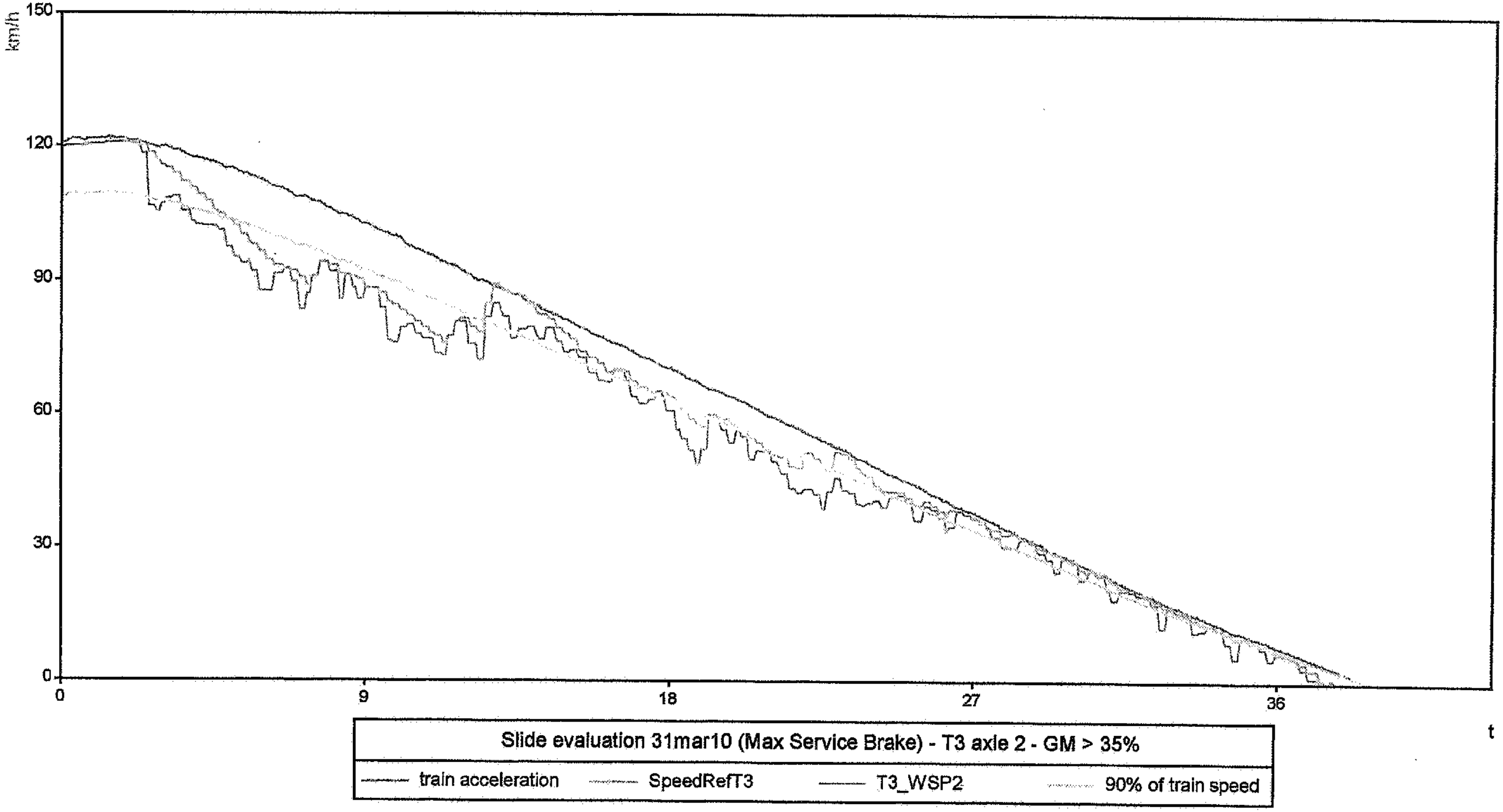

-1,2
-0,9
-0,6
-0,3
0
0,3
0
9
18
27
36
t
Efficiency = 93,2%
Antislide efficiency calculation 31mar10 (Max Service Brake) - Ta = 0,051 - Distance increase = 20,62% - Efficiency = 93,2%
train acceleration
train acceleration

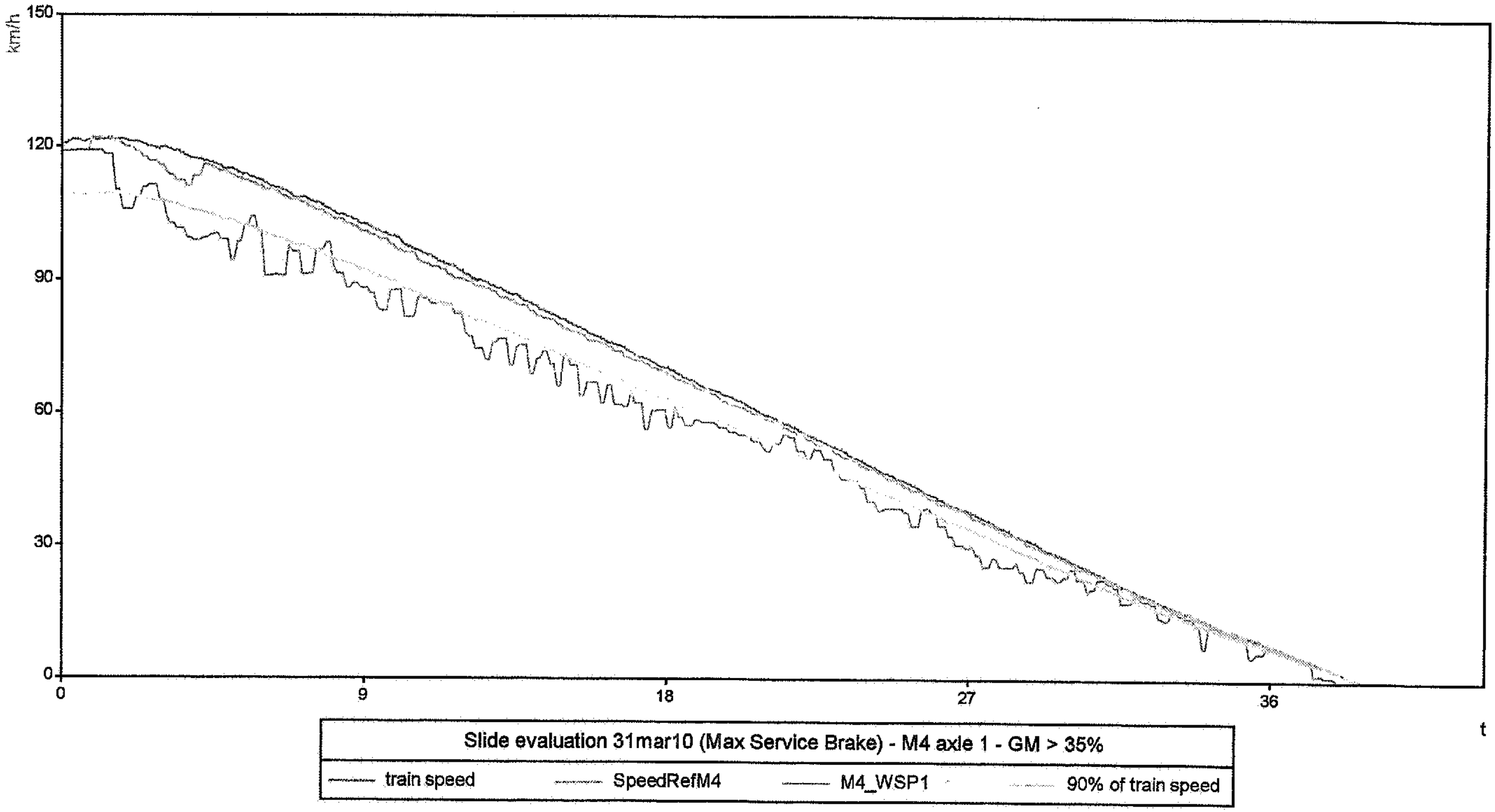

M4_31_mar_10
Speed [km/h]
14
12
10
8
6
4
2
0
-2
0
10
20
30
40
50
60
Time [s]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]

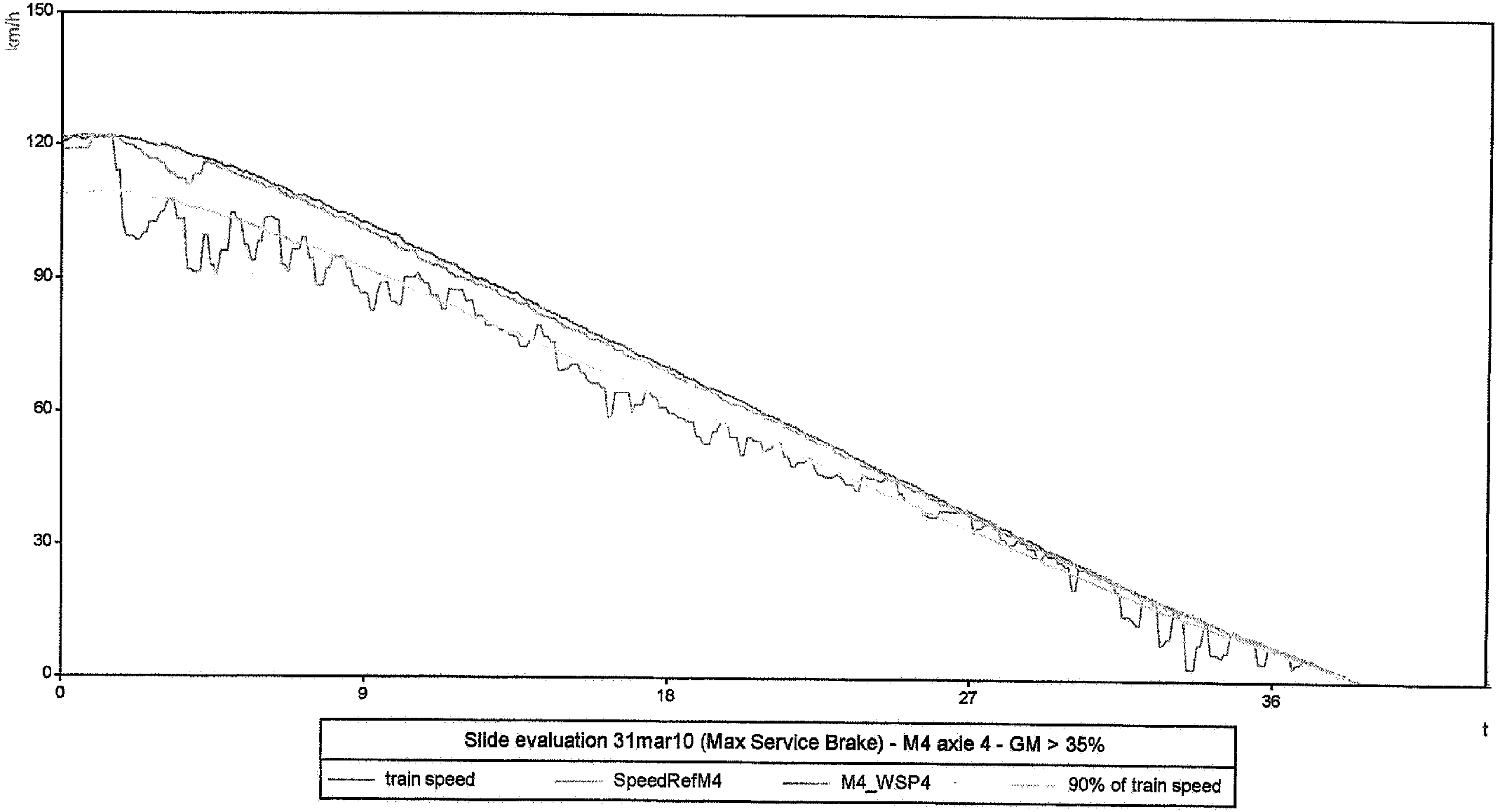

31 March Test 10
Pressure
Time
12
11
10
9
8
7
6
5
4
3
2
1
0
500
1000
1500
2000
2500
3000
3500
M.P. bar
BRAKE PIPE M1C bar
BRAKE PIPE T3 bar
BRAKE PIPE M4C bar
axle 1 T bar
axle 2 M bar
axle 3 M bar
axle 4 T bar
axle 5 T bar
axle 6 T bar
axle 7 T bar
axle 8 M bar
axle 9 M bar
axle 10 T bar
Brake signal V

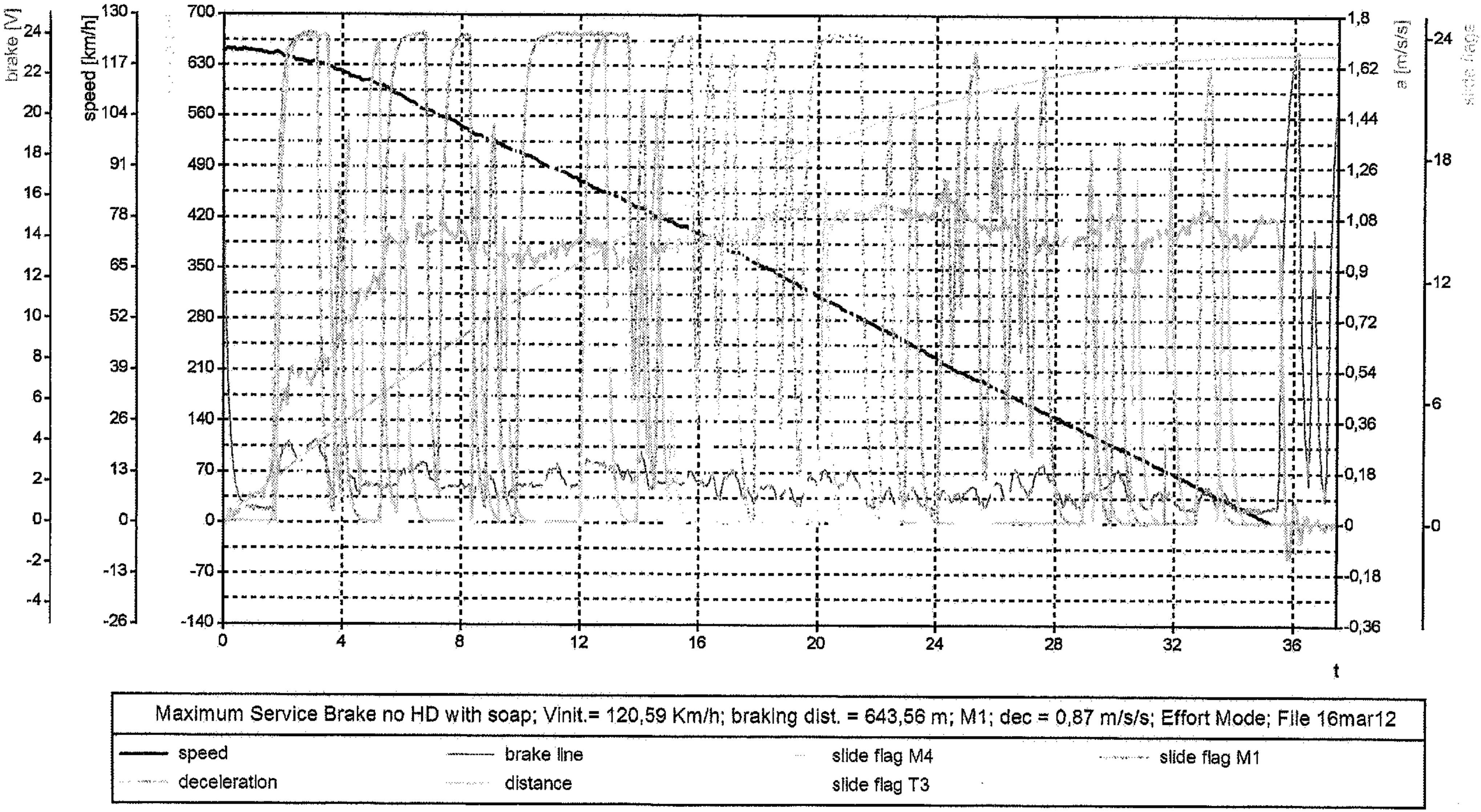

km/h
150
120
90
60
30
0
0
9
18
27
36
t
Slide evaluation 31mar10 (Max Service Brake) - M1axle 1 - GM > 35%
train speed
SpeedRefM1
M1_WSP1
90% of train speed


km/h
150
120
90
60
30
0
0
9
18
27
36
t
Slide evaluation 31mar10 (Max Service Brake) - M1axle 4 - GM > 35%
train speed
SpeedRefM1
M1_WSP4
90% of train speed

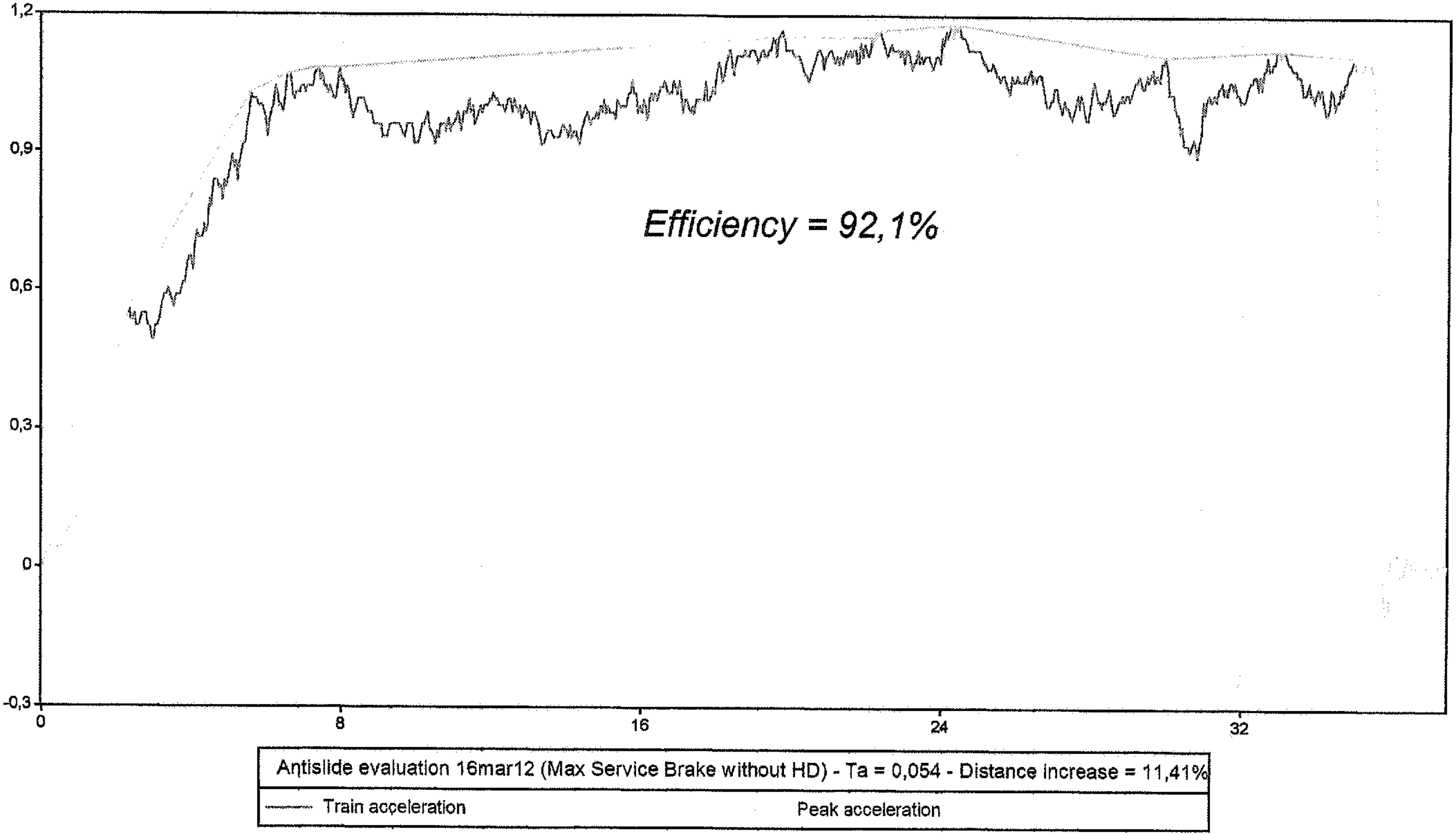

km/h
150
120
90
60
30
0
0
9
18
27
36
t
Slide evaluation 31mar10 (Max Service Brake) - T3 axle 2 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP2
90% of train speed


km/h
150
120
90
60
30
0
0
9
18
27
36
t
Slide evaluation 31mar10 (Max Service Brake) - M4 axle 1 - GM > 35%
train speed
SpeedRefM4
M4_WSP1
90% of train speed

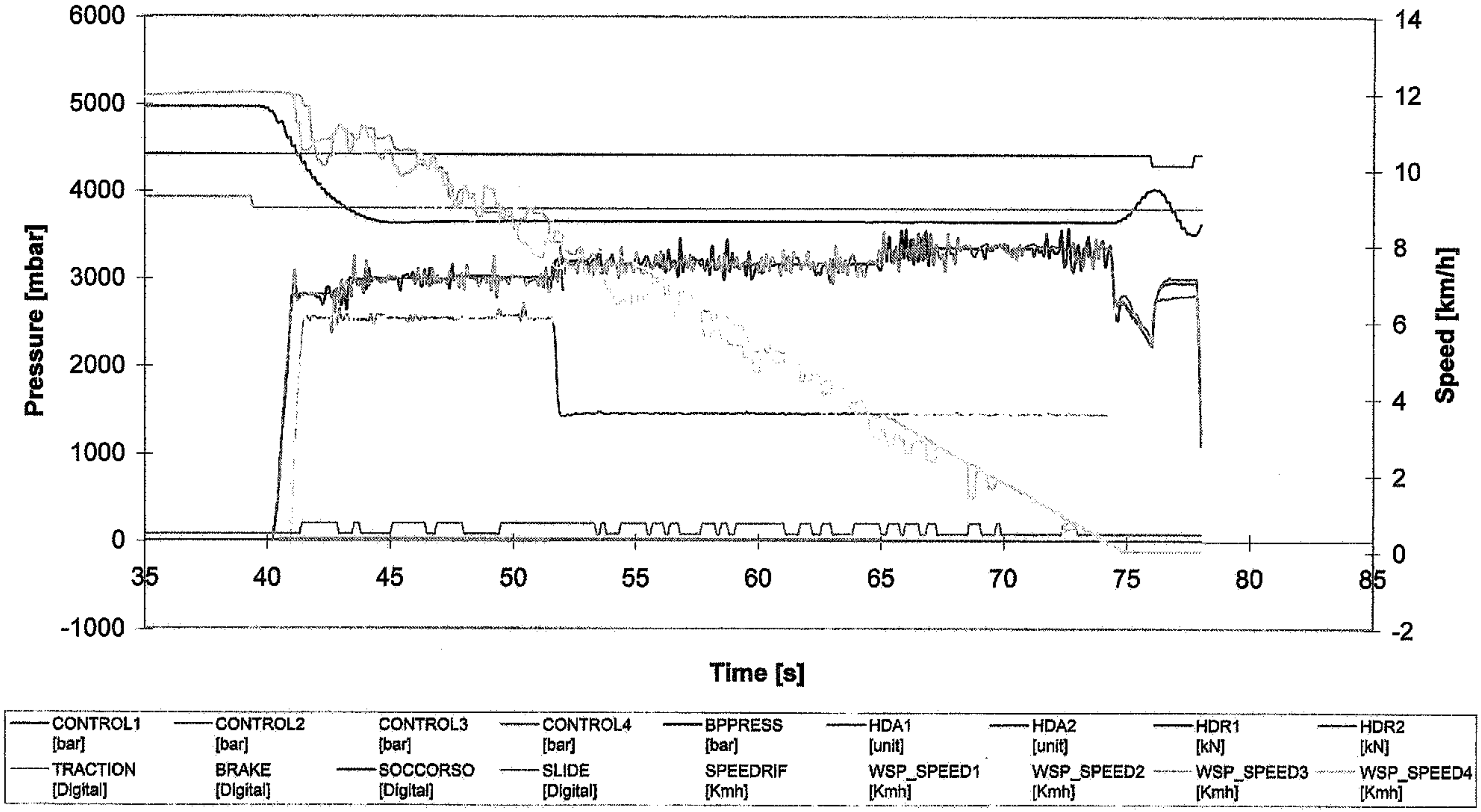

km/h
150
120
90
60
30
0
0
9
18
27
36
t
Slide evaluation 31mar10 (Max Service Brake) - M4 axle 4 - GM > 35%
train speed
SpeedRefM4
M4_WSP4
90% of train speed



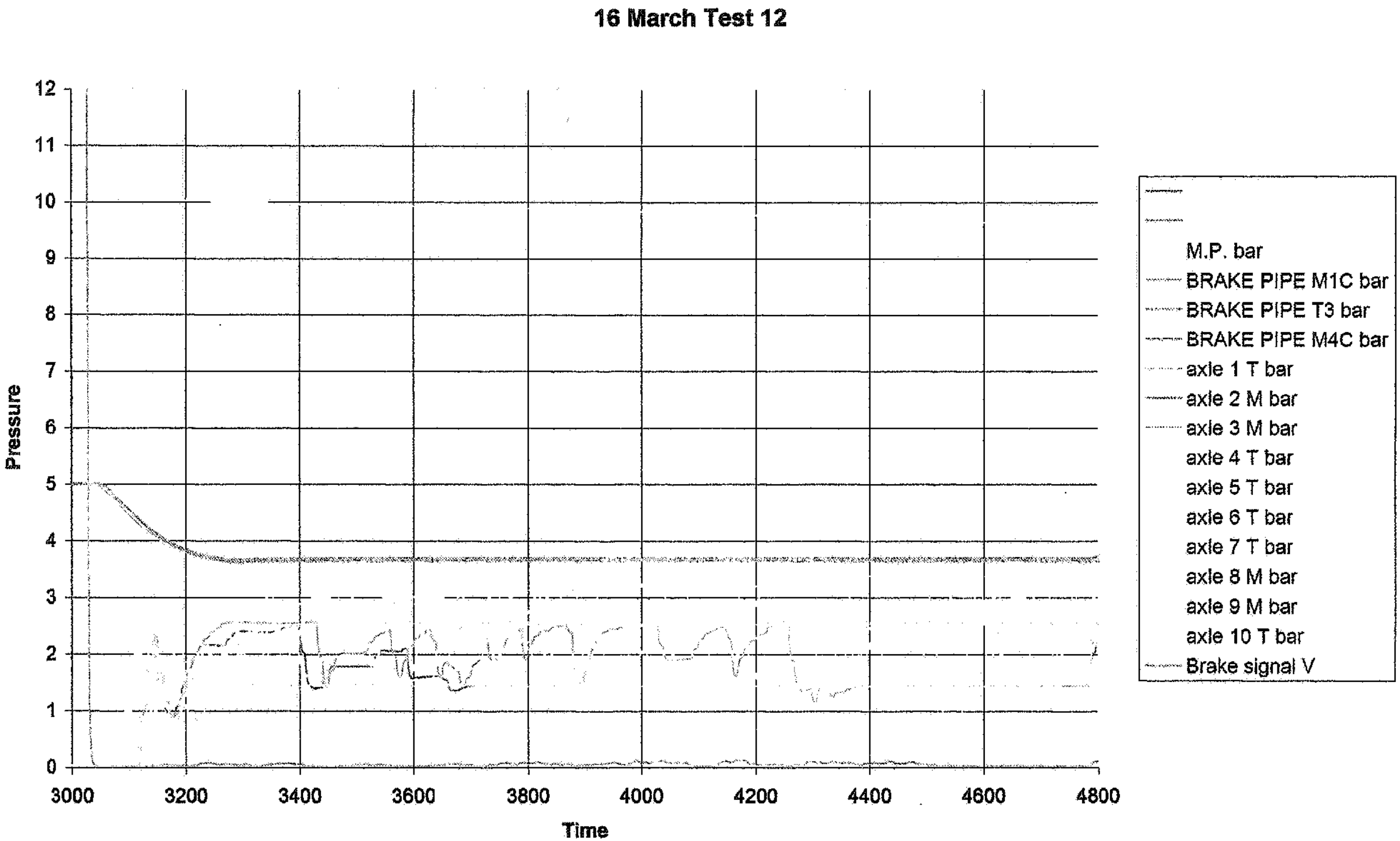
Maximum Service Brake no HD with soap; Vinit.= 120,59 Km/h; braking dist. = 643,56 m; M1; dec = 0,87 m/s/s; Effort Mode; File 16mar12


1,2
0,9
0,6
0,3
0
-0,3
0
8
16
24
32
Efficiency = 92,1%
Antislide evaluation 16mar12 (Max Service Brake without HD) - Ta = 0,054 - Distance increase = 11,41%
Train acceleration
Peak acceleration

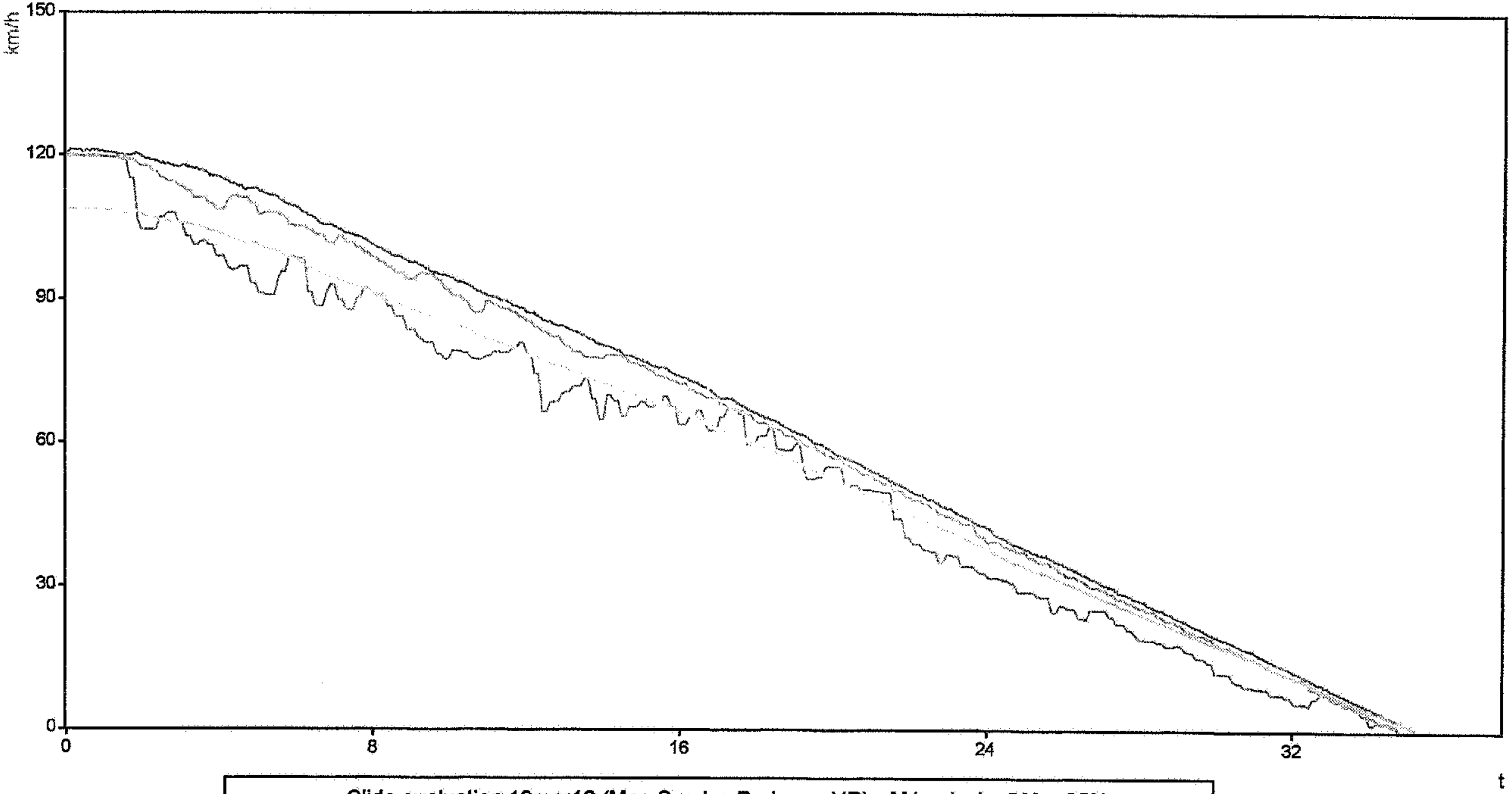
16_mar_12



6000
5000
4000
3000
2000
1000
0
-1000
Pressure [mbar]
14
12
10
8
6
4
2
0
-2
Speed [km/h]
35
40
45
50
55
60
65
70
75
80
85
Time [s]
CONTROL1 [bar]
CONTROL2 [bar]
CONTROL3 [bar]
CONTROL4 [bar]
BPPRESS [bar]
HDA1 [unit]
HDA2 [unit]
HDR1 [kN]
HDR2 [kN]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]

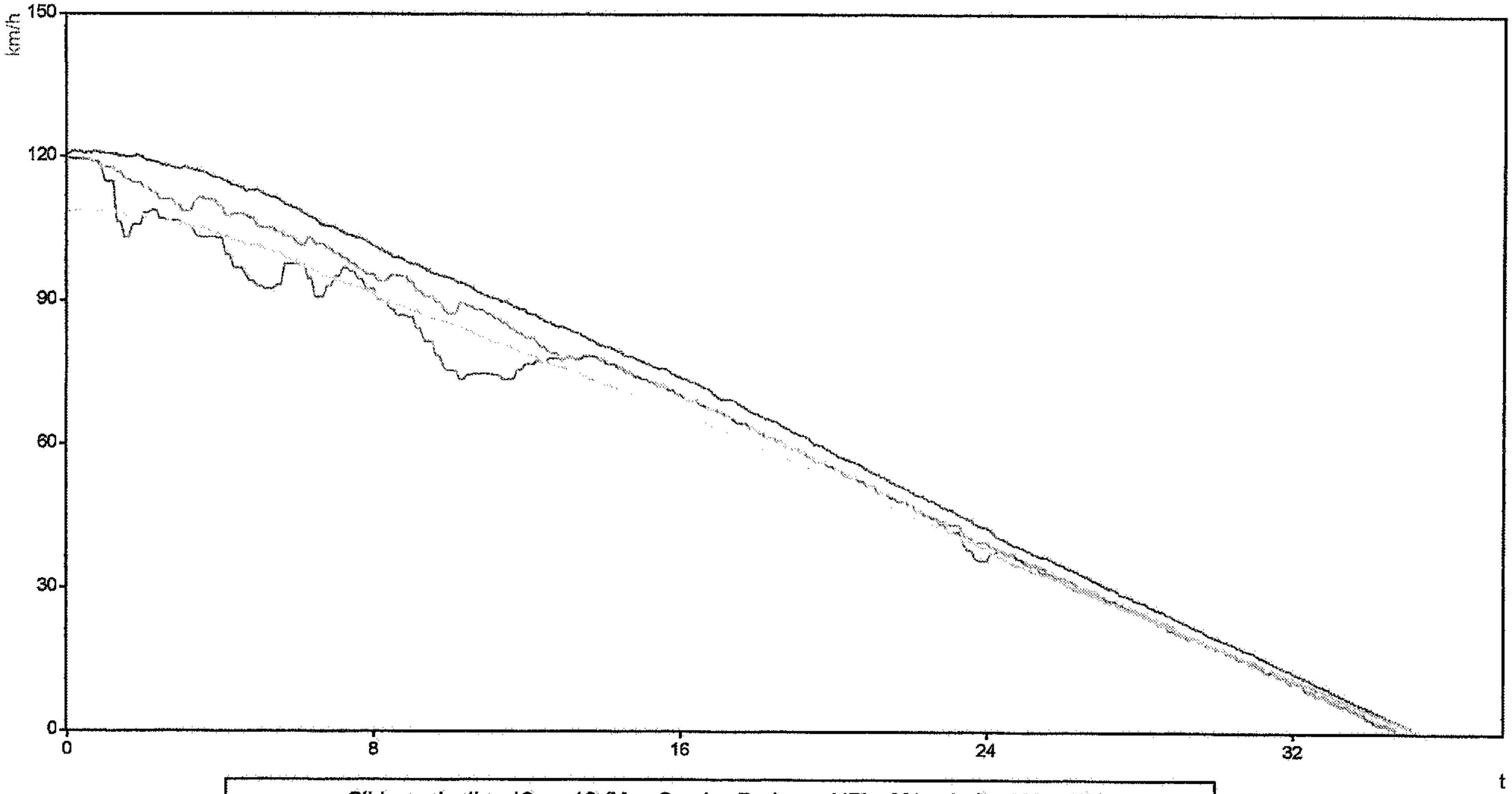


16 March Test 12
Pressure
Time
0
1
2
3
4
5
6
7
8
9
10
11
12
3000
3200
3400
3600
3800
4000
4200
4400
4600
4800
M.P. bar
BRAKE PIPE M1C bar
BRAKE PIPE T3 bar
BRAKE PIPE M4C bar
axle 1 T bar
axle 2 M bar
axle 3 M bar
axle 4 T bar
axle 5 T bar
axle 6 T bar
axle 7 T bar
axle 8 M bar
axle 9 M bar
axle 10 T bar
Brake signal V

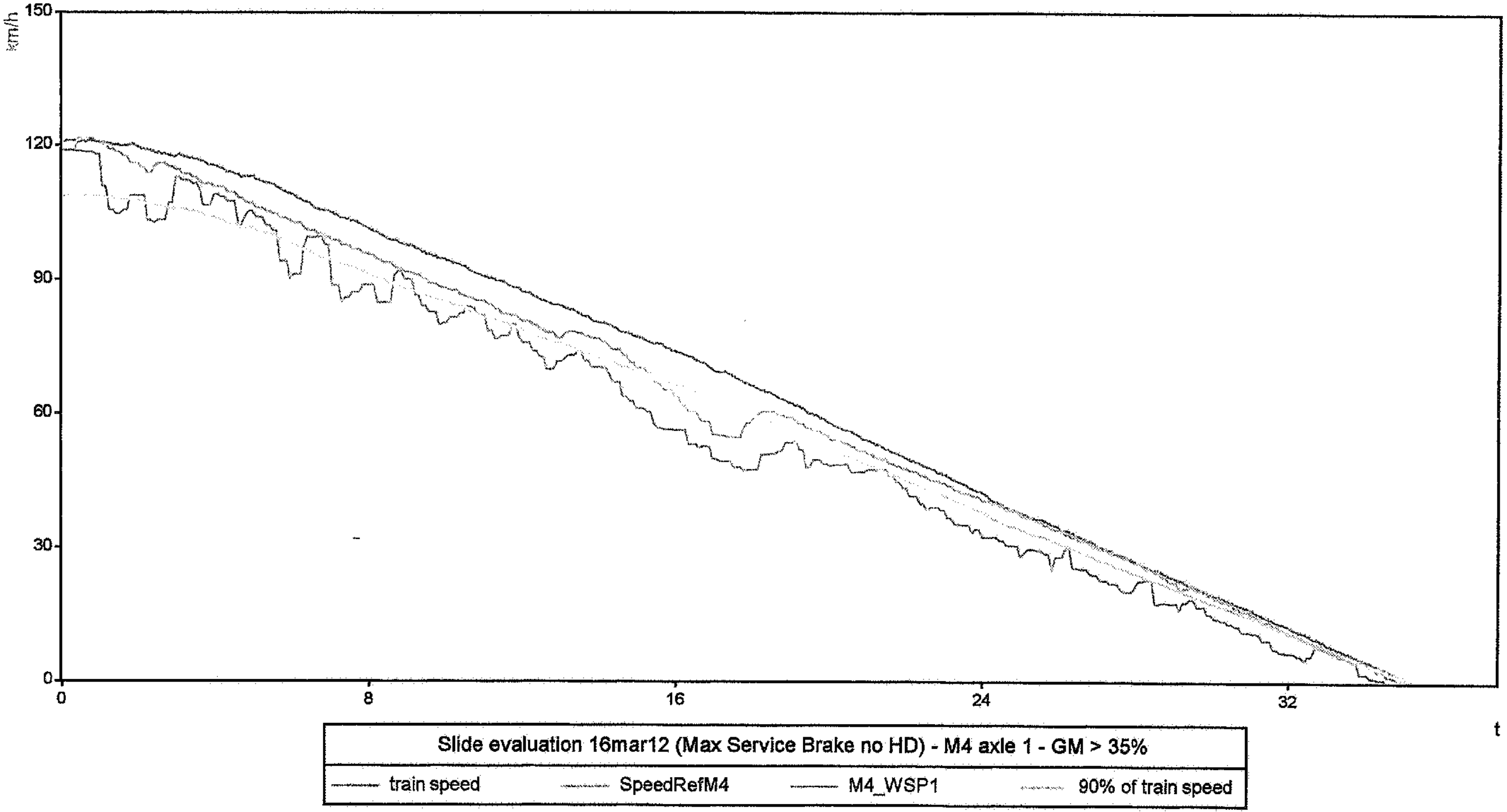


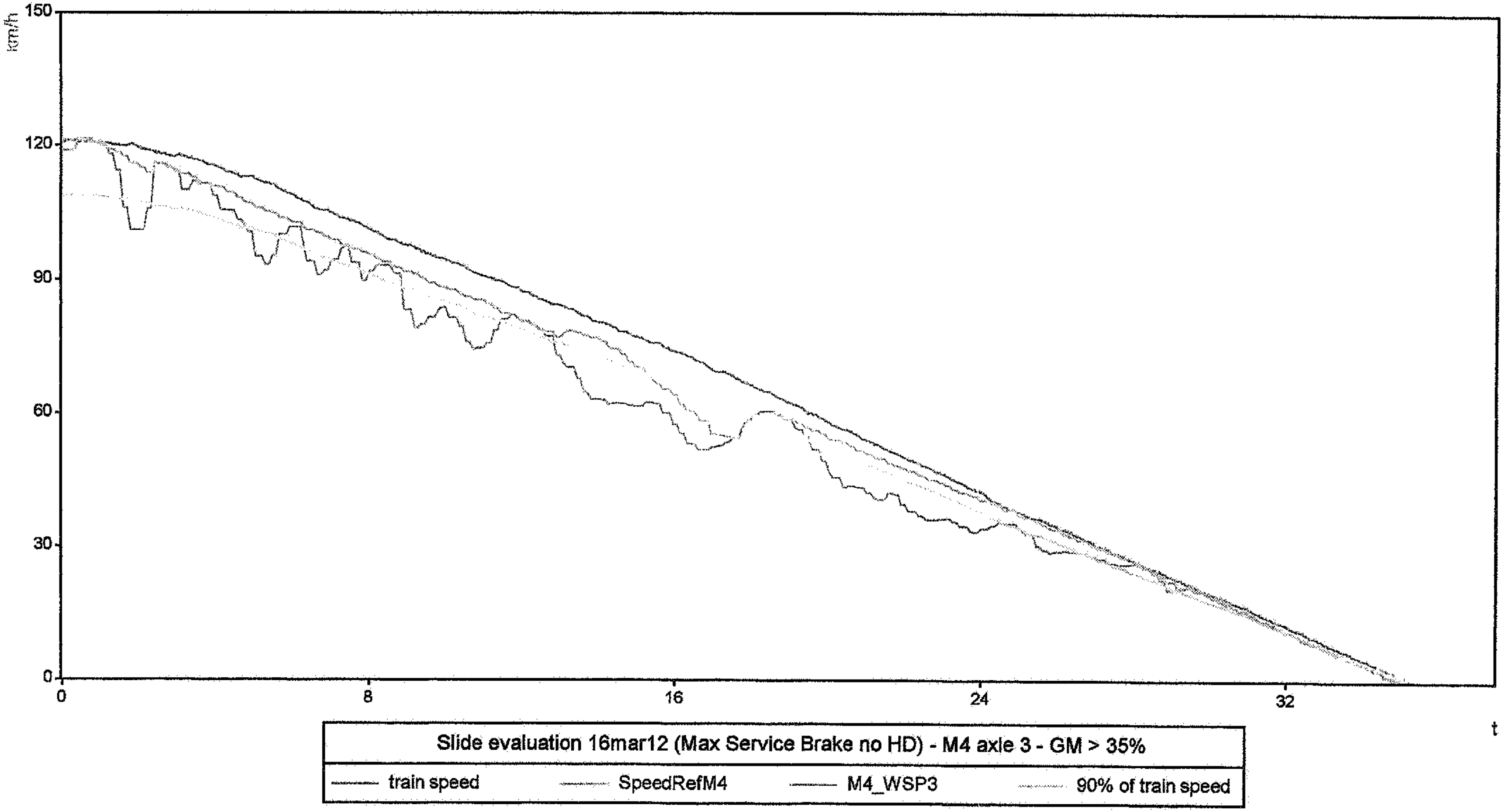
Slide evaluation 16mar12 (Max Service Brake no HD) - M1 axle 1 - GM > 35%

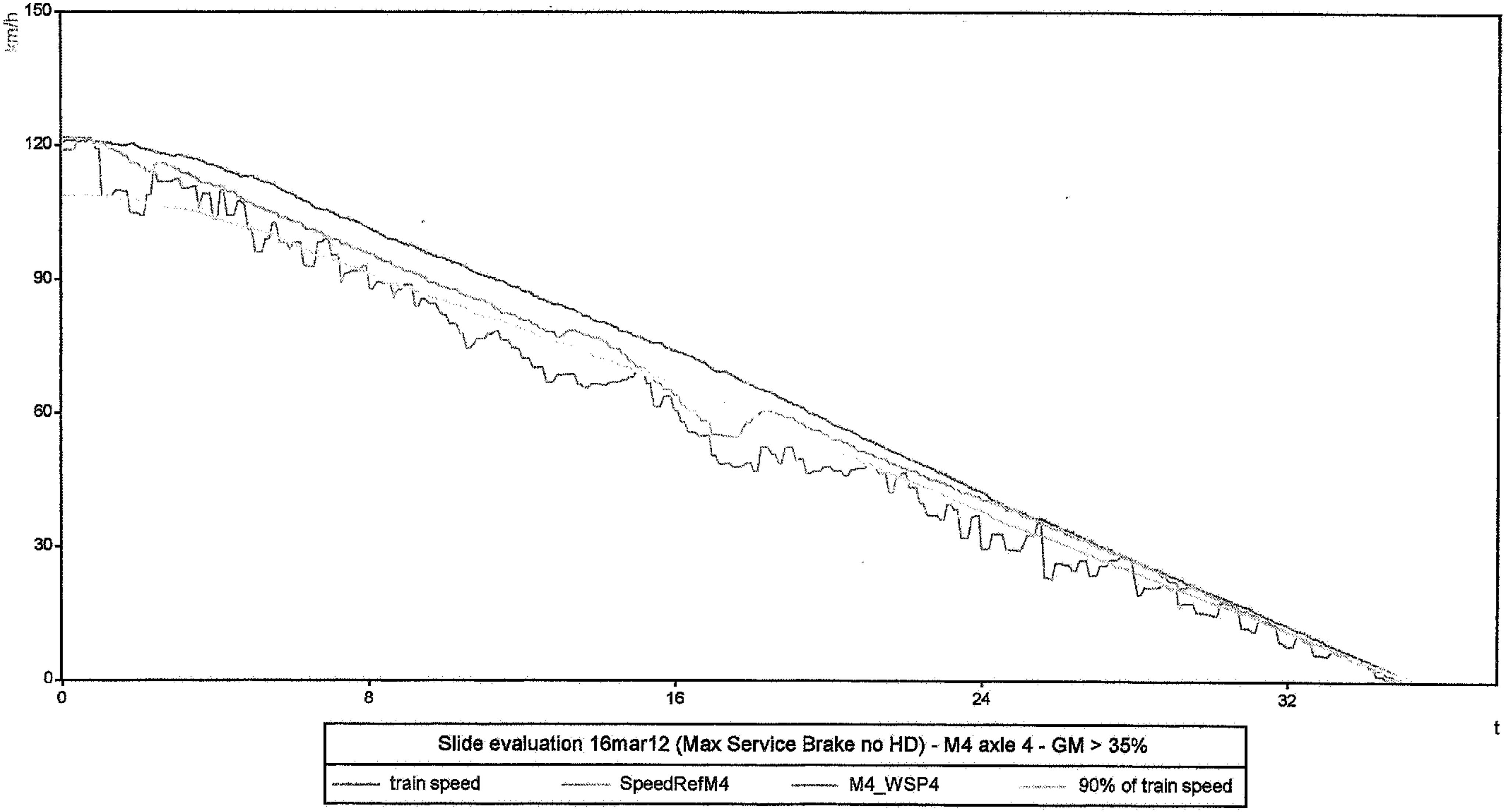
train speed SpeedRefM1 M1_WSP1 90% of train speed

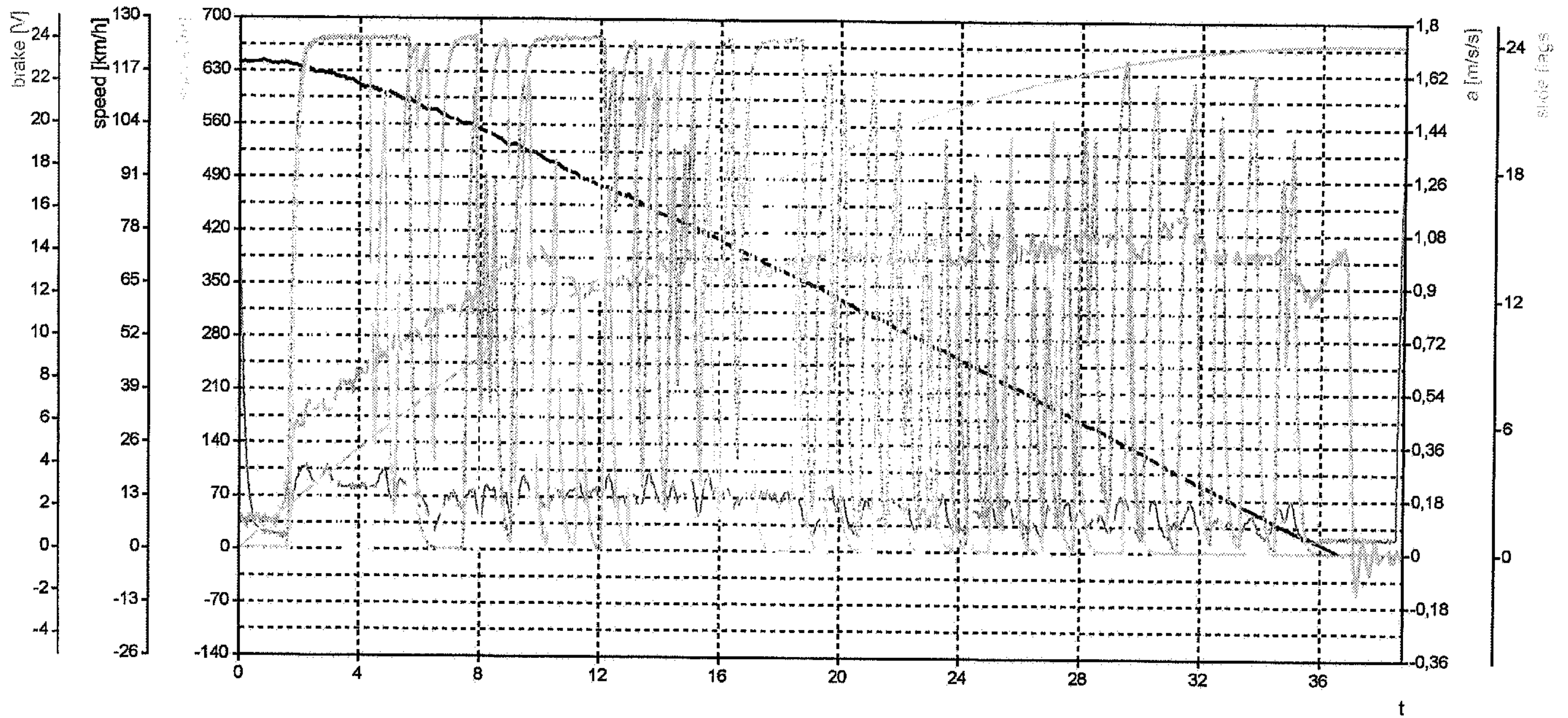


Slide evaluation 16mar12 (Max Service Brake no HD) - M1 axle 2 - GM > 35%


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar12 (Max Service Brake no HD) - M4 axle 1 - GM > 35%
train speed
SpeedRefM4
M4_WSP1
90% of train speed

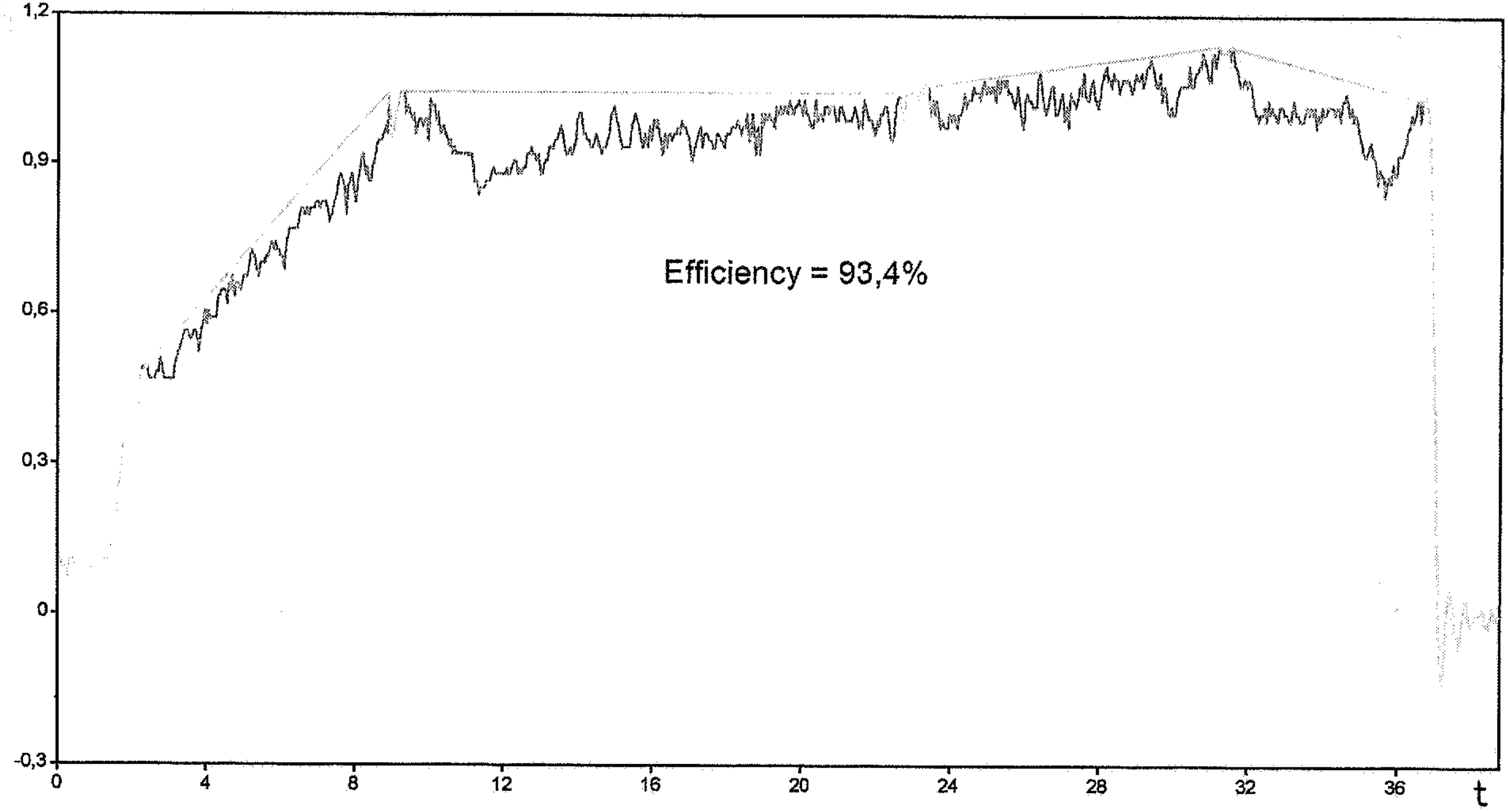

km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar12 (Max Service Brake no HD) - M4 axle 3 - GM > 35%
train speed
SpeedRefM4
M4_WSP3
90% of train speed


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar12 (Max Service Brake no HD) - M4 axle 4 - GM > 35%
train speed
SpeedRefM4
M4_WSP4
90% of train speed



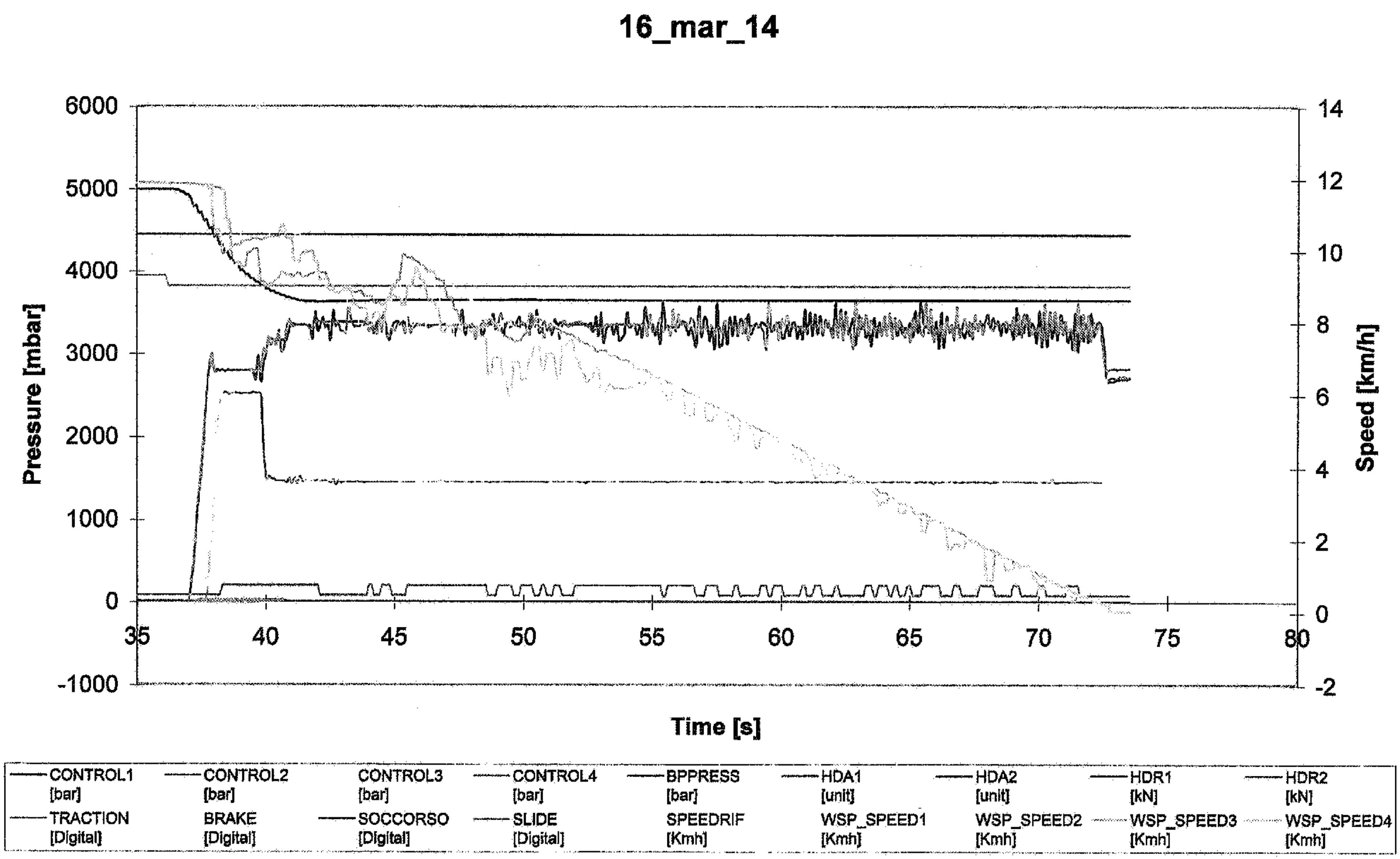
Maximum Service Brake no HD with soap; Vinit.= 118,91 Km/h; braking dist. = 669,12 m; M1; dec = 0,82 m/s/s; Effort Mode; File 16mar14

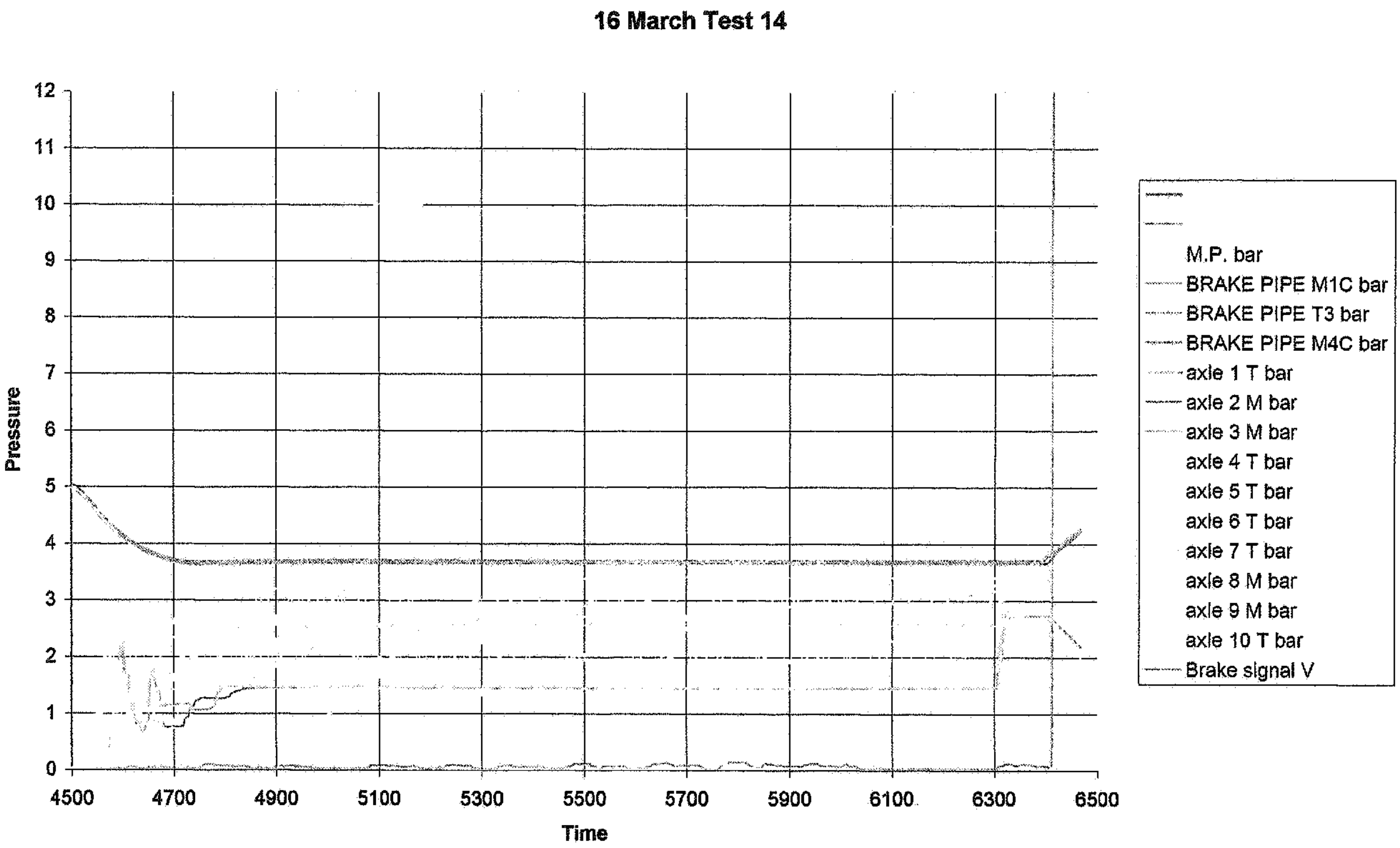
speed — brake line — slide flag M4 — slide flag M1
deceleration — distance — slide flag T3



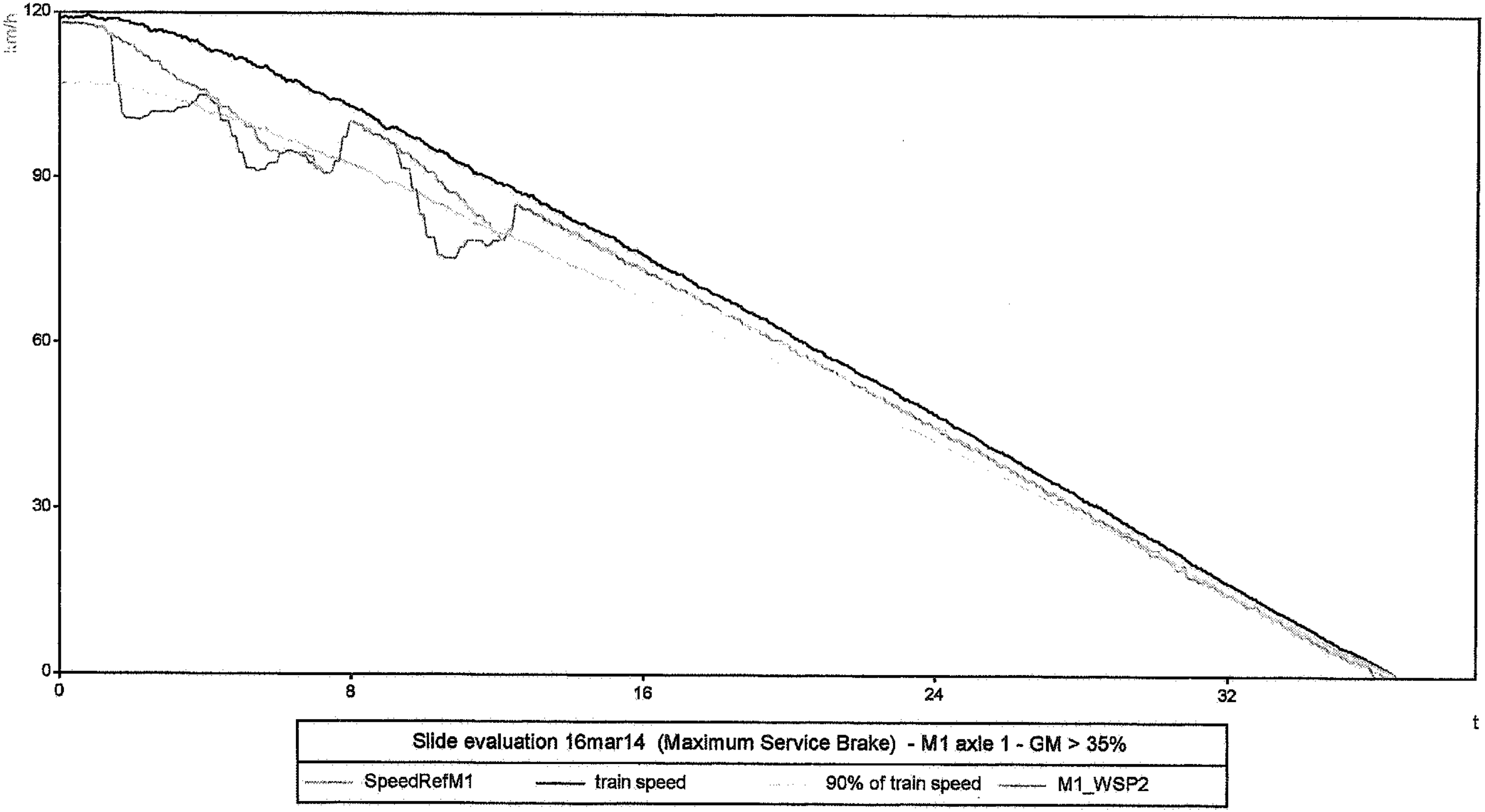
Antislide Efficiency Calculation 16mar14 Maximum Service Brake without HD - Ta = 0,049 - Distance increase = 19,13%

Train_Acceleration — PeaK Acceleration

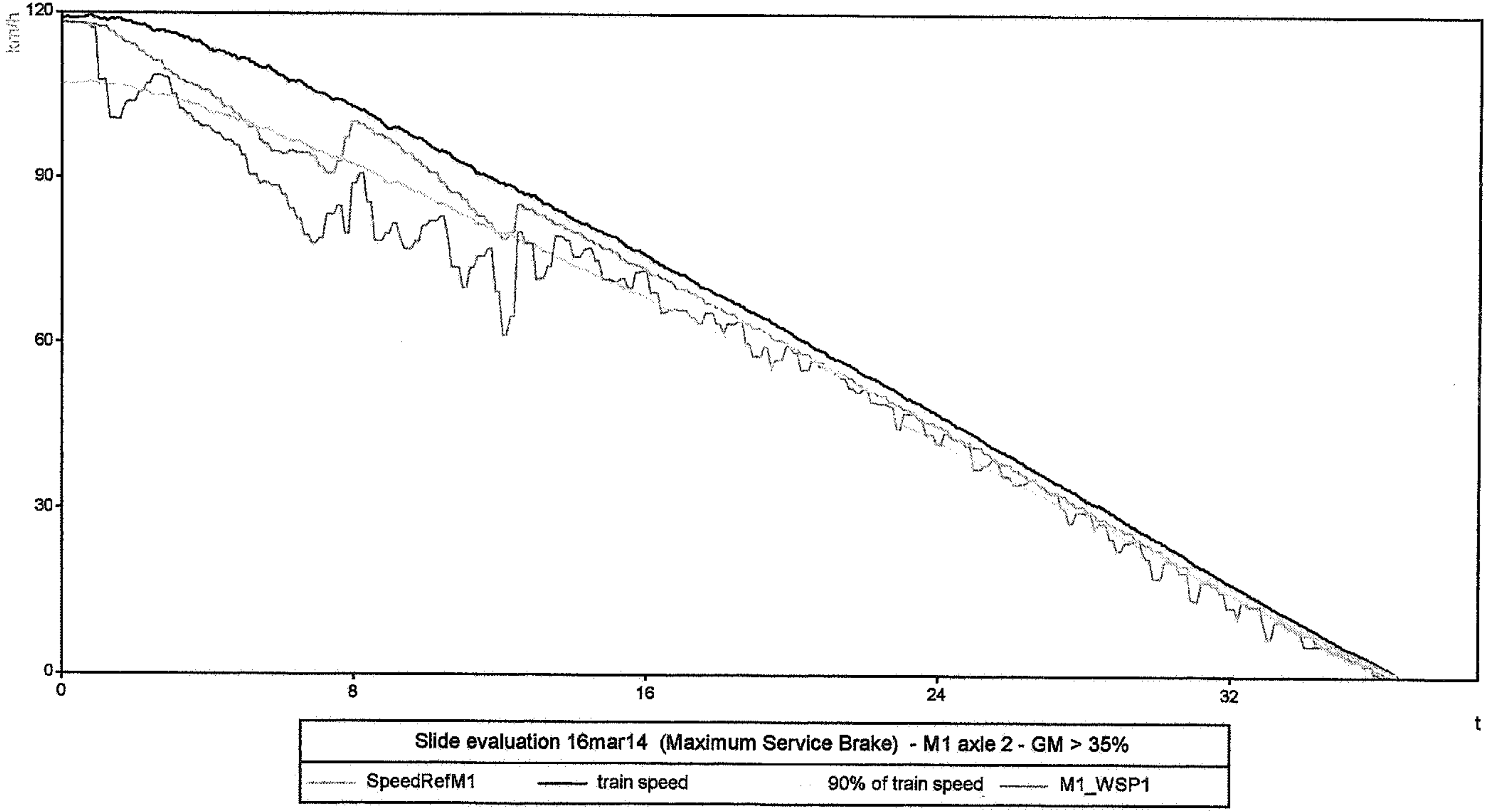

16_mar_14
Pressure [mbar]
Speed [km/h]
Time [s]
6000
5000
4000
3000
2000
1000
0
-1000
14
12
10
8
6
4
2
0
-2
35
40
45
50
55
60
65
70
75
80
CONTROL1 [bar]
CONTROL2 [bar]
CONTROL3 [bar]
CONTROL4 [bar]
BPPRESS [bar]
HDA1 [unit]
HDA2 [unit]
HDR1 [kN]
HDR2 [kN]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]



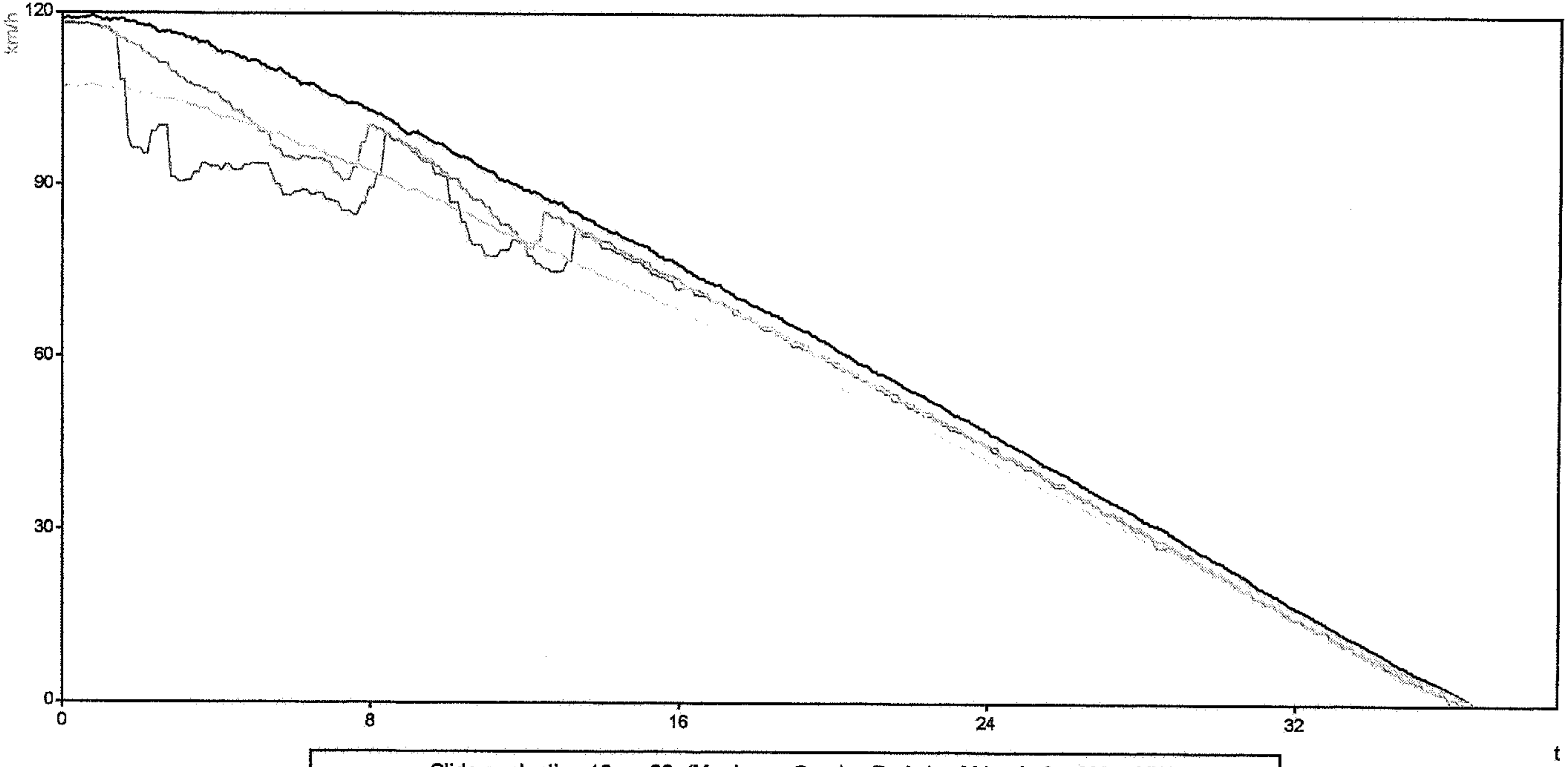
16 March Test 14
Pressure
Time
0
1
2
3
4
5
6
7
8
9
10
11
12
4500
4700
4900
5100
5300
5500
5700
5900
6100
6300
6500
M.P. bar
BRAKE PIPE M1C bar
BRAKE PIPE T3 bar
BRAKE PIPE M4C bar
axle 1 T bar
axle 2 M bar
axle 3 M bar
axle 4 T bar
axle 5 T bar
axle 6 T bar
axle 7 T bar
axle 8 M bar
axle 9 M bar
axle 10 T bar
Brake signal V



km/h
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar14 (Maximum Service Brake) - M1 axle 1 - GM > 35%
SpeedRefM1
train speed
90% of train speed
M1_WSP2

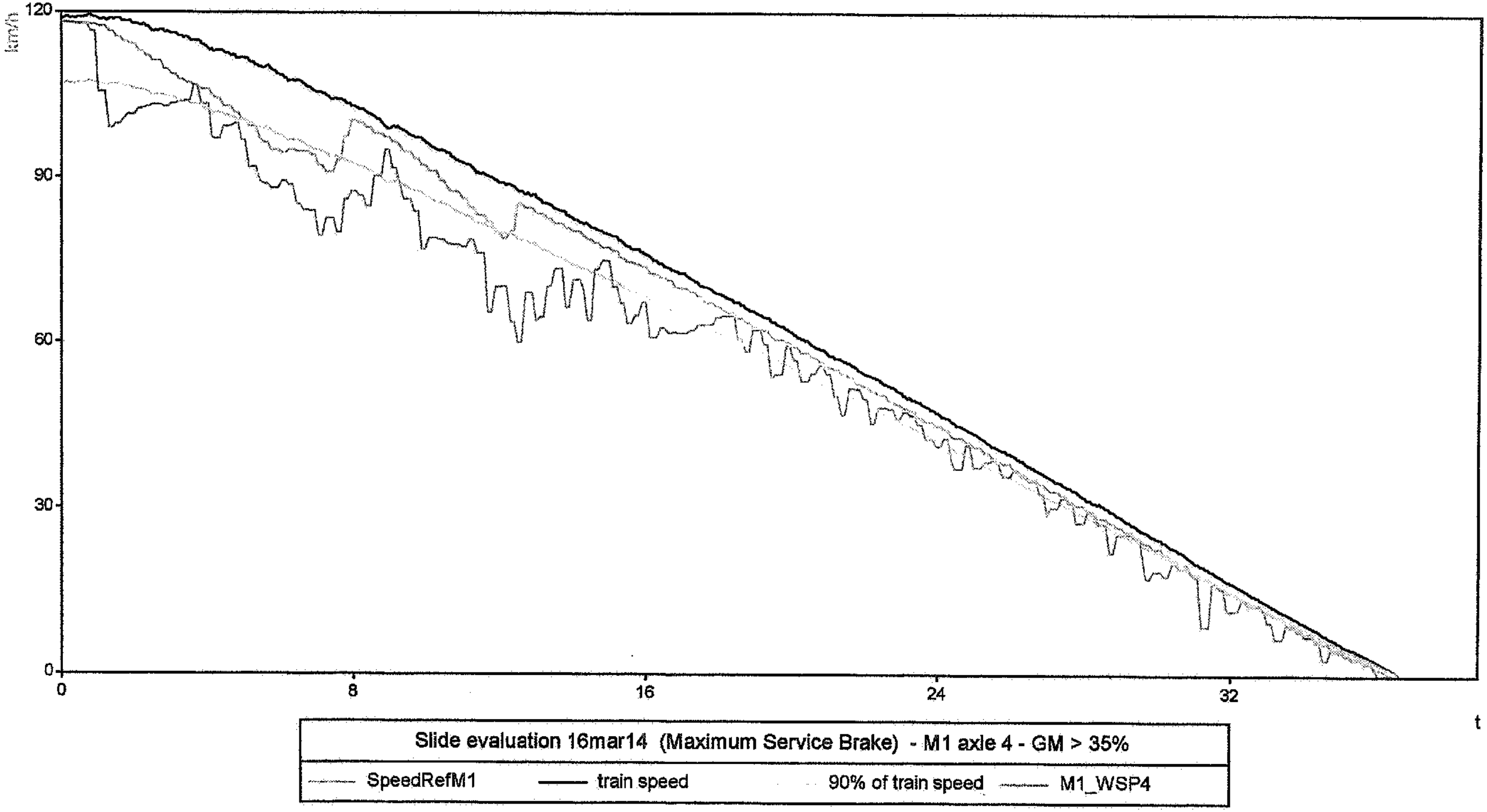


120
90
60
30
0
km/h
0
8
16
24
32
t
Slide evaluation 16mar14 (Maximum Service Brake) - M1 axle 2 - GM > 35%
SpeedRefM1
train speed
90% of train speed
M1_WSP1

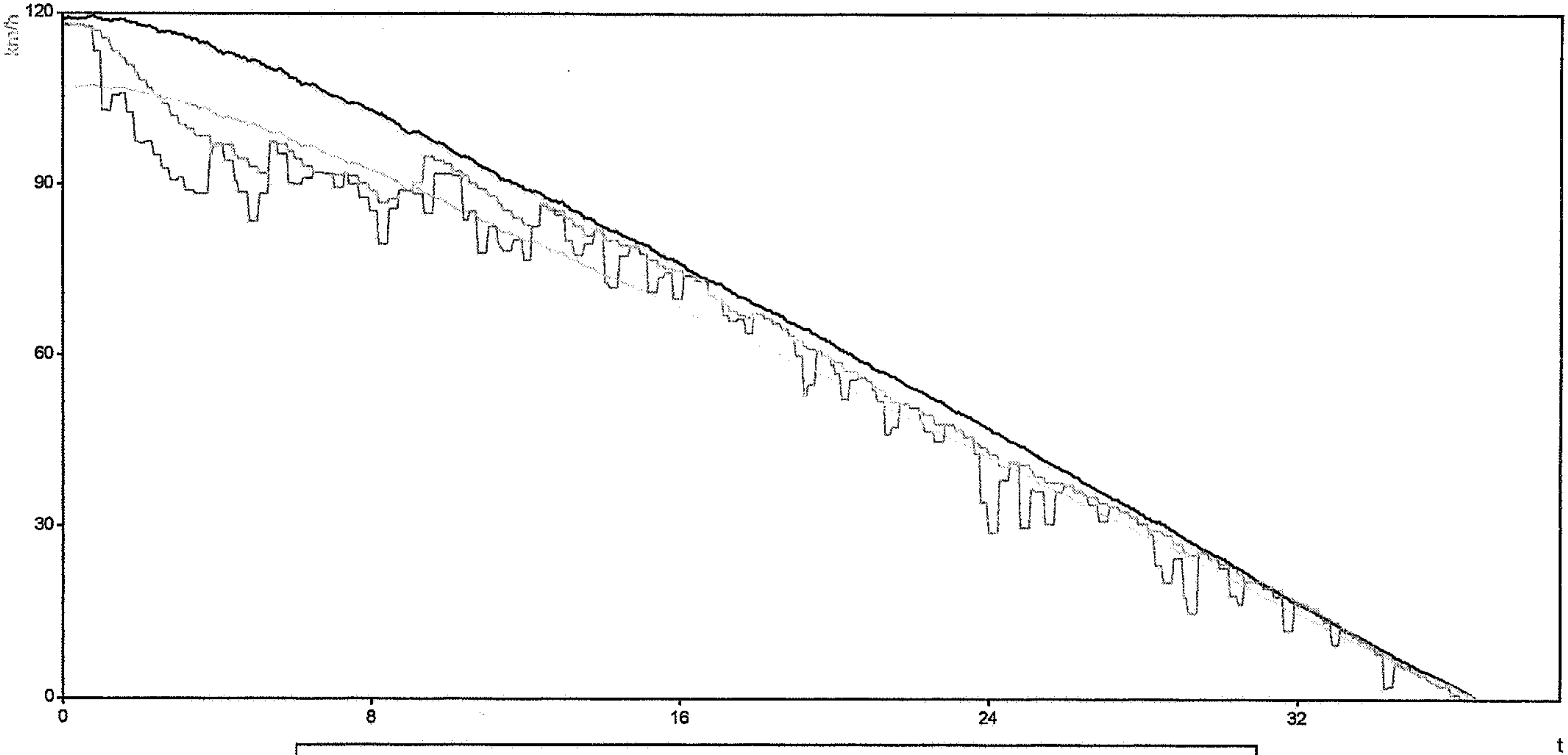


Slide evaluation 16mar09 (Maximum Service Brake) - M1 axle 3 - GM > 35%

SpeedRefM1 — train speed — 90% of train speed — M1_WSP3

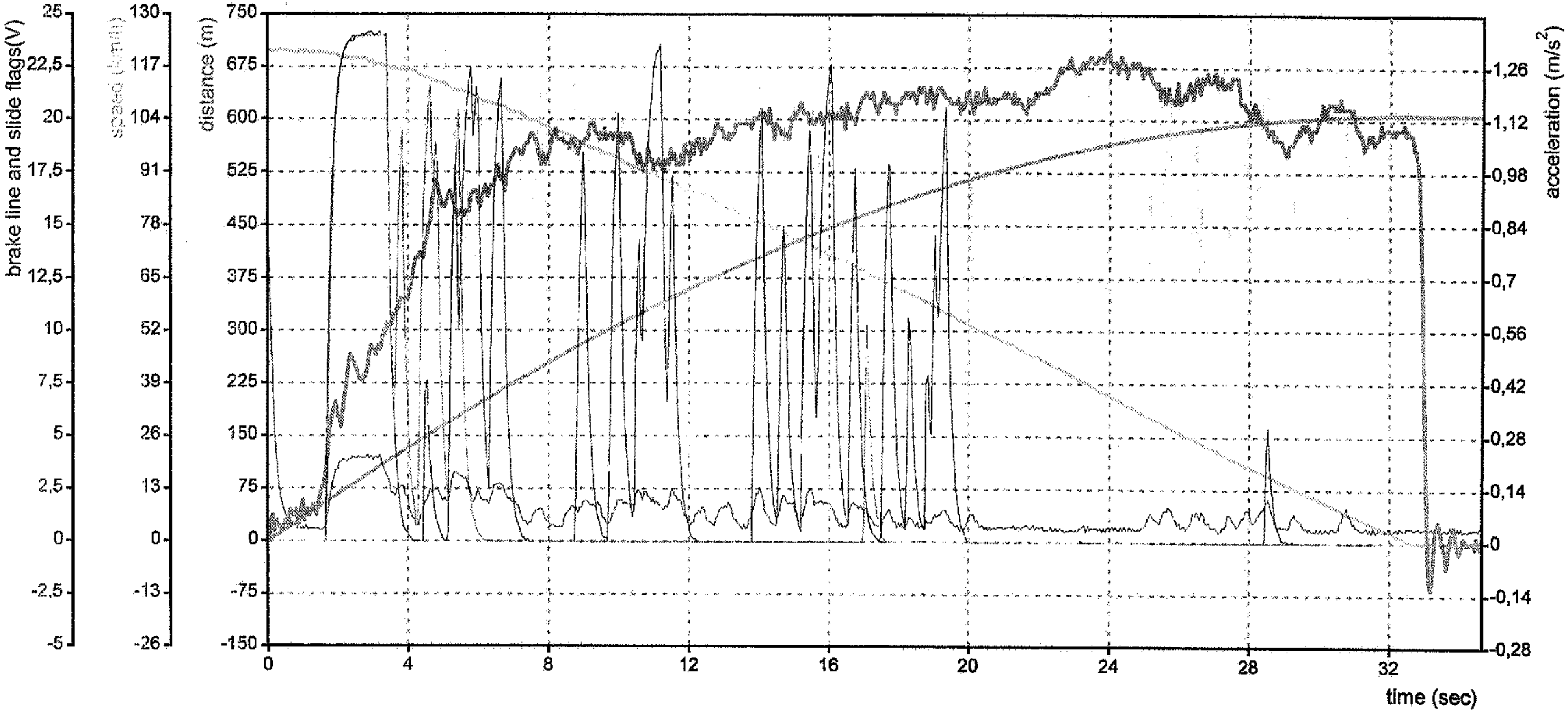


km/h
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar14 (Maximum Service Brake) - M1 axle 4 - GM > 35%
SpeedRefM1
train speed
90% of train speed
M1_WSP4



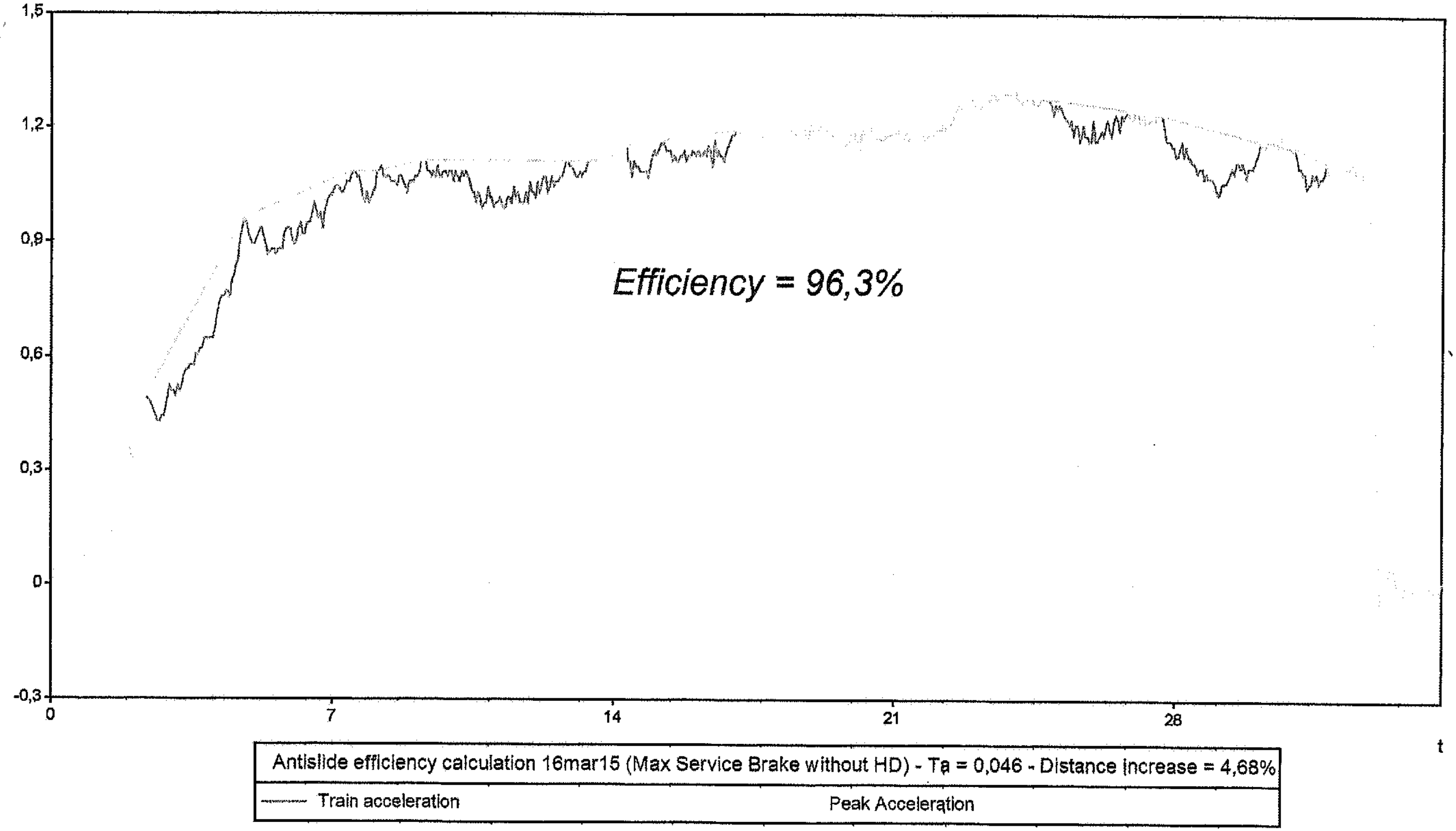
Slide evaluation 16mar14 (Maximum Service Brake) - T3 axle 2 - GM > 35%

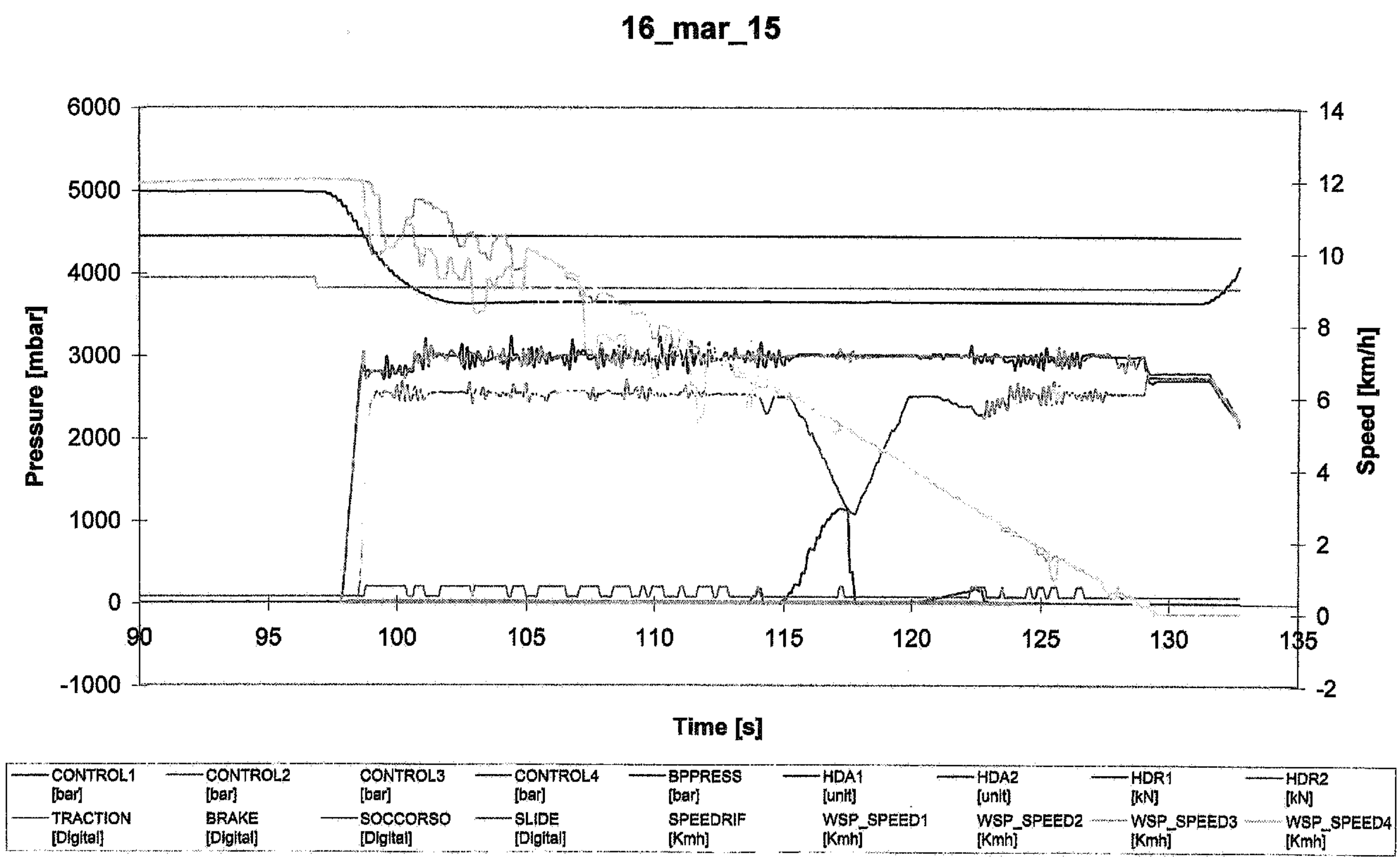
SpeedRefT3 — train speed — 90% of train speed — T3_WSP2

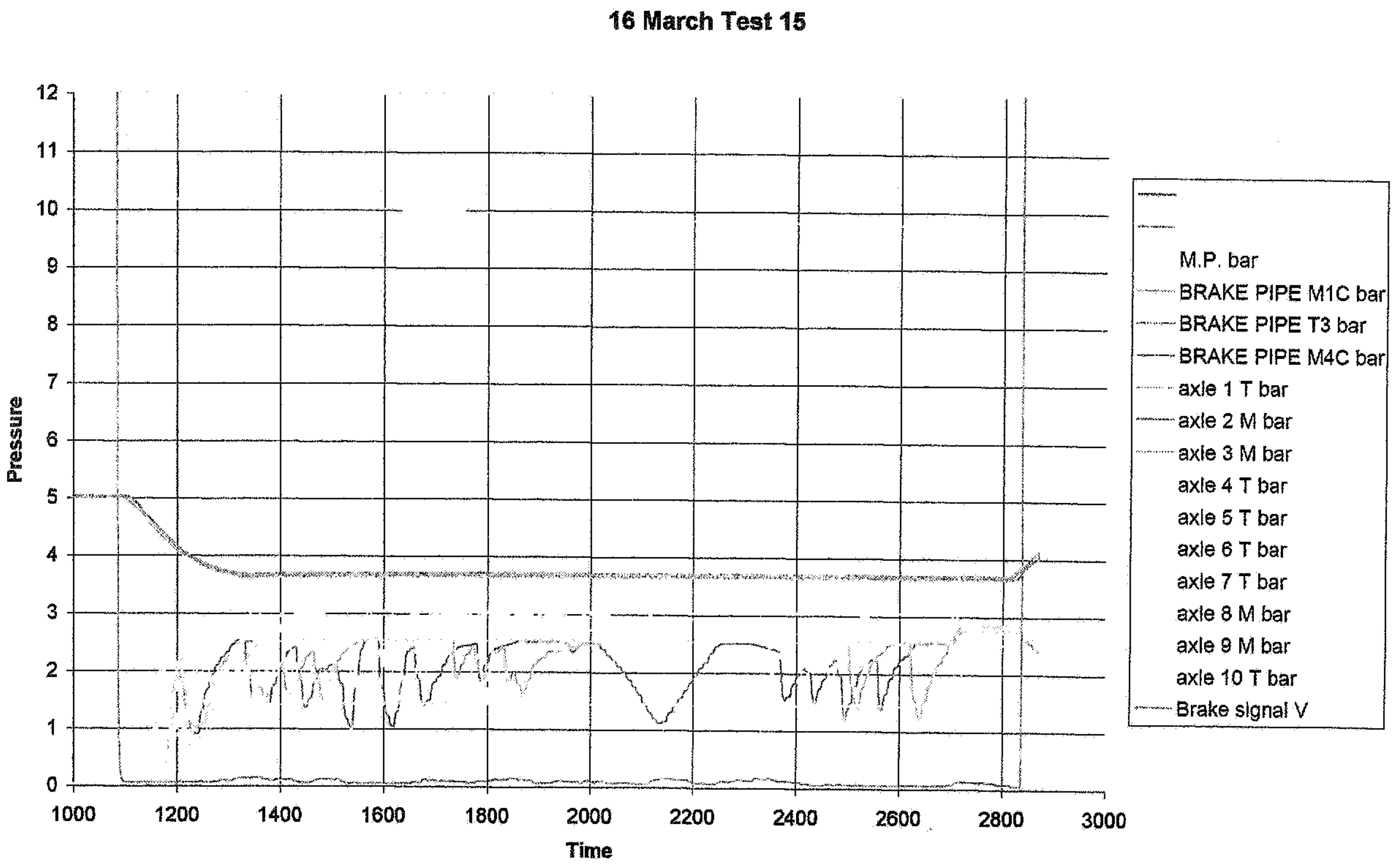


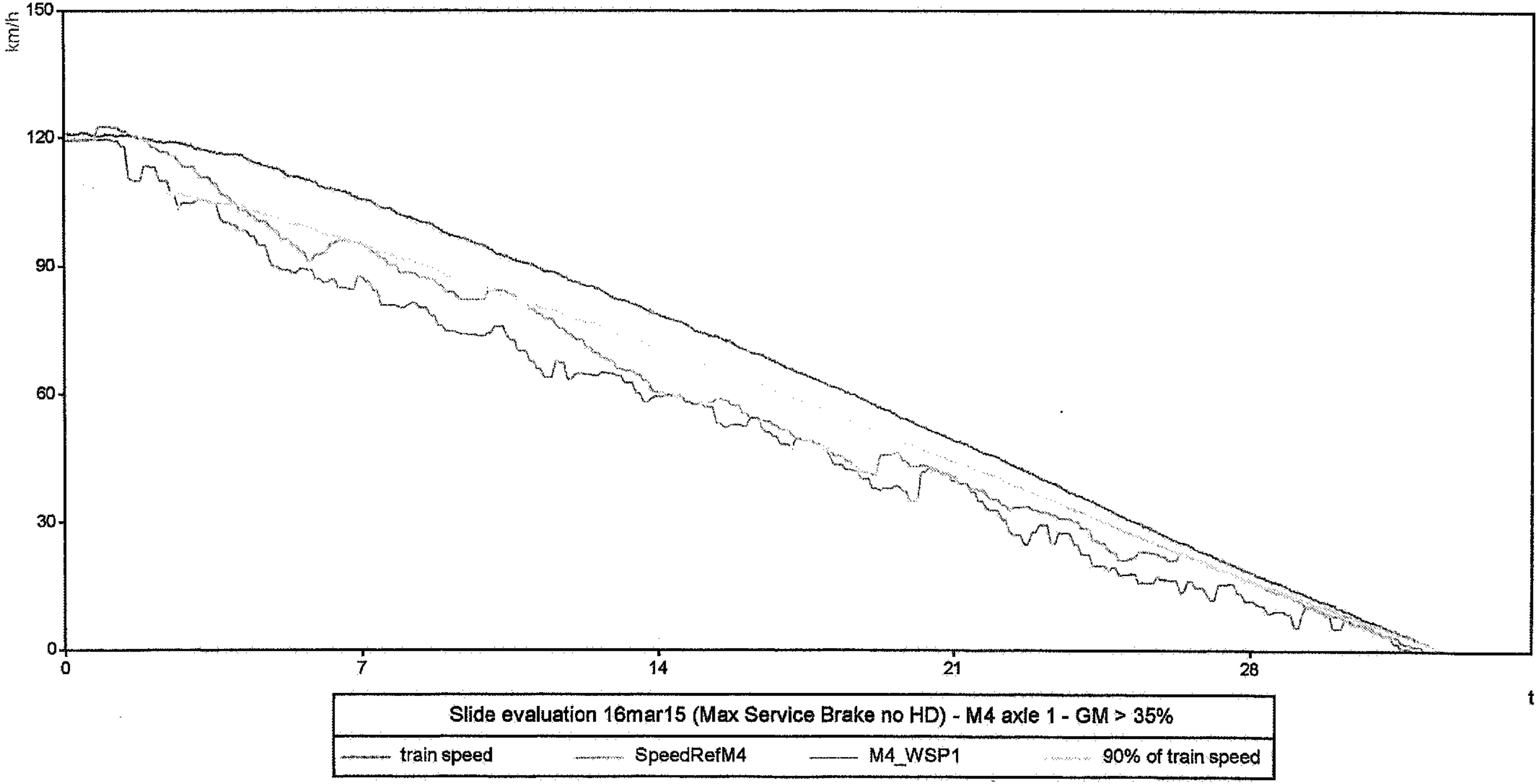
Max Service Brake without HD with soap from M4; initial speed = 120,90 km/h; stopp. distance = 607,79 m; mean dec = 0,93 m/s^2; File: 16mar15

speed
distance
brake line
acceleration
Slide flag T3
slide flag M4
Slide flag M1

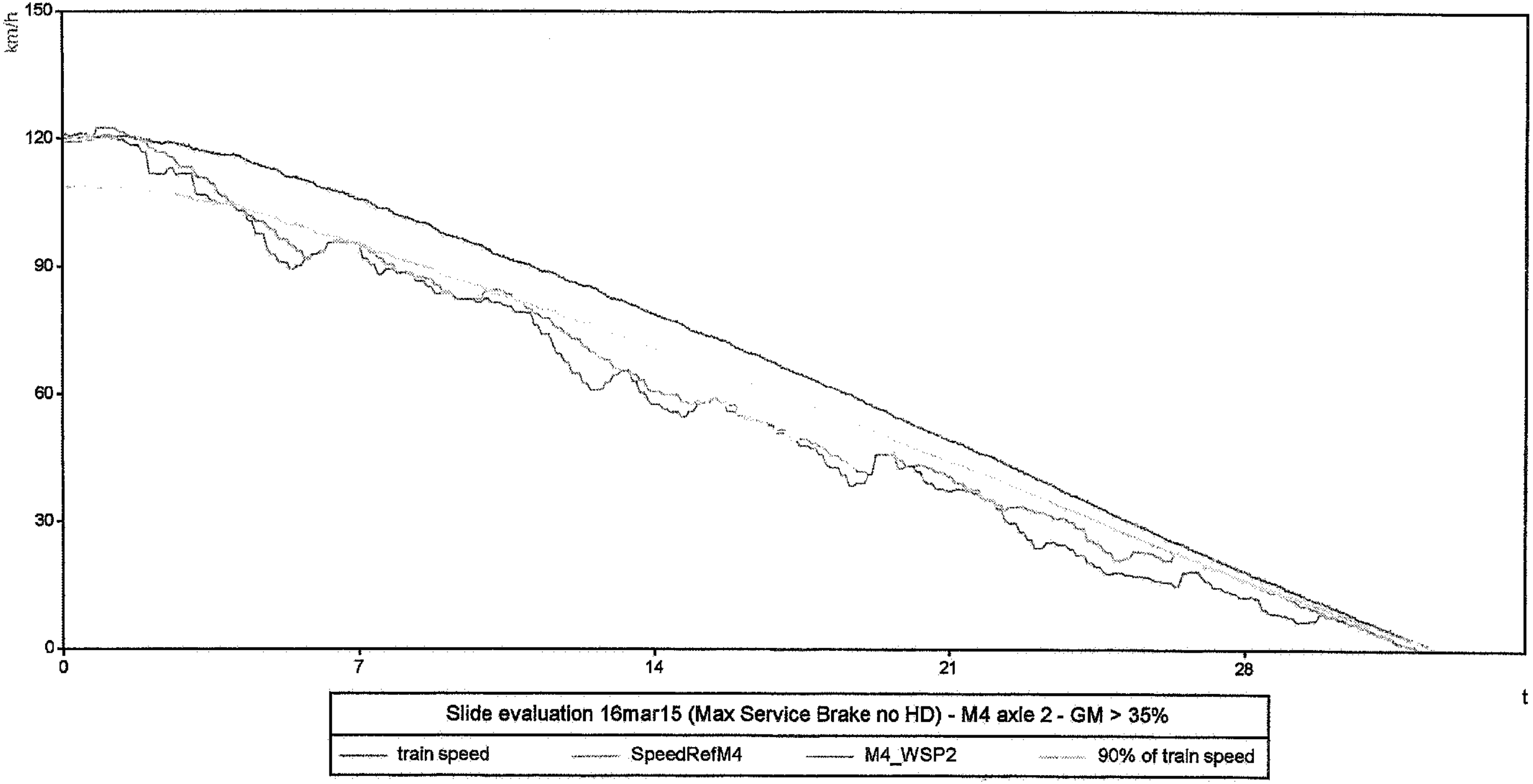

1,5
1,2
0,9
0,6
0,3
0
-0,3
0
7
14
21
28
t
Efficiency = 96,3%
Antislide efficiency calculation 16mar15 (Max Service Brake without HD) - Ta = 0,046 - Distance increase = 4,68%
Train acceleration
Peak Acceleration


16_mar_15
Pressure [mbar]
6000
5000
4000
3000
2000
1000
0
-1000
Speed [km/h]
14
12
10
8
6
4
2
0
-2
90
95
100
105
110
115
120
125
130
135
Time [s]
CONTROL1 [bar]
CONTROL2 [bar]
CONTROL3 [bar]
CONTROL4 [bar]
BPPRESS [bar]
HDA1 [unit]
HDA2 [unit]
HDR1 [kN]
HDR2 [kN]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]

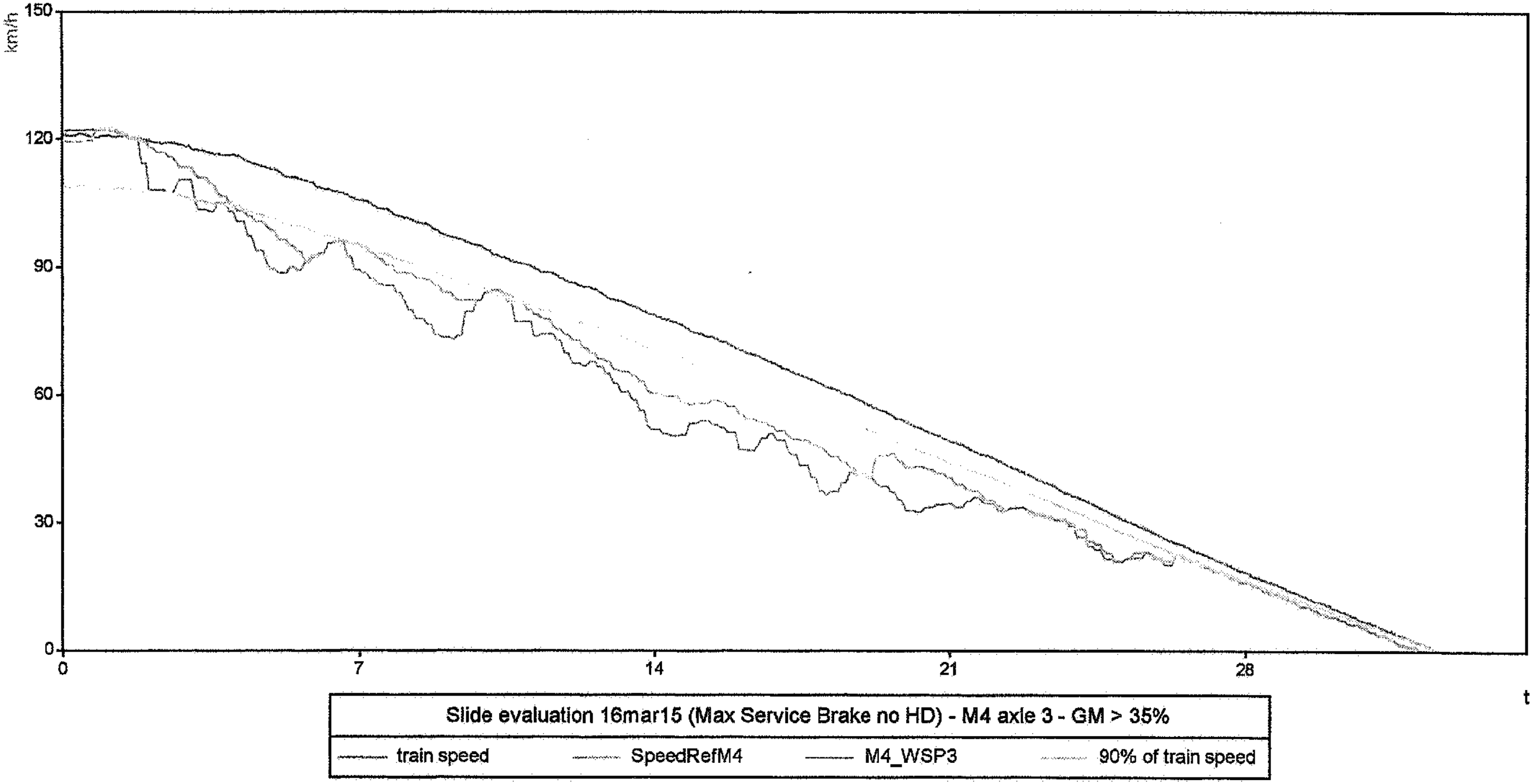

16 March Test 15
Pressure
Time
0
1
2
3
4
5
6
7
8
9
10
11
12
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
M.P. bar
BRAKE PIPE M1C bar
BRAKE PIPE T3 bar
BRAKE PIPE M4C bar
axle 1 T bar
axle 2 M bar
axle 3 M bar
axle 4 T bar
axle 5 T bar
axle 6 T bar
axle 7 T bar
axle 8 M bar
axle 9 M bar
axle 10 T bar
Brake signal V



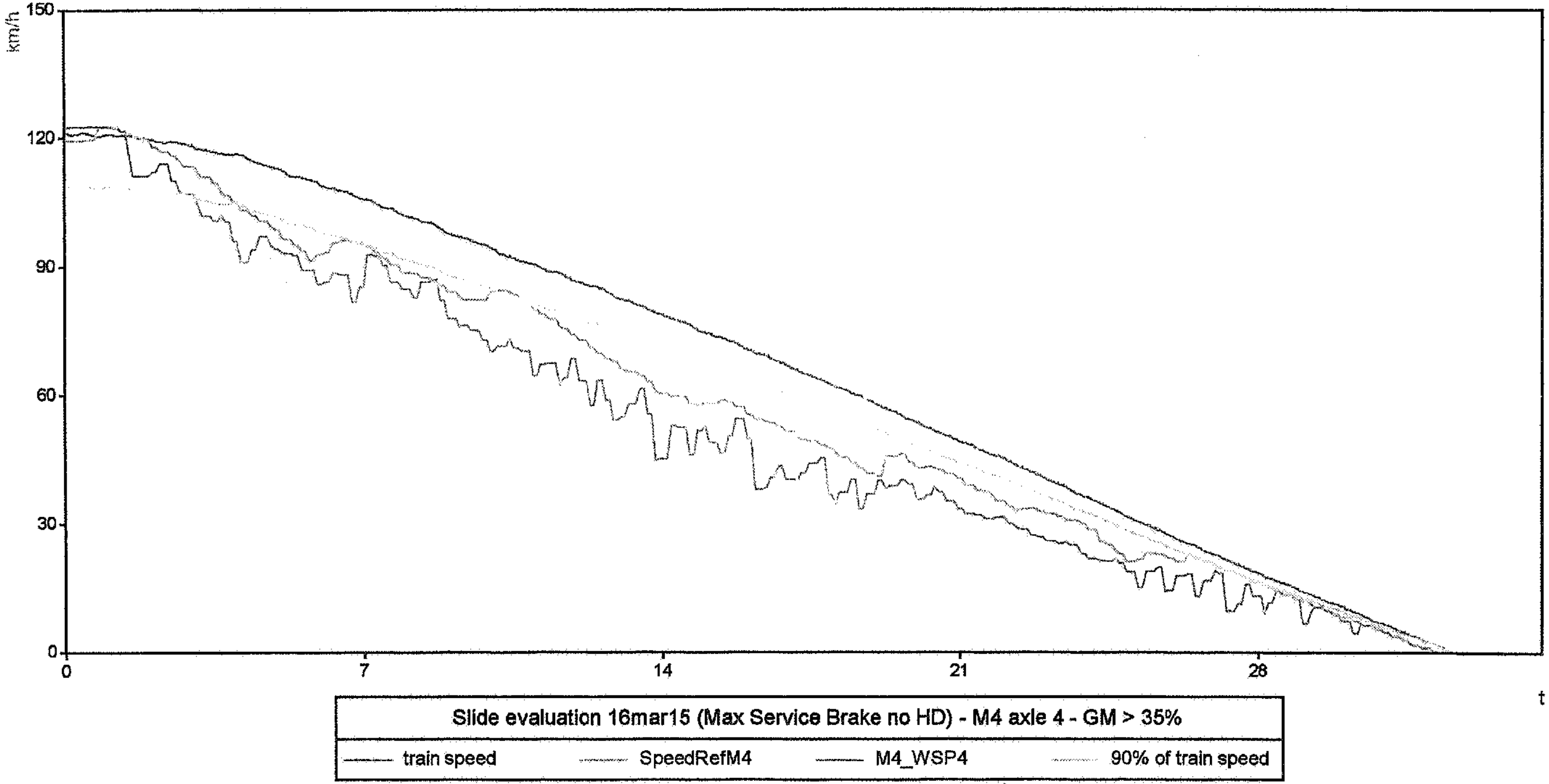
km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar15 (Max Service Brake no HD) - M4 axle 1 - GM > 35%
train speed
SpeedRefM4
M4_WSP1
90% of train speed



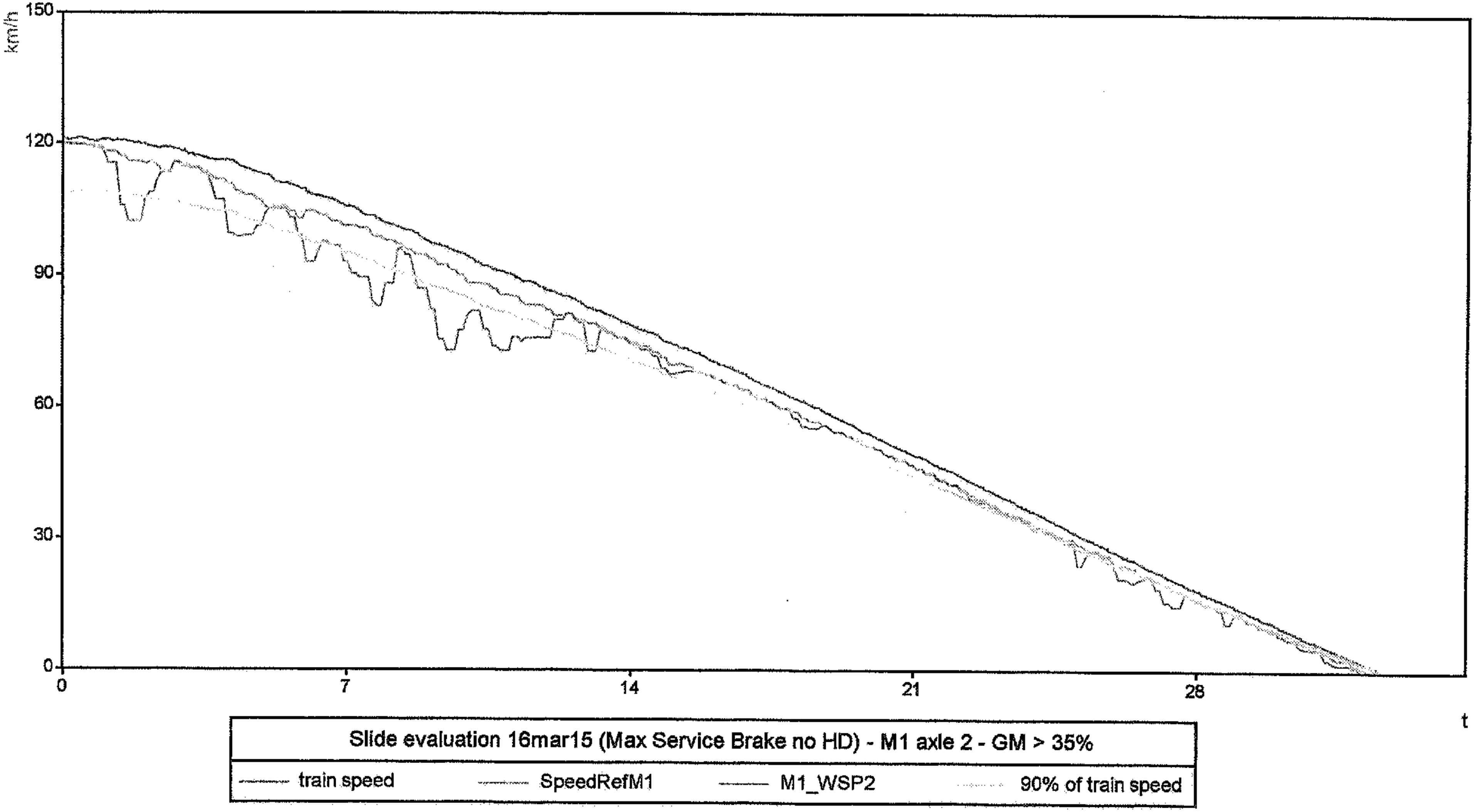
km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar15 (Max Service Brake no HD) - M4 axle 2 - GM > 35%
train speed
SpeedRefM4
M4_WSP2
90% of train speed



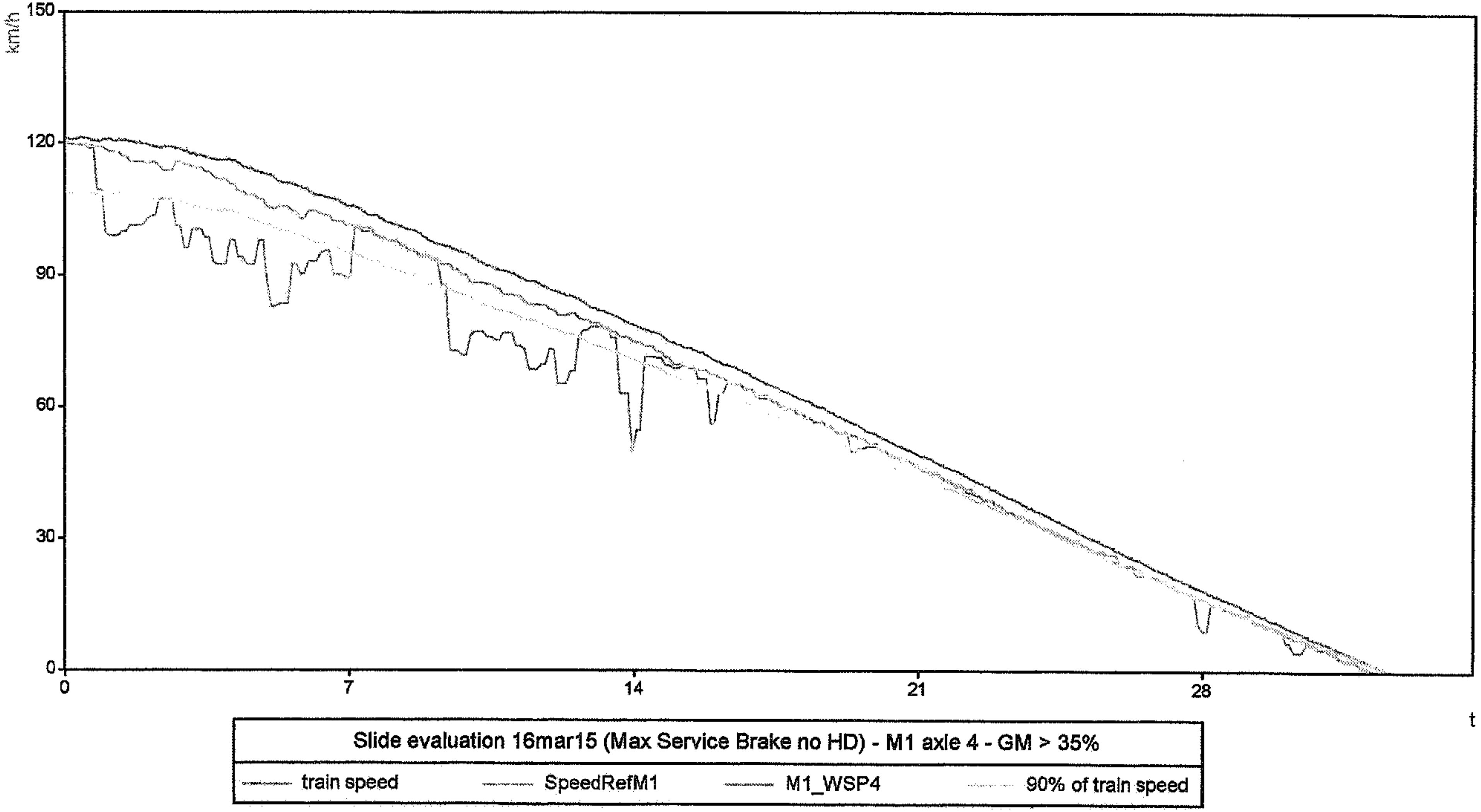
km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar15 (Max Service Brake no HD) - M4 axle 3 - GM > 35%
train speed
SpeedRefM4
M4_WSP3
90% of train speed

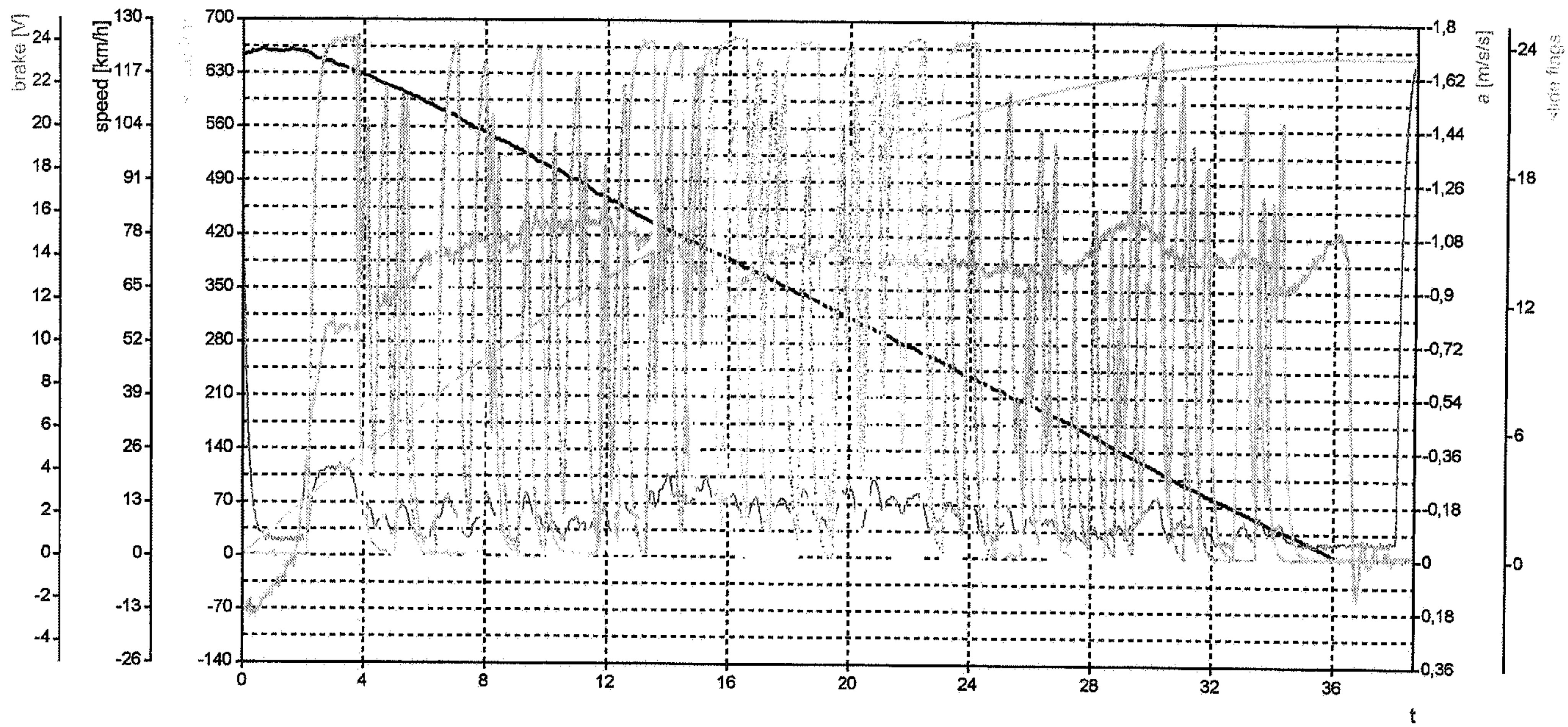


km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar15 (Max Service Brake no HD) - M4 axle 4 - GM > 35%
train speed
SpeedRefM4
M4_WSP4
90% of train speed

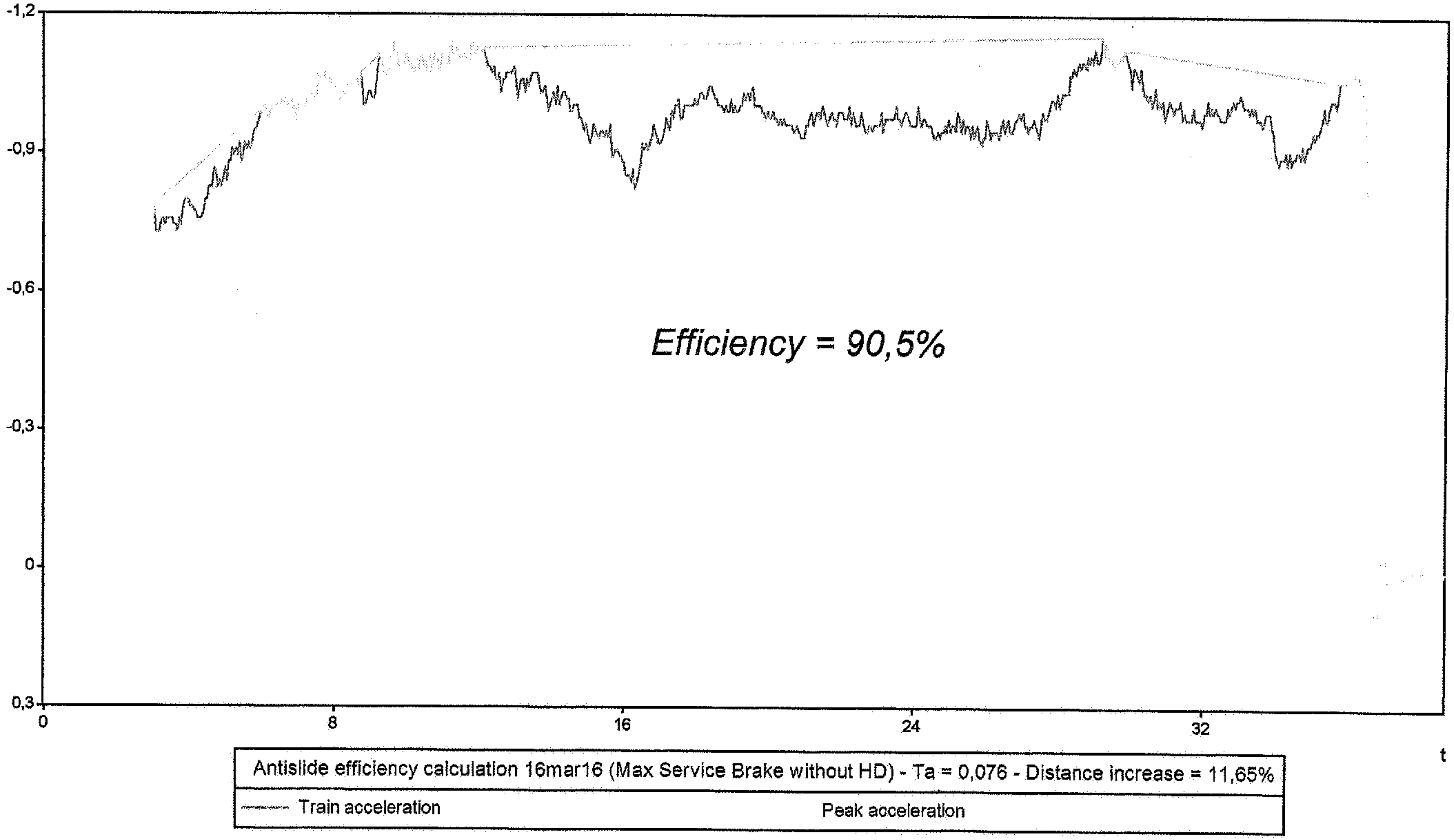


km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar15 (Max Service Brake no HD) - M1 axle 2 - GM > 35%
train speed
SpeedRefM1
M1_WSP2
90% of train speed

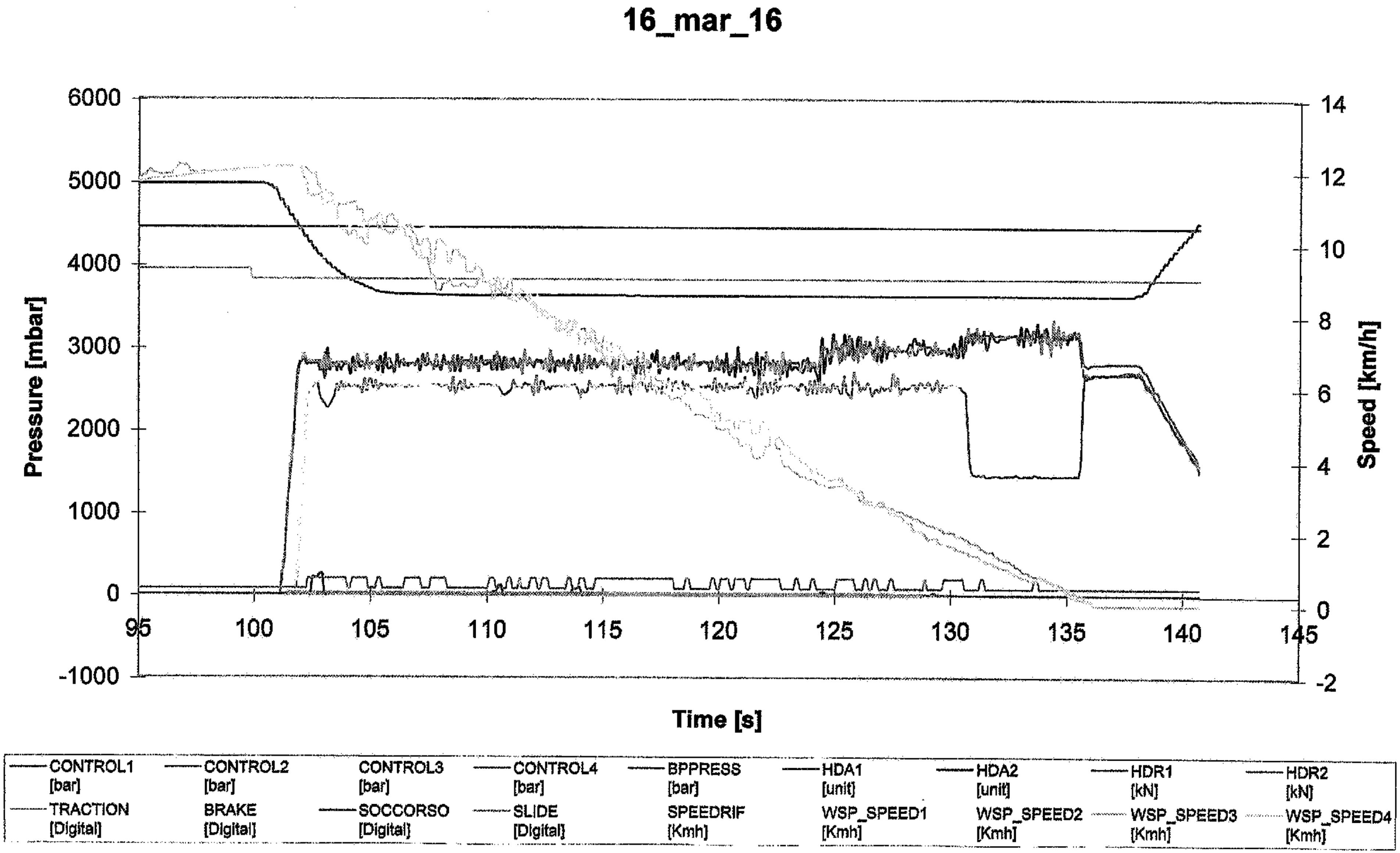

km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar15 (Max Service Brake no HD) - M1 axle 4 - GM > 35%
train speed
SpeedRefM1
M1_WSP4
90% of train speed



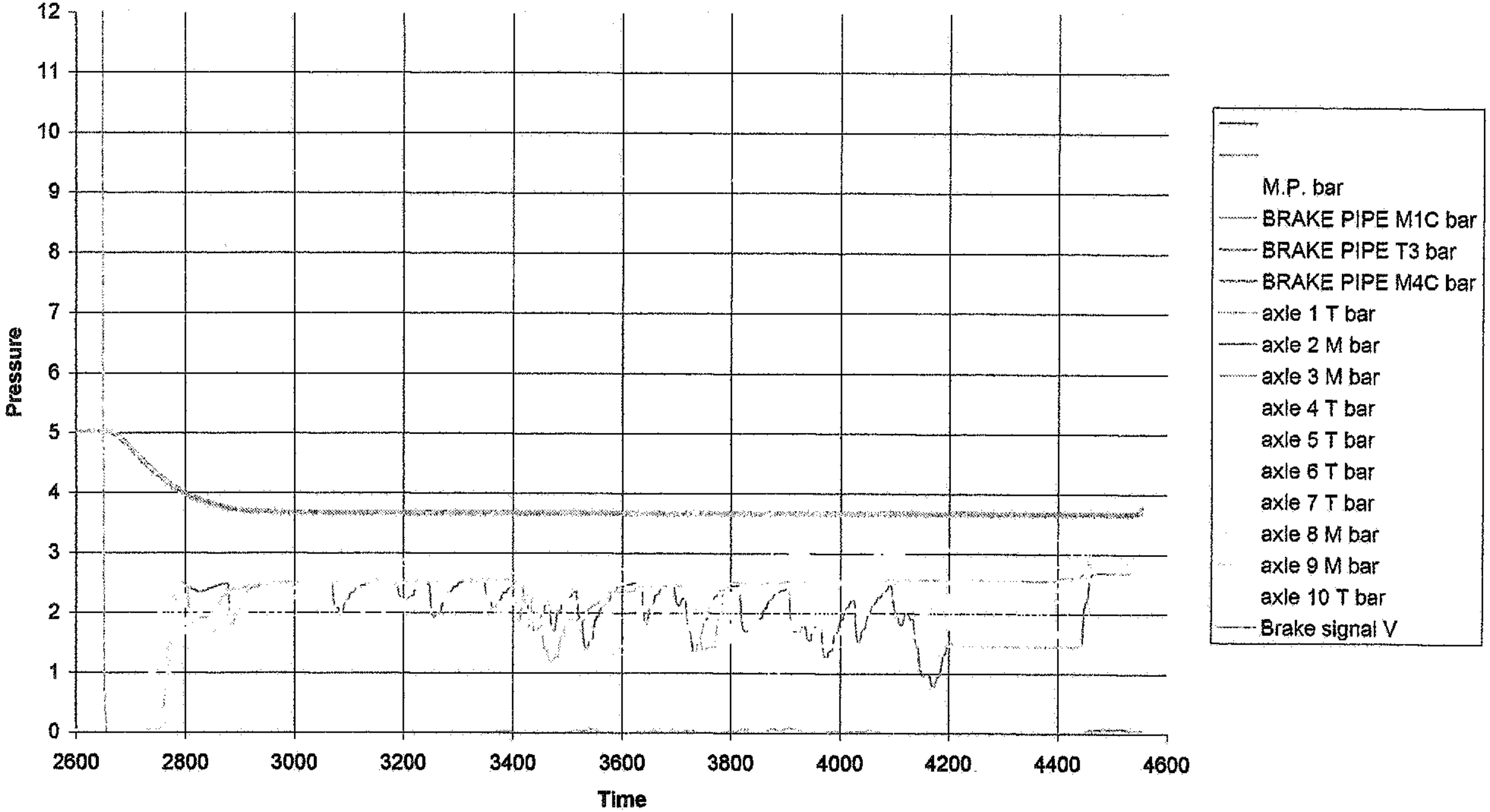
Maximum Service Brake no HD with soap; Vinit.= 121,45 Km/h; braking dist. = 654,17 m; M4; dec = 0,87 m/s/s; Effort Mode; File 16mar16			
speed	brake line	slide flag M4	slide flag M1
deceleration	distance	slide flag T3	

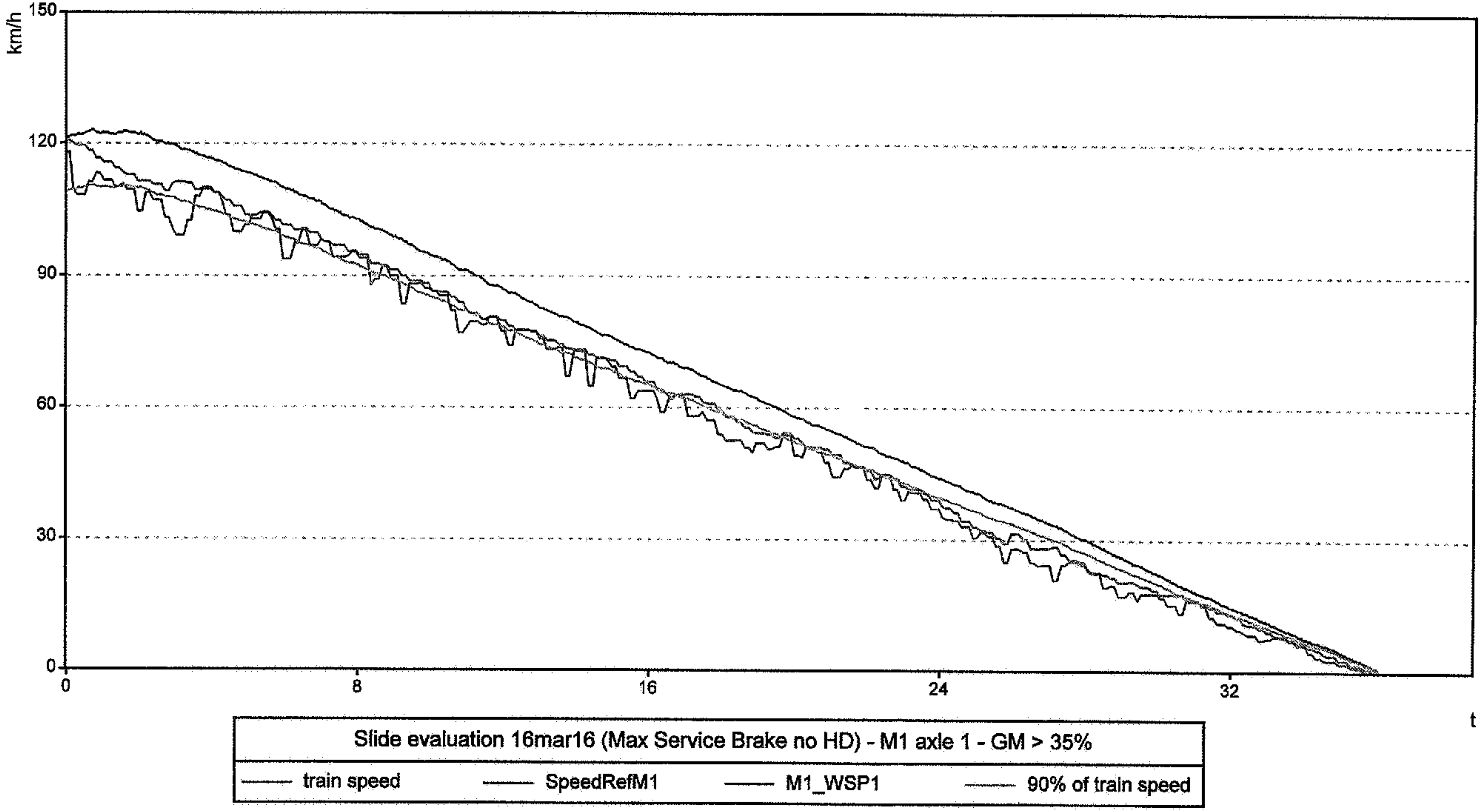


-1,2
-0,9
-0,6
-0,3
0
0,3
0
8
16
24
32
t
Efficiency = 90,5%
Antislide efficiency calculation 16mar16 (Max Service Brake without HD) - Ta = 0,076 - Distance increase = 11,65%
Train acceleration
Peak acceleration

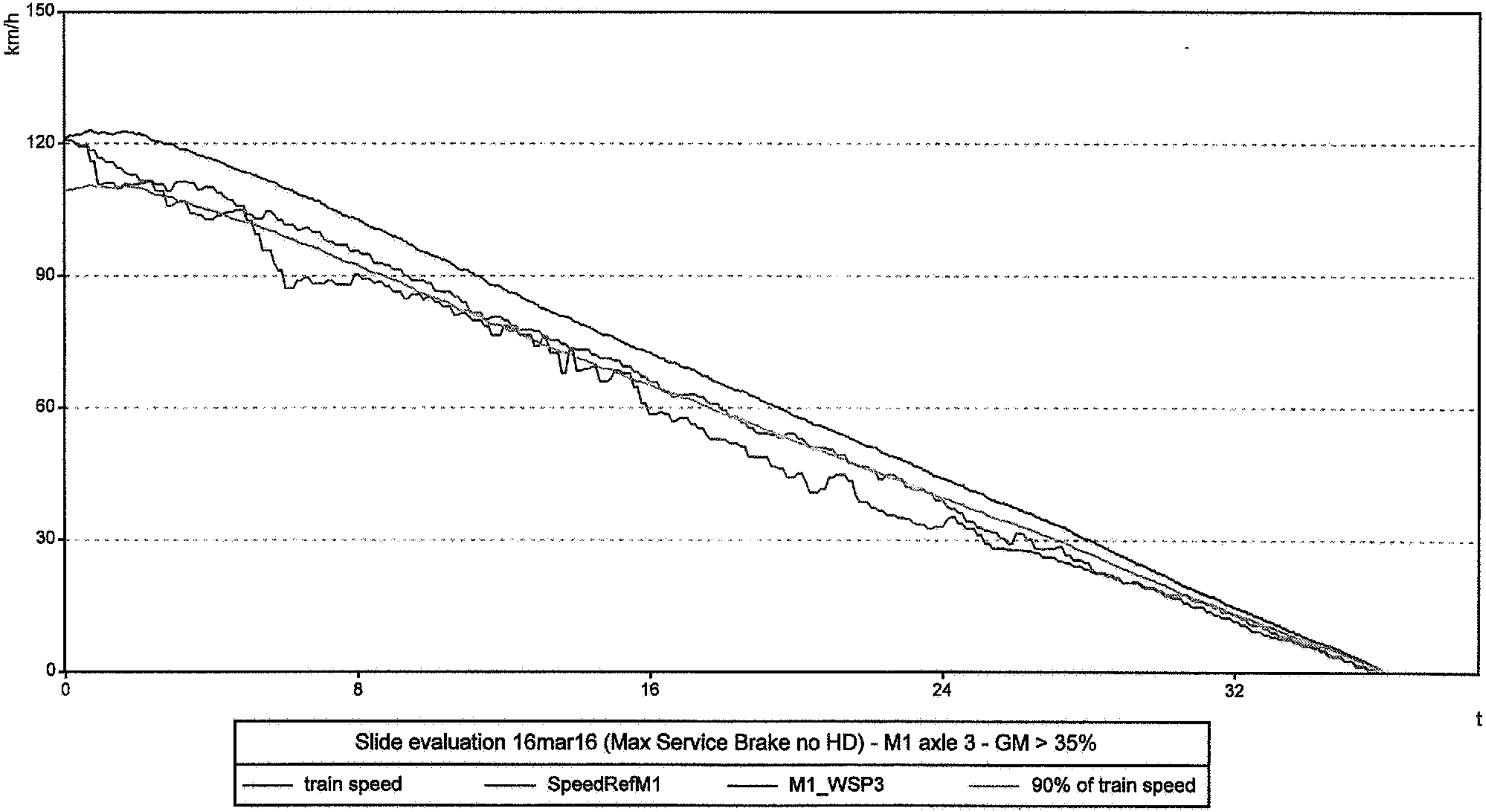

16_mar_16
Pressure [mbar]
Speed [km/h]
Time [s]
6000
5000
4000
3000
2000
1000
0
-1000
14
12
10
8
6
4
2
0
-2
95
100
105
110
115
120
125
130
135
140
145
CONTROL1 [bar]
CONTROL2 [bar]
CONTROL3 [bar]
CONTROL4 [bar]
BPPRESS [bar]
HDA1 [unit]
HDA2 [unit]
HDR1 [kN]
HDR2 [kN]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]

16 March Test 16

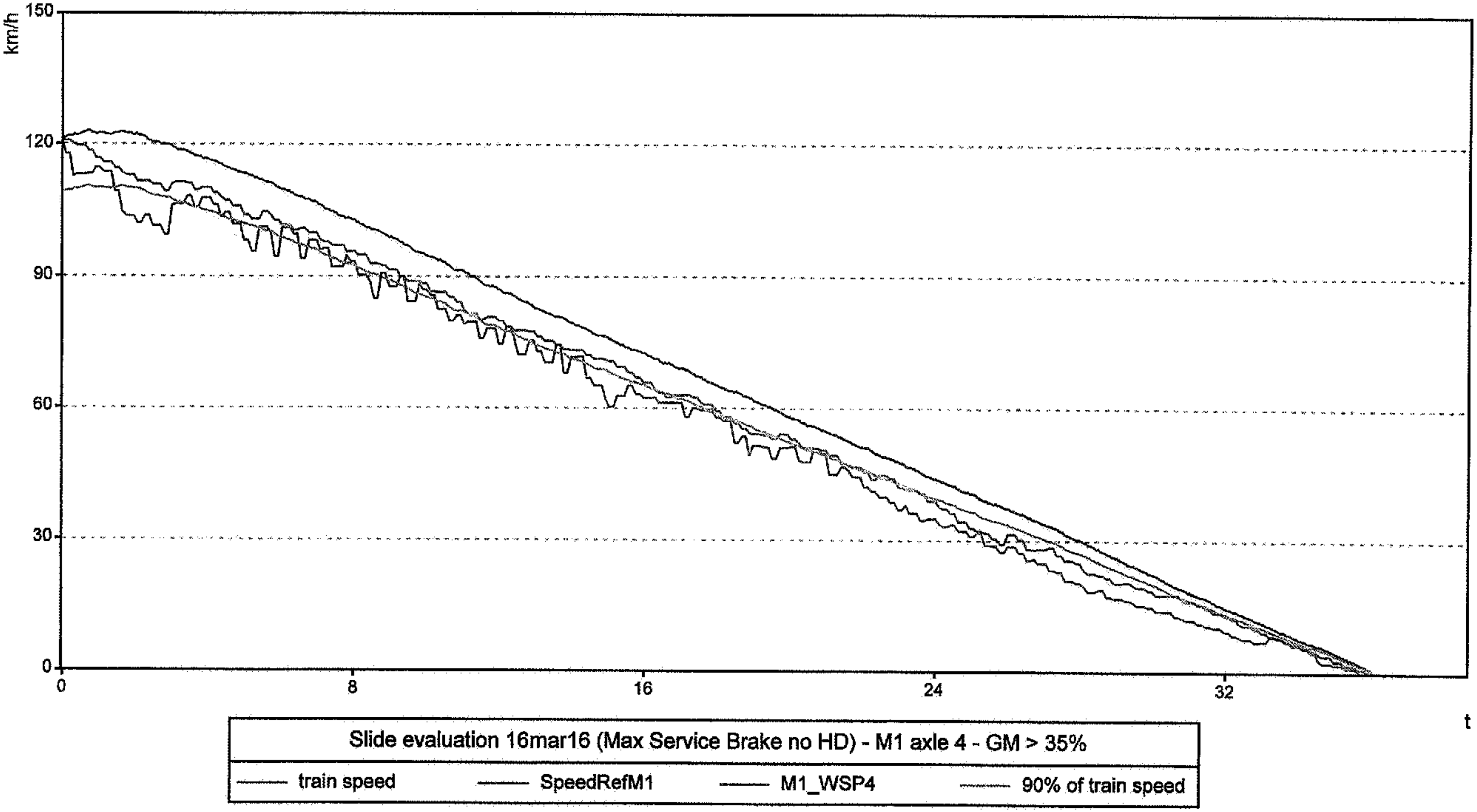




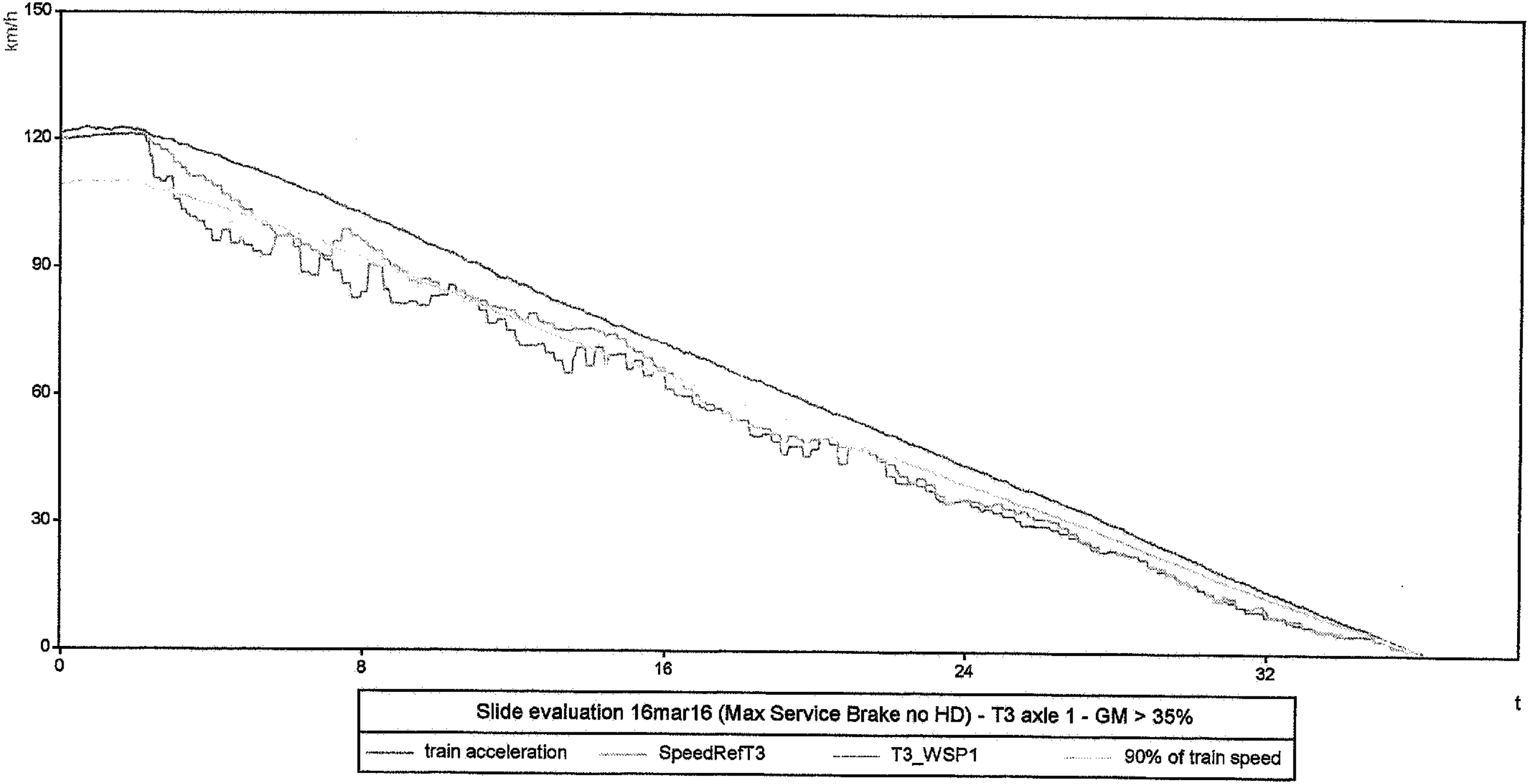
km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar16 (Max Service Brake no HD) - M1 axle 1 - GM > 35%
train speed
SpeedRefM1
M1_WSP1
90% of train speed



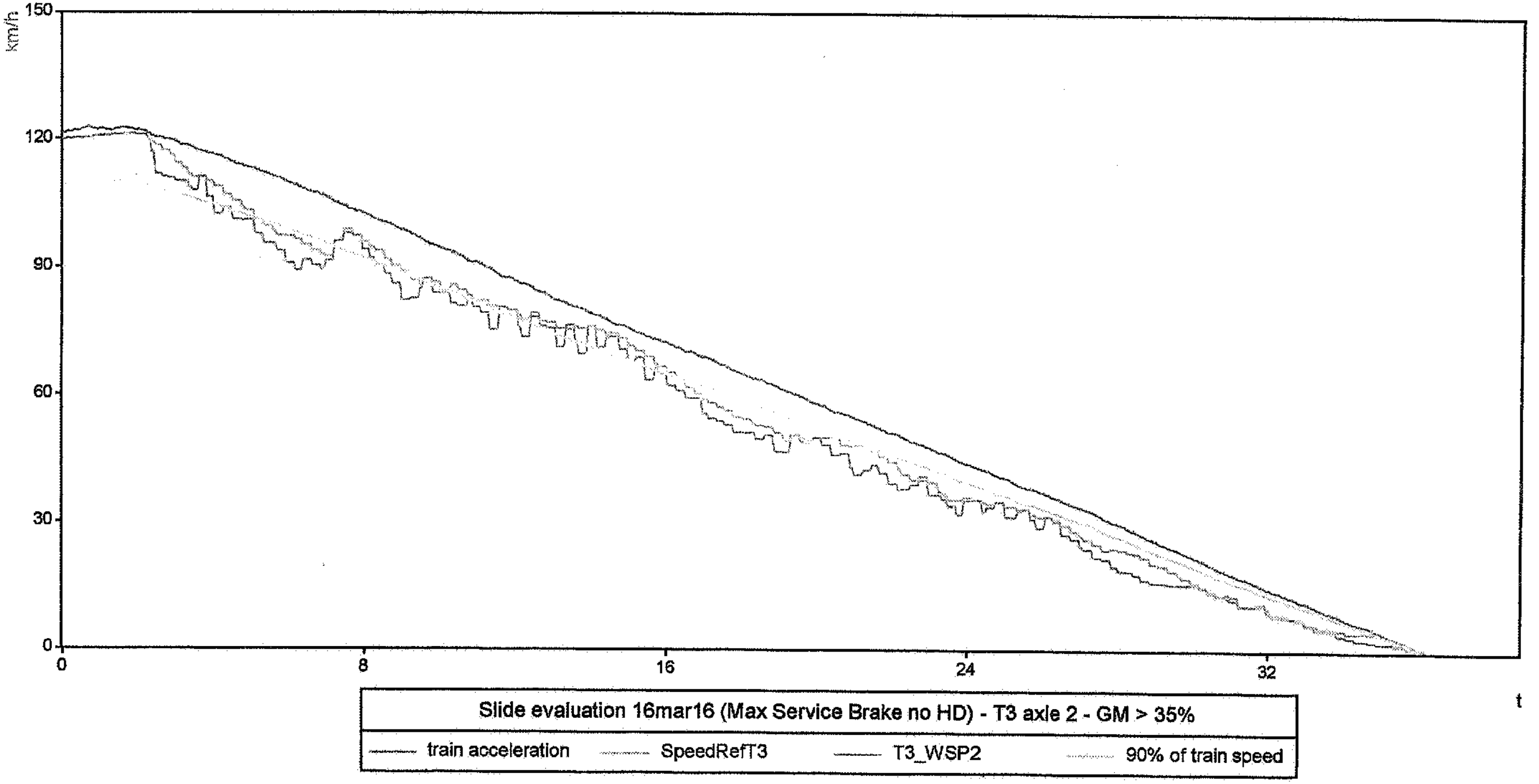
km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar16 (Max Service Brake no HD) - M1 axle 3 - GM > 35%
train speed
SpeedRefM1
M1_WSP3
90% of train speed



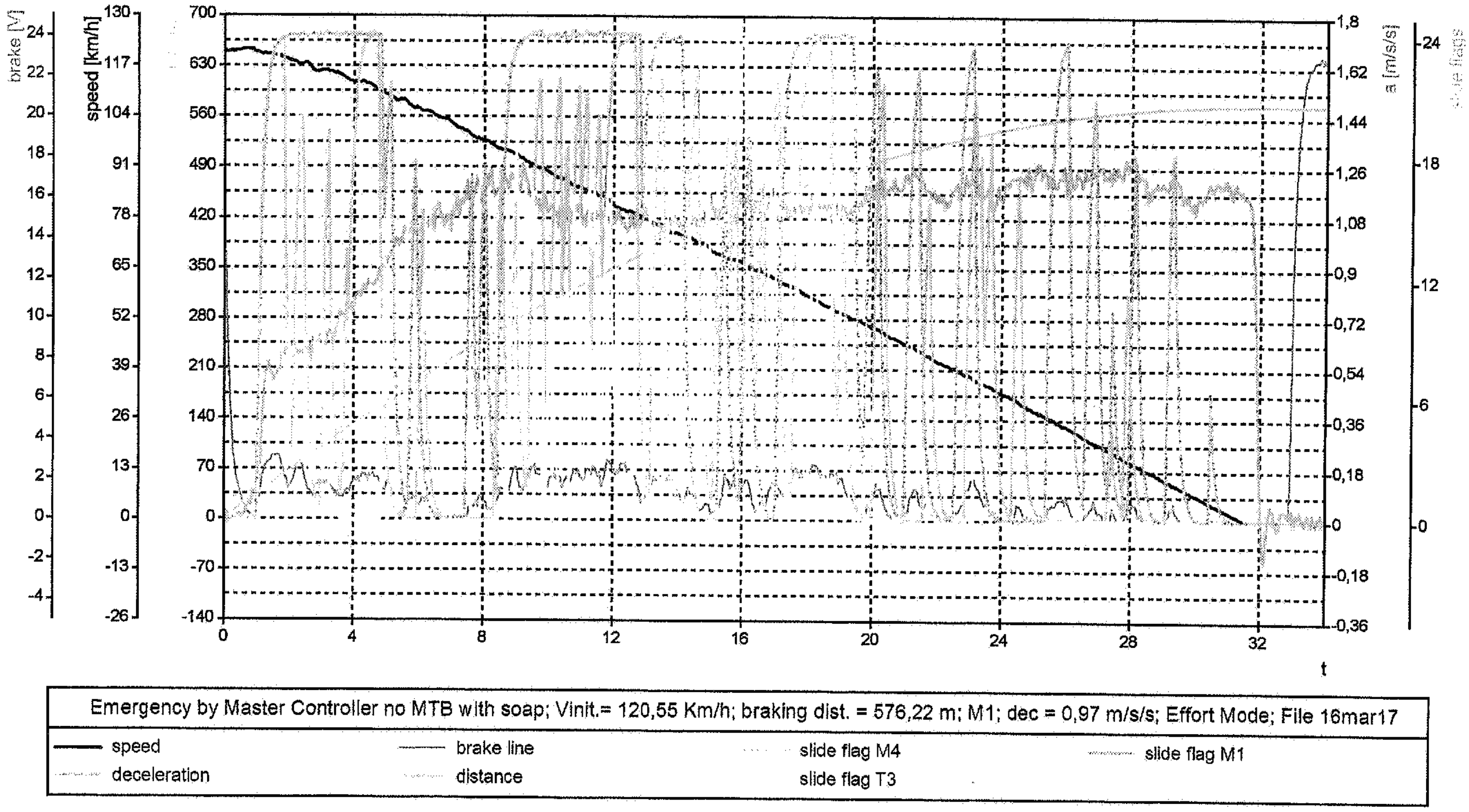
km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar16 (Max Service Brake no HD) - M1 axle 4 - GM > 35%
train speed
SpeedRefM1
M1_WSP4
90% of train speed



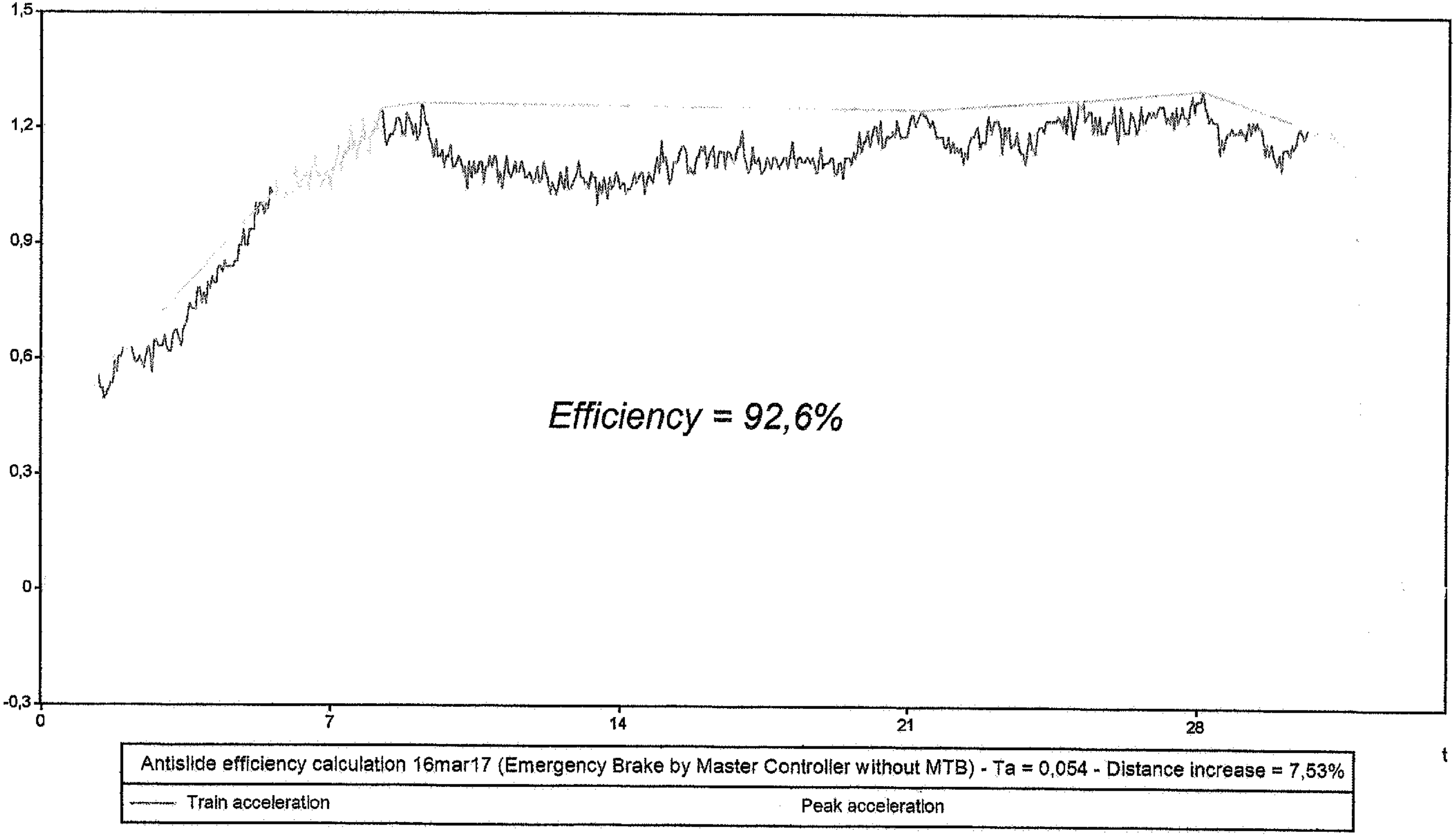
km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar16 (Max Service Brake no HD) - T3 axle 1 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP1
90% of train speed

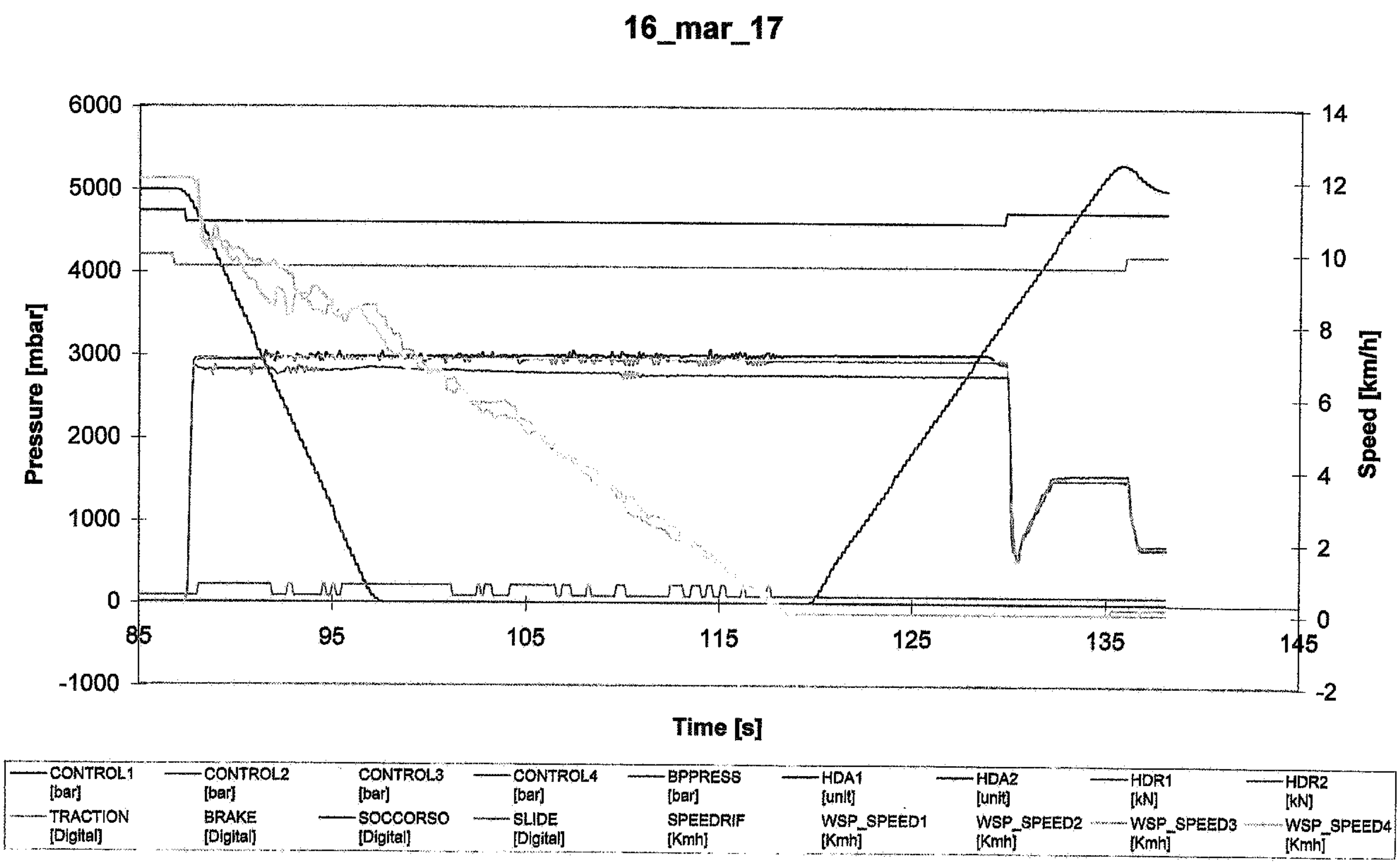


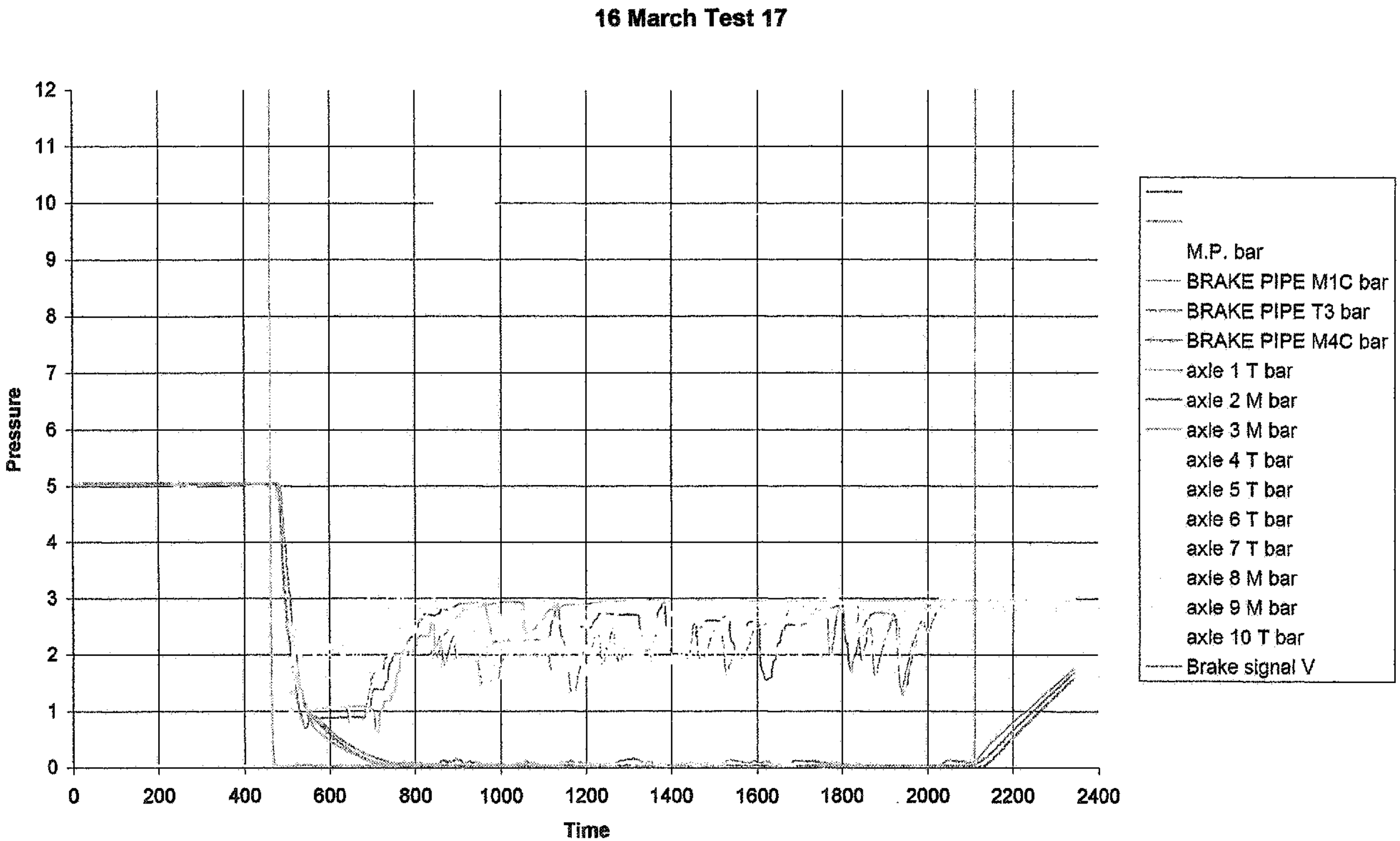
km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 16mar16 (Max Service Brake no HD) - T3 axle 2 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP2
90% of train speed

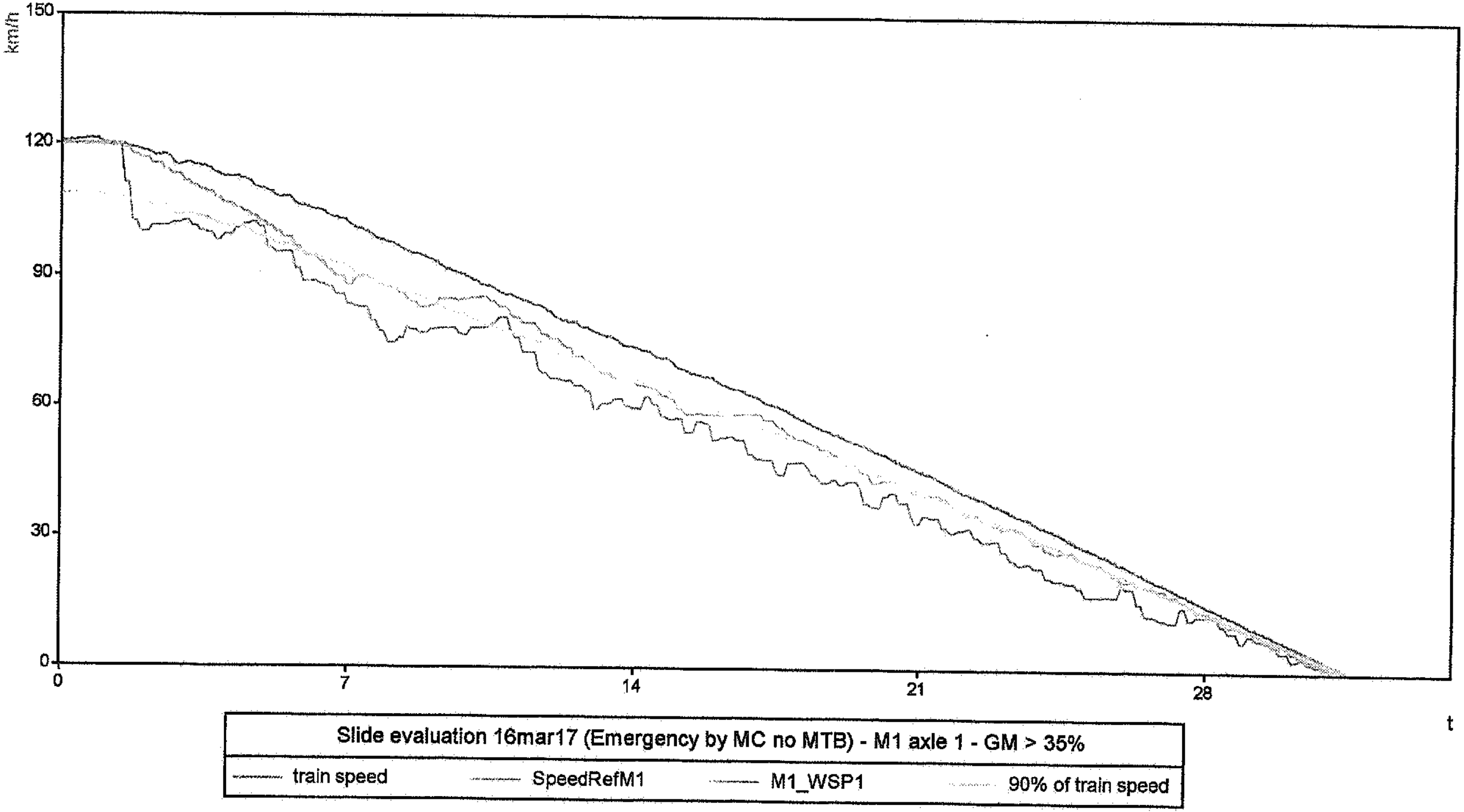


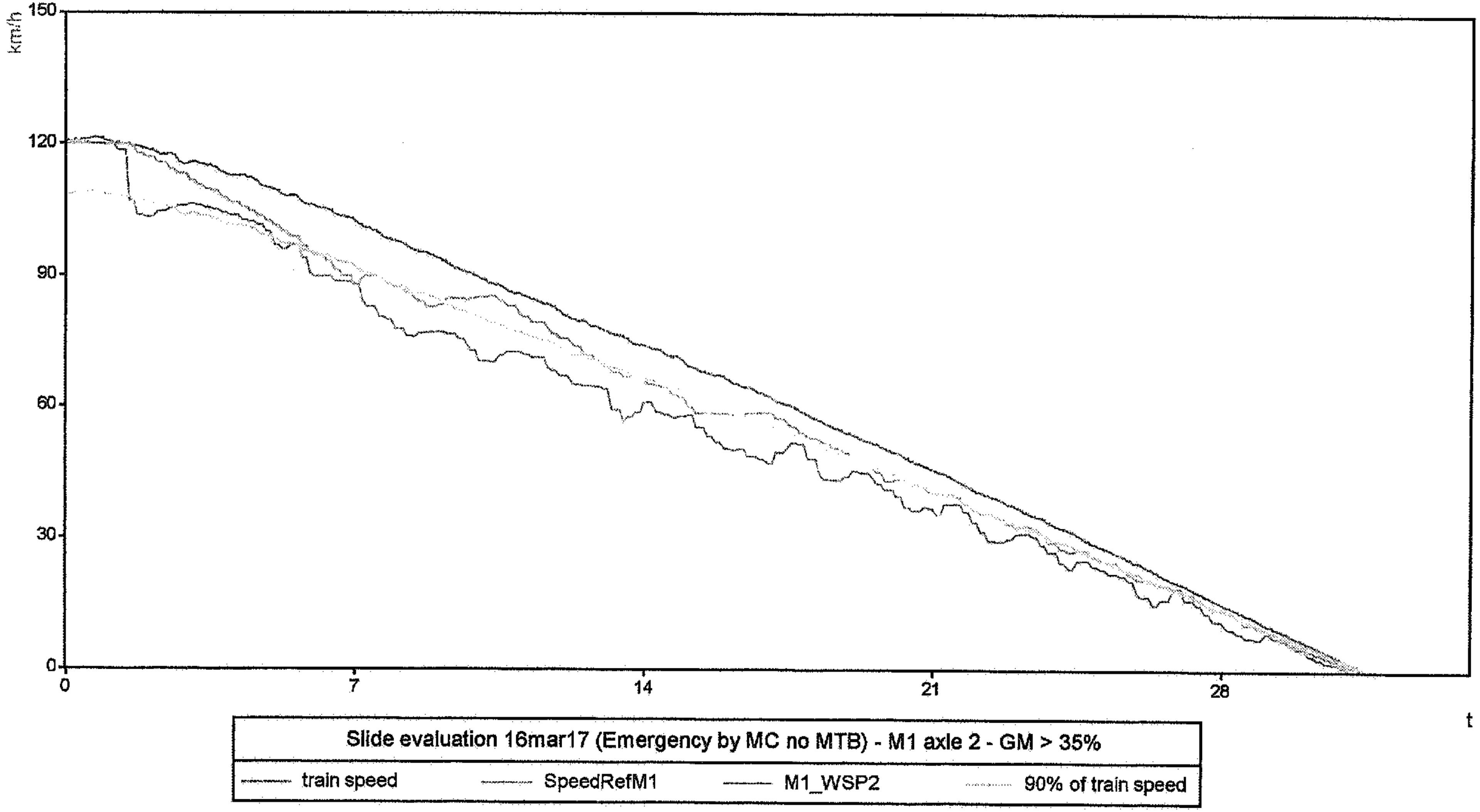
brake [V]
speed [km/h]
a [m/s/s]
slide flags
t
Emergency by Master Controller no MTB with soap; Vinit.= 120,55 Km/h; braking dist. = 576,22 m; M1; dec = 0,97 m/s/s; Effort Mode; File 16mar17
speed
brake line
slide flag M4
slide flag M1
deceleration
distance
slide flag T3

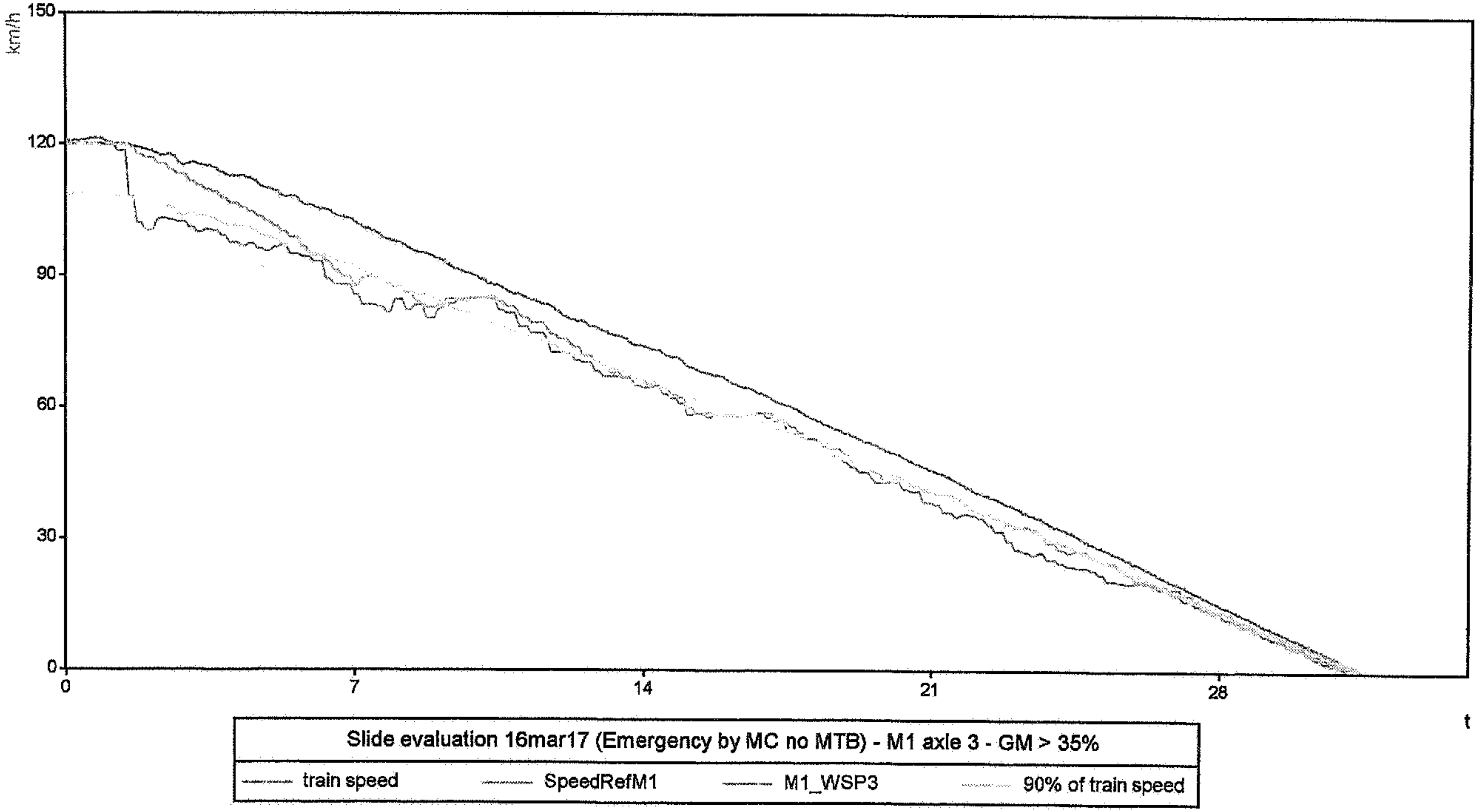

1,5
1,2
0,9
0,6
0,3
0
-0,3
0
7
14
21
28
t
Efficiency = 92,6%
Antislide efficiency calculation 16mar17 (Emergency Brake by Master Controller without MTB) - Ta = 0,054 - Distance increase = 7,53%
Train acceleration
Peak acceleration

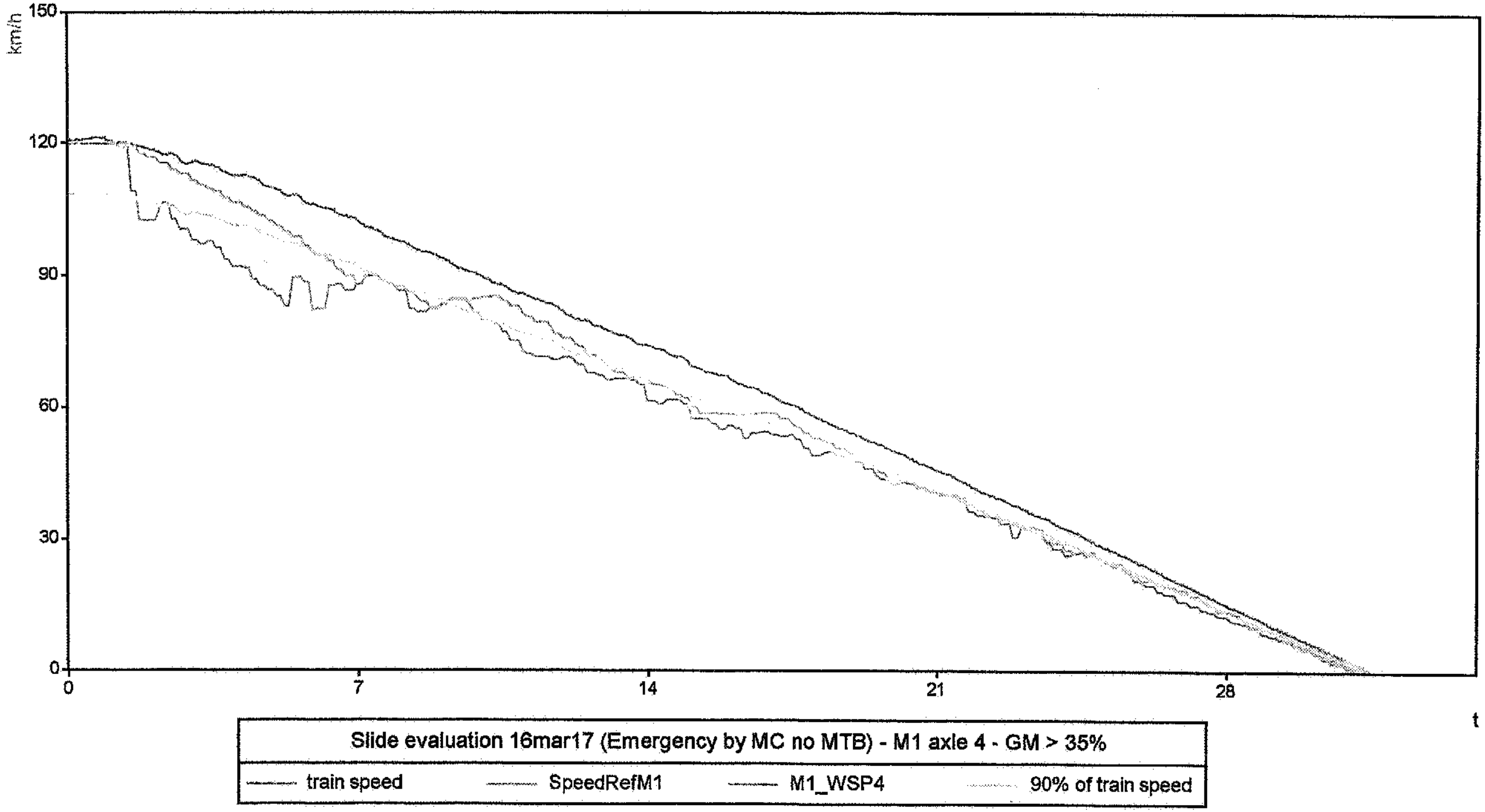

16_mar_17
Pressure [mbar]
Speed [km/h]
Time [s]
6000
5000
4000
3000
2000
1000
0
-1000
14
12
10
8
6
4
2
0
-2
85
95
105
115
125
135
145
CONTROL1 [bar]
CONTROL2 [bar]
CONTROL3 [bar]
CONTROL4 [bar]
BPPRESS [bar]
HDA1 [unit]
HDA2 [unit]
HDR1 [kN]
HDR2 [kN]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]


16 March Test 17
Pressure
Time
12
11
10
9
8
7
6
5
4
3
2
1
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
M.P. bar
BRAKE PIPE M1C bar
BRAKE PIPE T3 bar
BRAKE PIPE M4C bar
axle 1 T bar
axle 2 M bar
axle 3 M bar
axle 4 T bar
axle 5 T bar
axle 6 T bar
axle 7 T bar
axle 8 M bar
axle 9 M bar
axle 10 T bar
Brake signal V

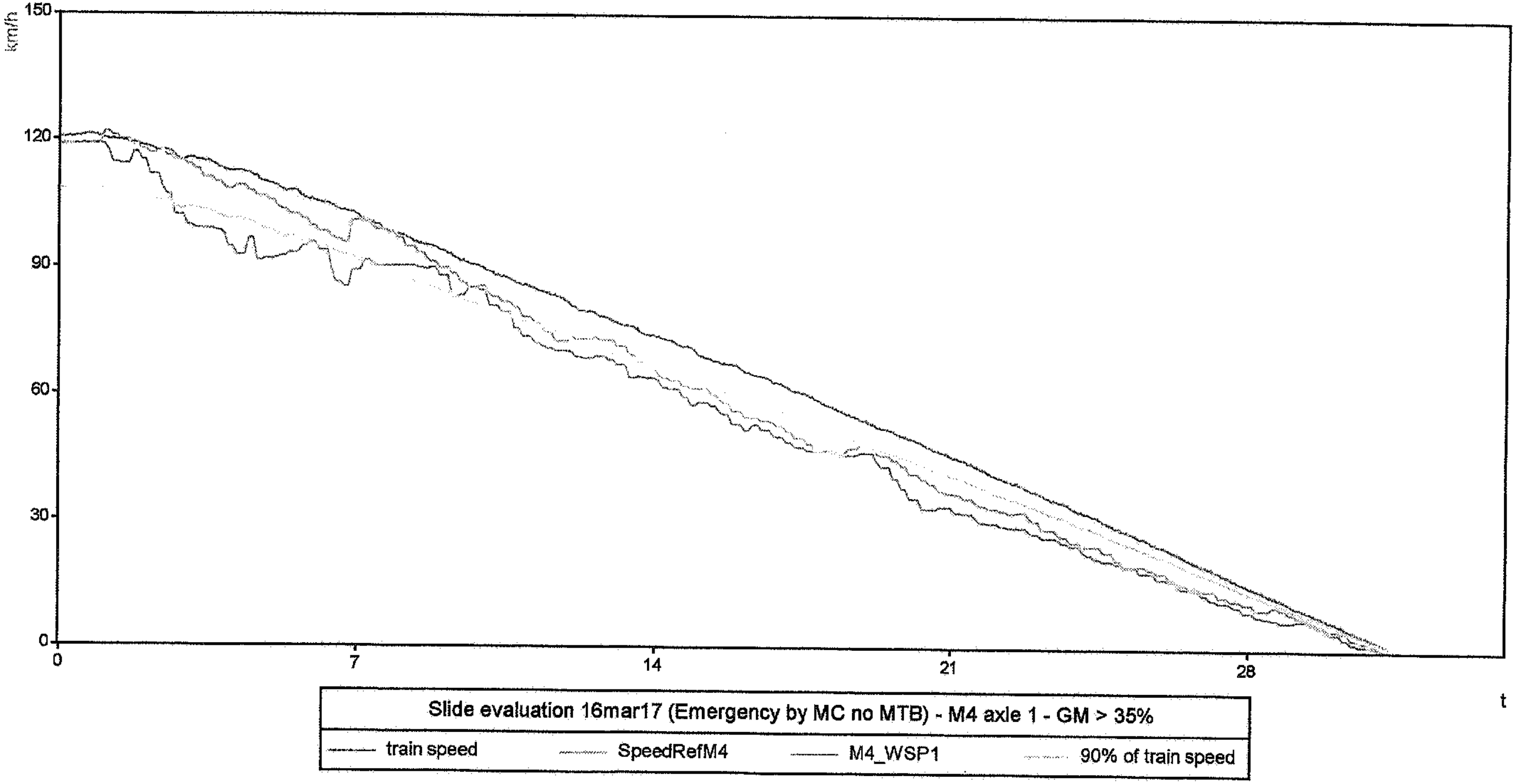

km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar17 (Emergency by MC no MTB) - M1 axle 1 - GM > 35%
train speed
SpeedRefM1
M1_WSP1
90% of train speed

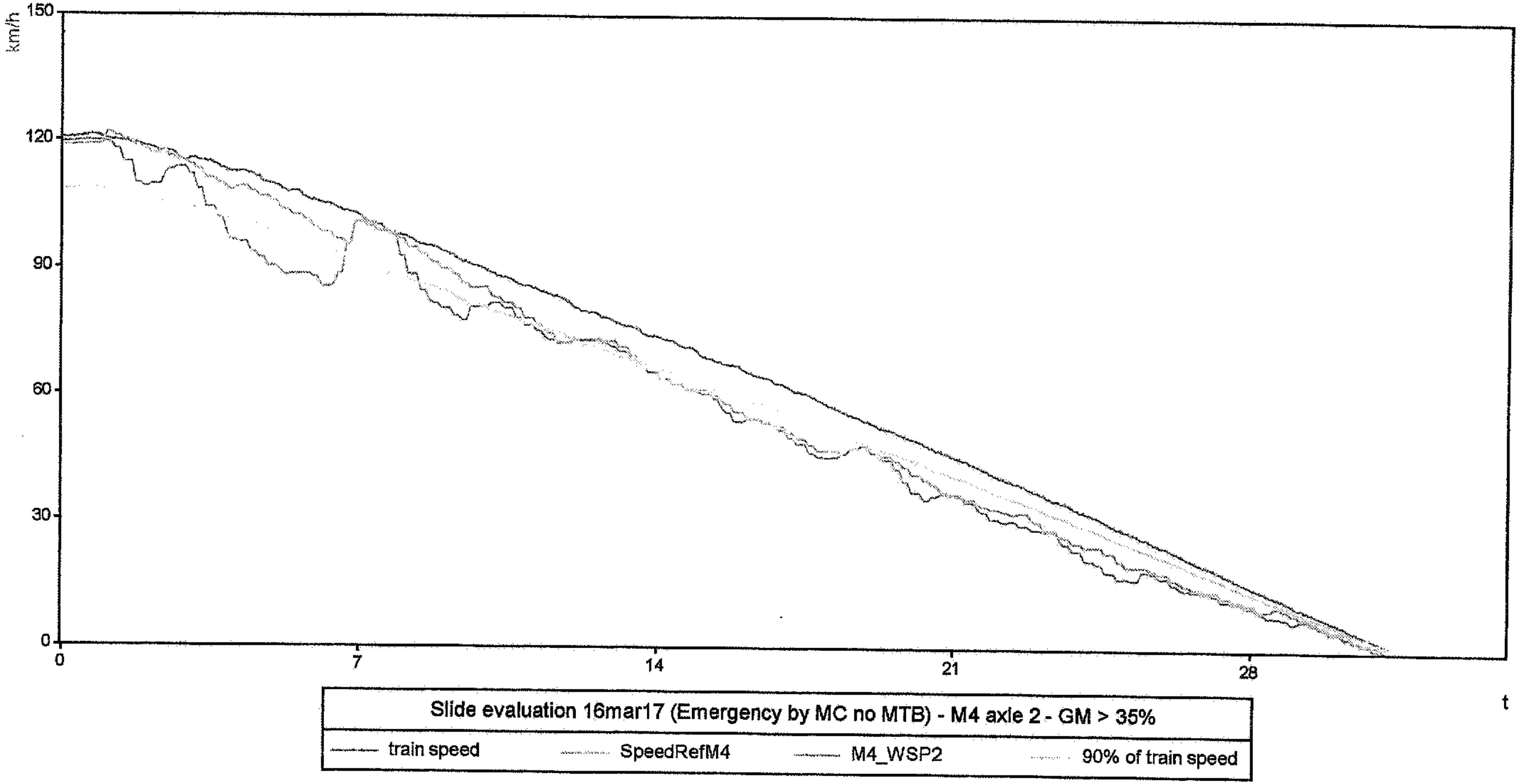

km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar17 (Emergency by MC no MTB) - M1 axle 2 - GM > 35%
train speed
SpeedRefM1
M1_WSP2
90% of train speed

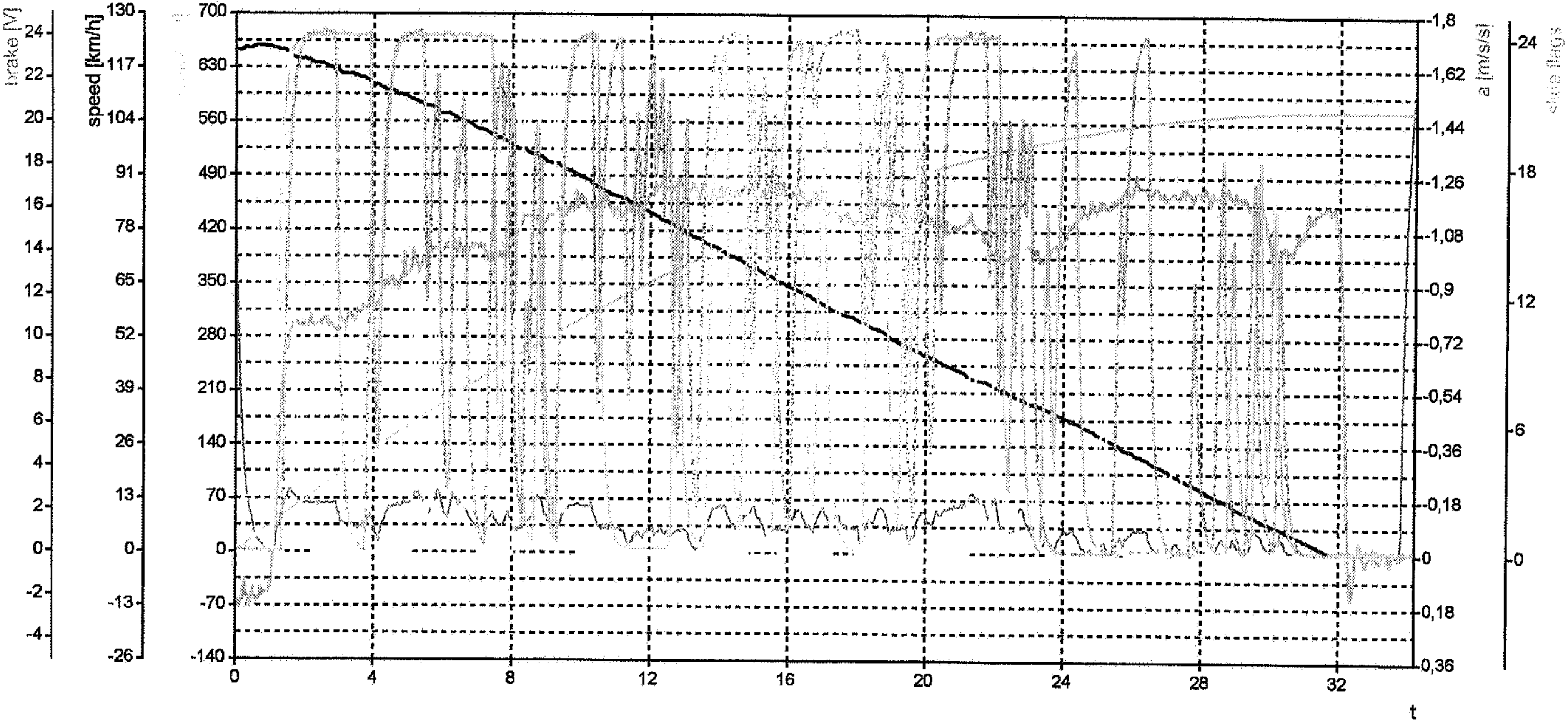

km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar17 (Emergency by MC no MTB) - M1 axle 3 - GM > 35%
train speed
SpeedRefM1
M1_WSP3
90% of train speed



km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar17 (Emergency by MC no MTB) - M1 axle 4 - GM > 35%
train speed
SpeedRefM1
M1_WSP4
90% of train speed

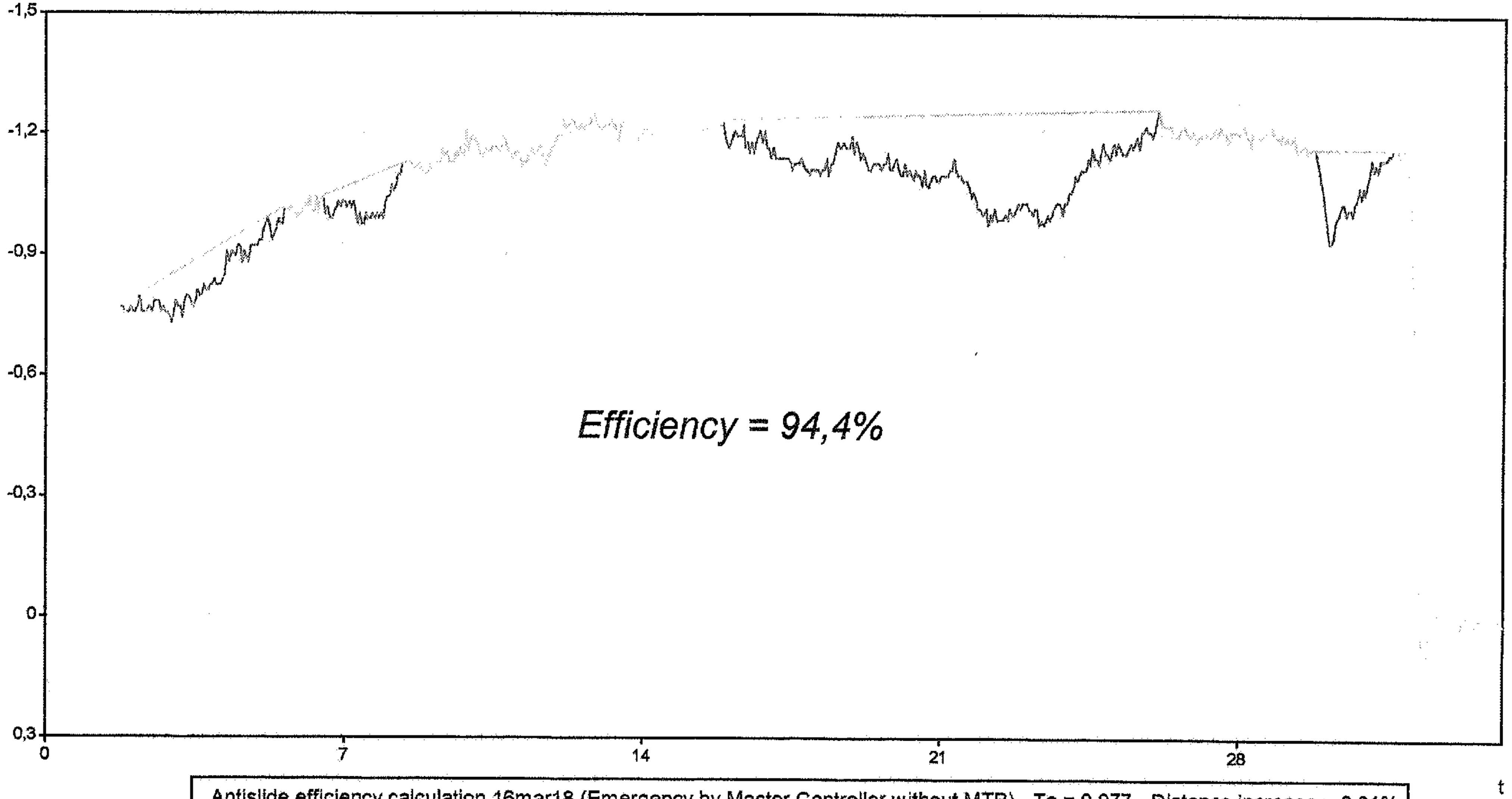

km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar17 (Emergency by MC no MTB) - M4 axle 1 - GM > 35%
train speed
SpeedRefM4
M4_WSP1
90% of train speed


km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar17 (Emergency by MC no MTB) - M4 axle 2 - GM > 35%
train speed
SpeedRefM4
M4_WSP2
90% of train speed



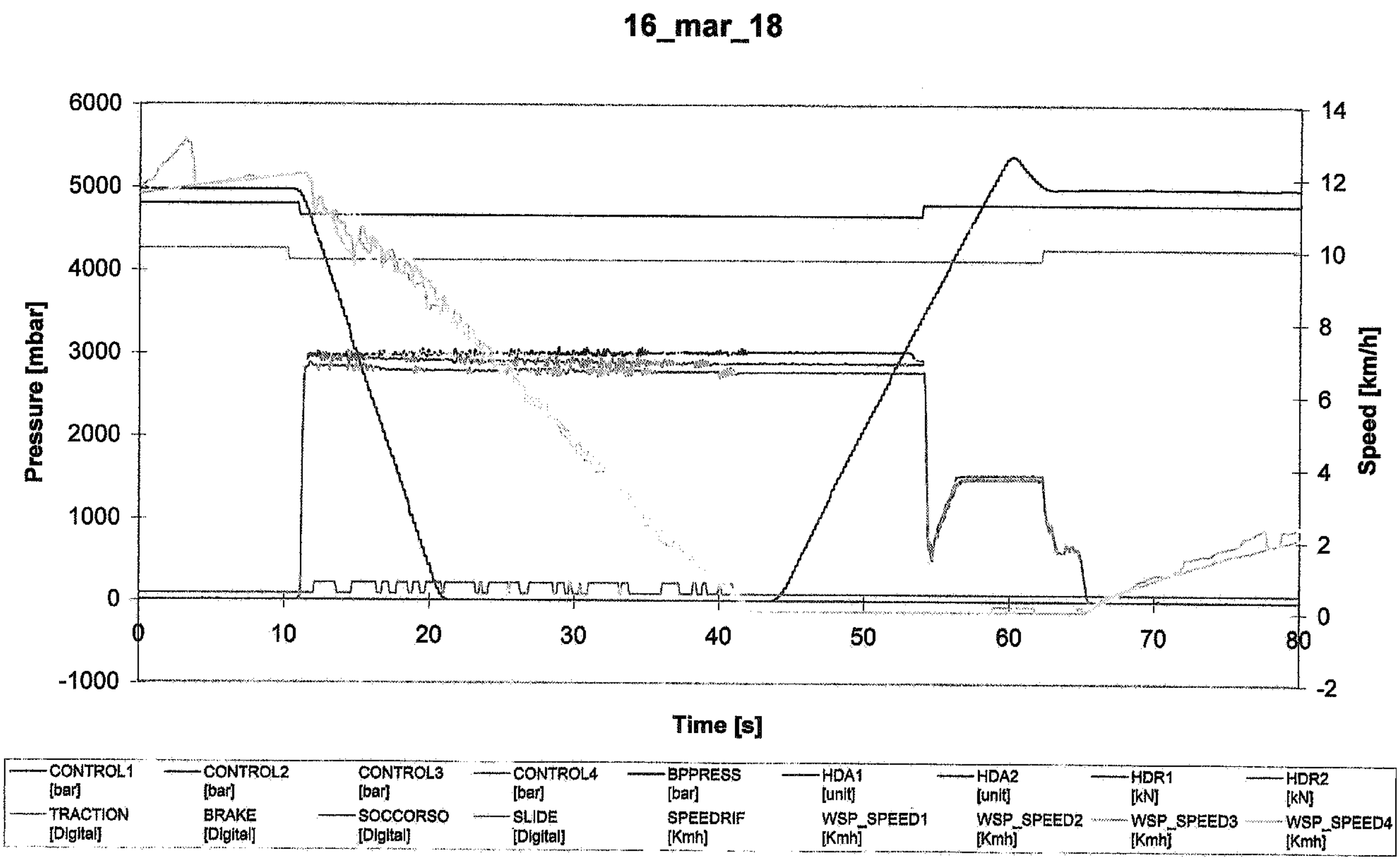
Emergency by Master Controller no MTB with soap; Vinit.= 121,25 Km/h; braking dist. = 574,69 m; M4; dec = 0,99 m/s/s; Effort Mode; File 16mar18

speed — brake line — slide flag M4 — slide flag M1
deceleration — distance — slide flag T3



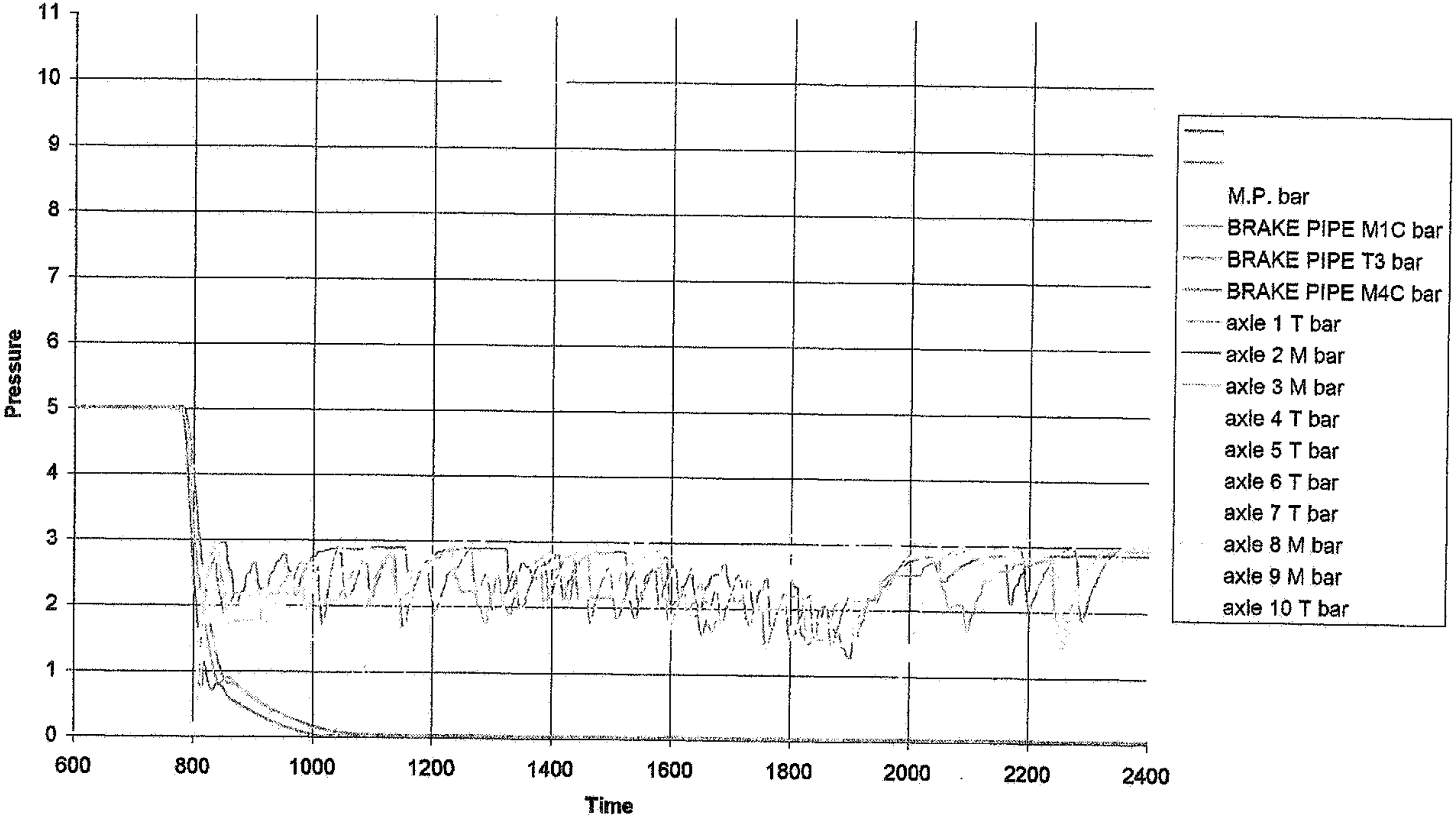
Antislide efficiency calculation 16mar18 (Emergency by Master Controller without MTB) - Ta = 0,077 - Distance increase = 6,01%

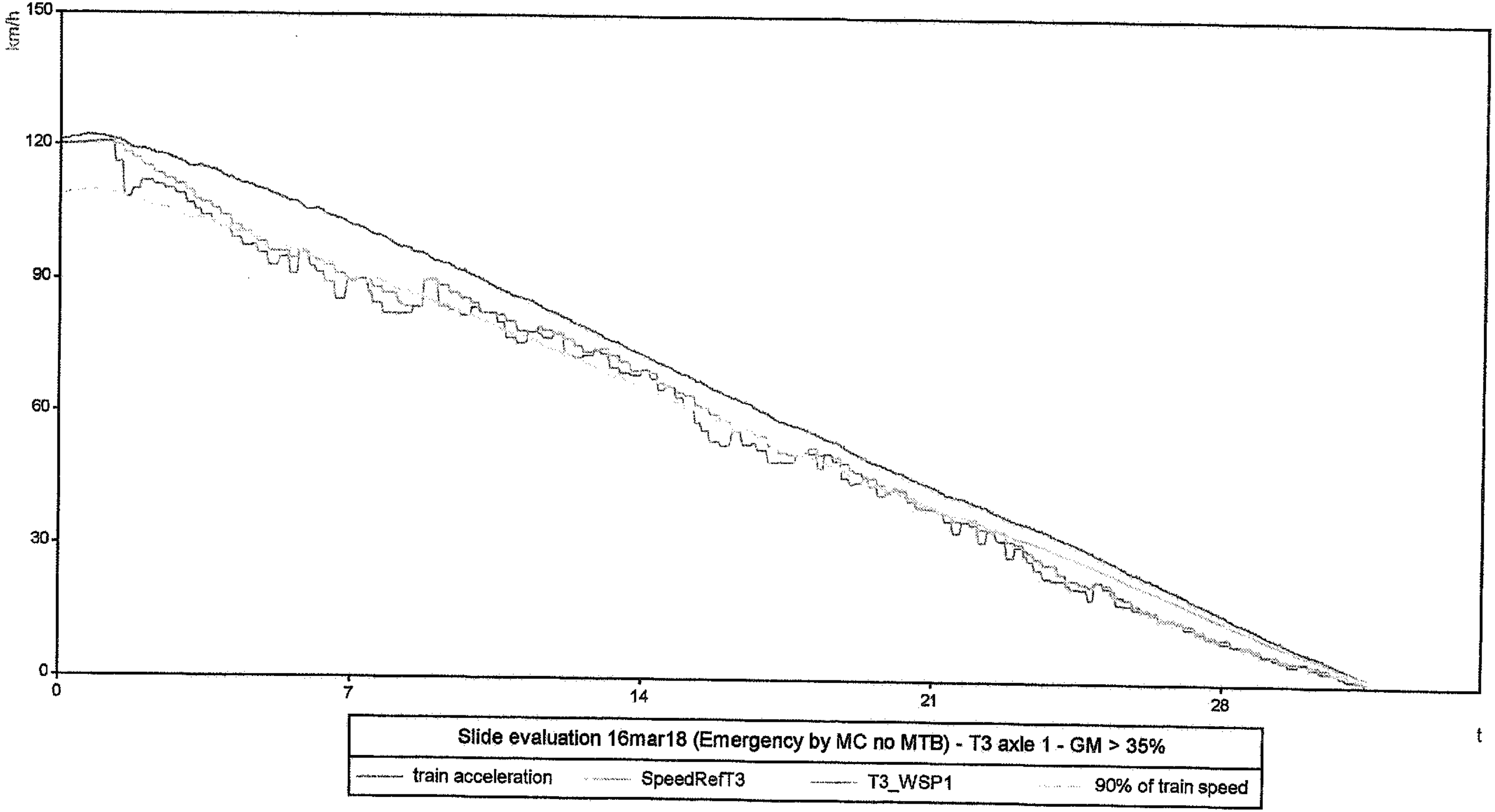
Train acceleration — peak acceleration



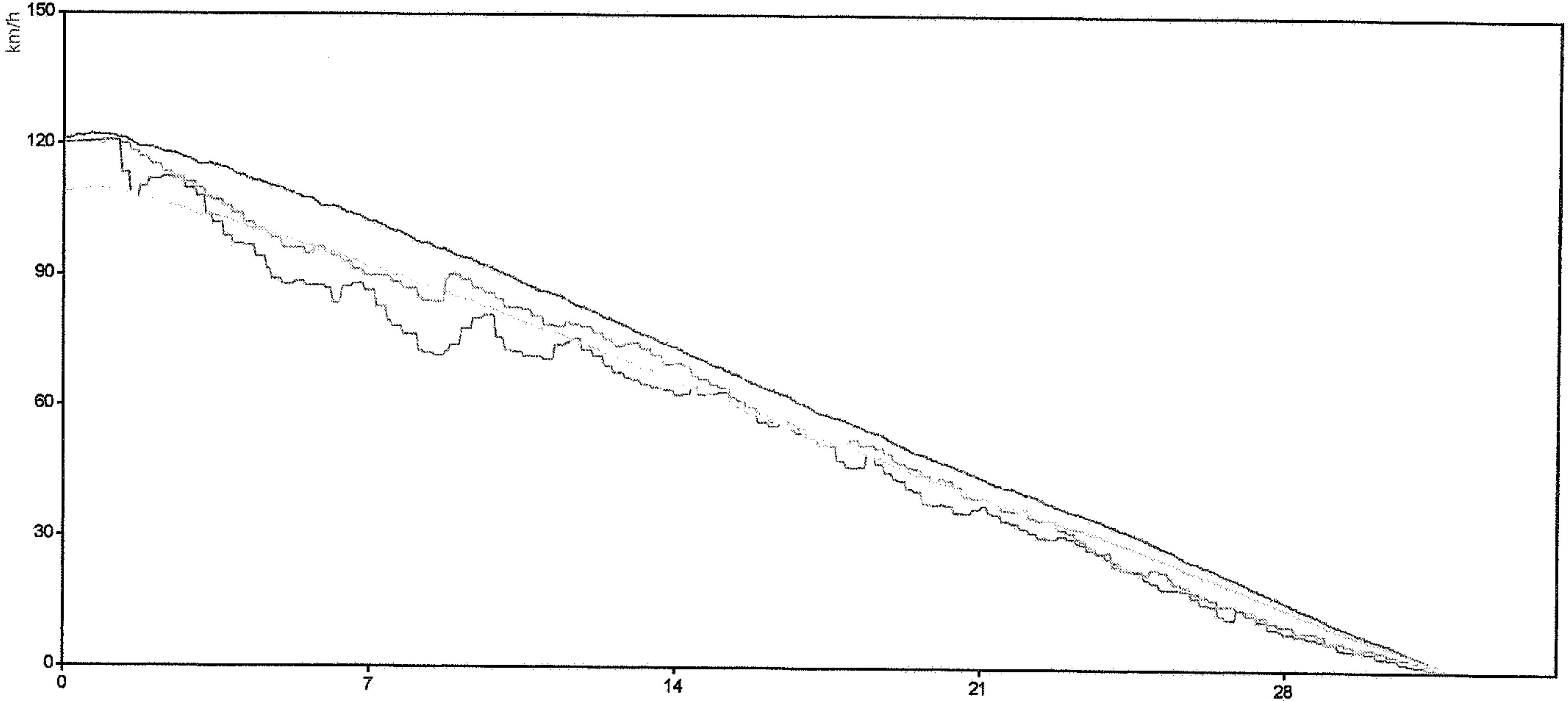
16_mar_18
Pressure [mbar]
Speed [km/h]
Time [s]
6000
5000
4000
3000
2000
1000
0
-1000
14
12
10
8
6
4
2
0
-2
0
10
20
30
40
50
60
70
80
CONTROL1 [bar]
CONTROL2 [bar]
CONTROL3 [bar]
CONTROL4 [bar]
BPPRESS [bar]
HDA1 [unit]
HDA2 [unit]
HDR1 [kN]
HDR2 [kN]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]

16 March Test 18



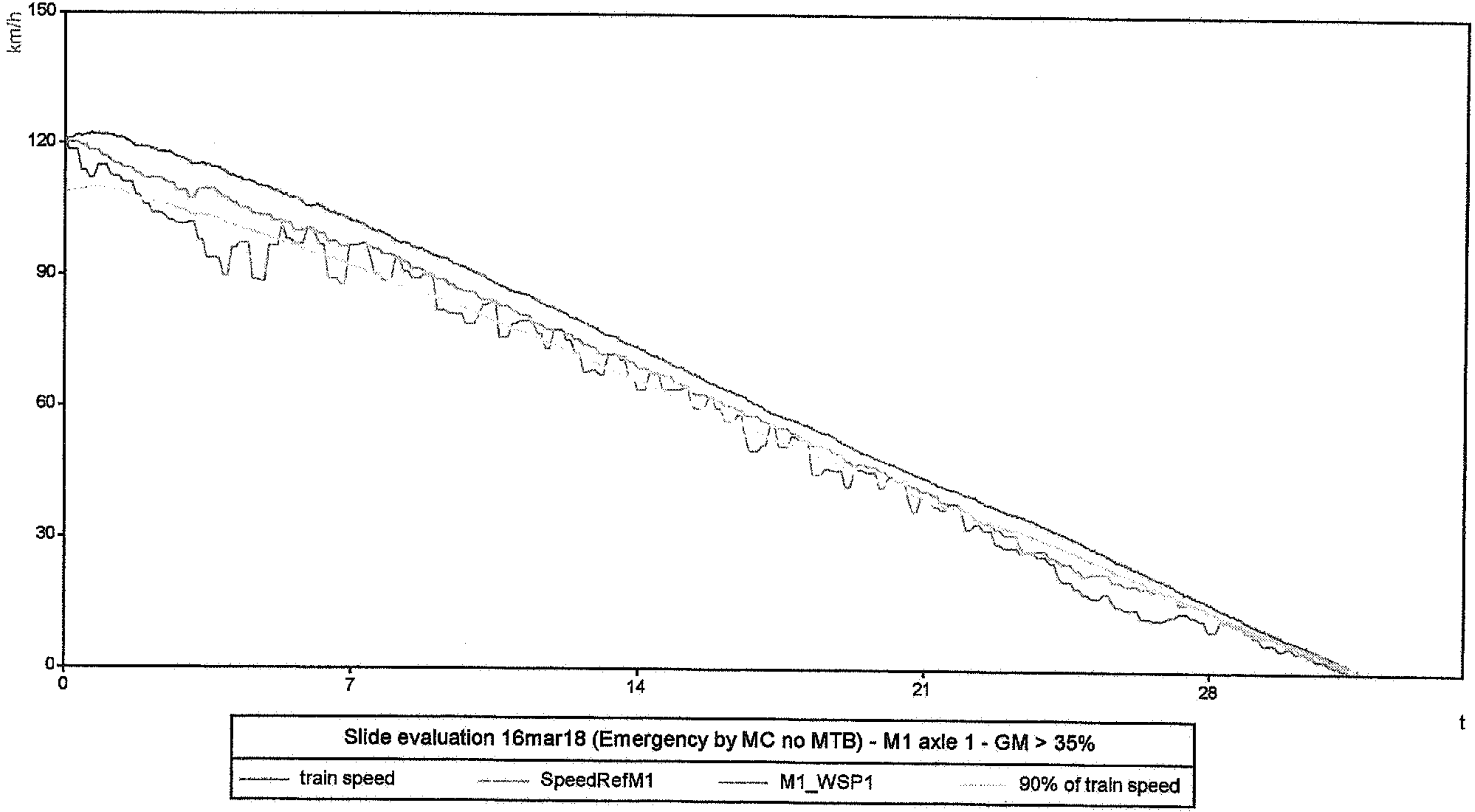


km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar18 (Emergency by MC no MTB) - T3 axle 1 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP1
90% of train speed

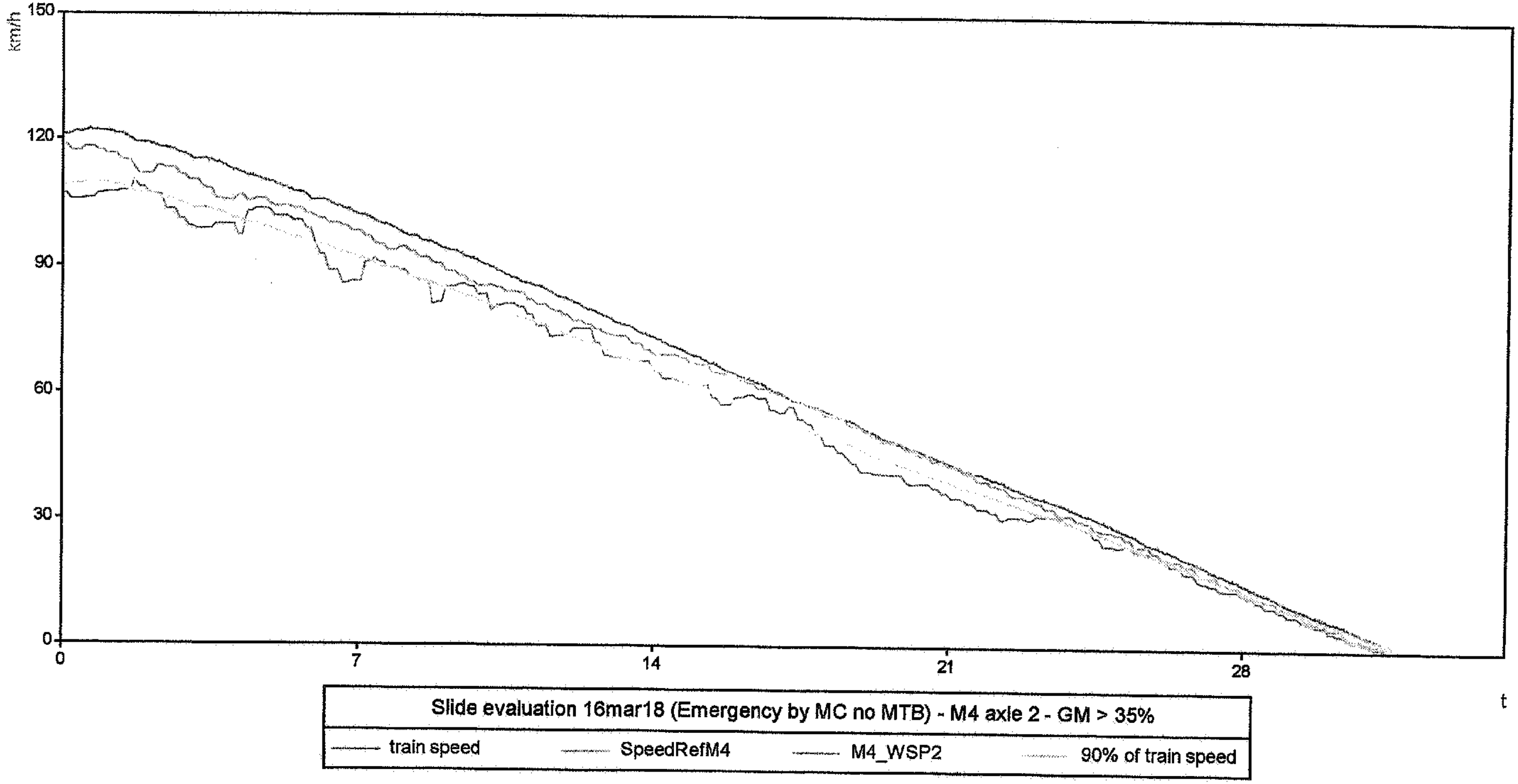


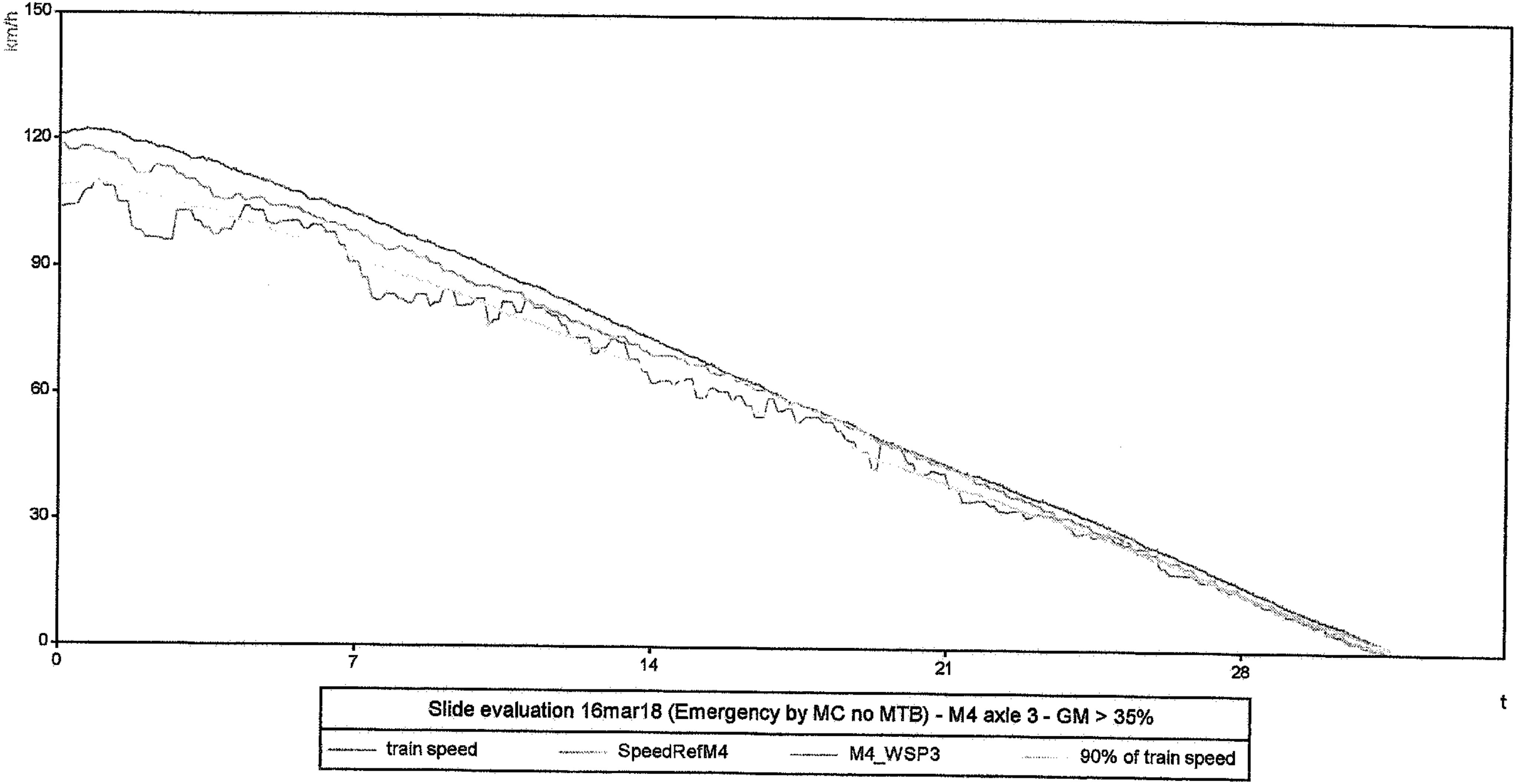
Slide evaluation 16mar18 (Emergency by MC no MTB) - T3 axle 2 - GM > 35%

train acceleration — SpeedRefT3 — T3_WSP2 — 90% of train speed

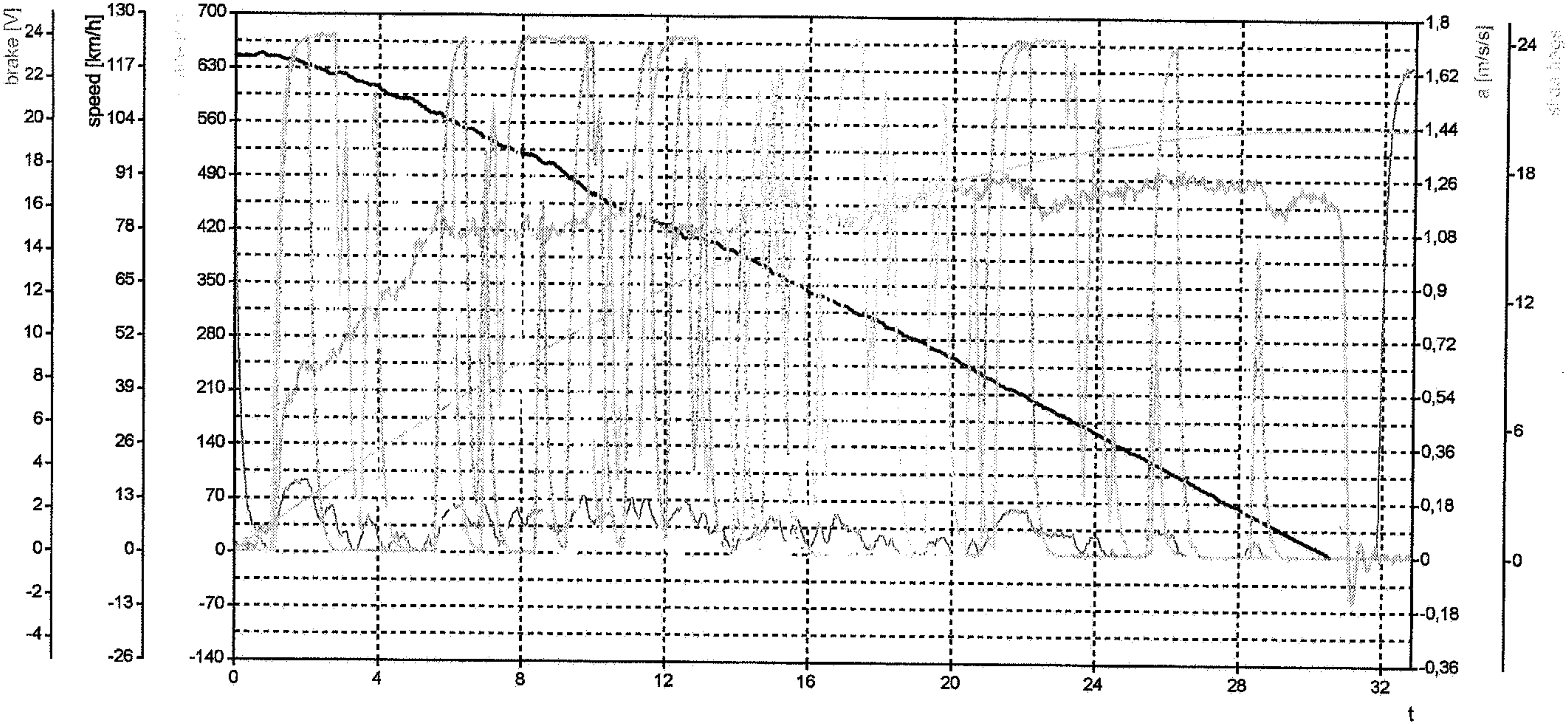


km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar18 (Emergency by MC no MTB) - M1 axle 1 - GM > 35%
train speed
SpeedRefM1
M1_WSP1
90% of train speed


km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar18 (Emergency by MC no MTB) - M4 axle 2 - GM > 35%
train speed
SpeedRefM4
M4_WSP2
90% of train speed



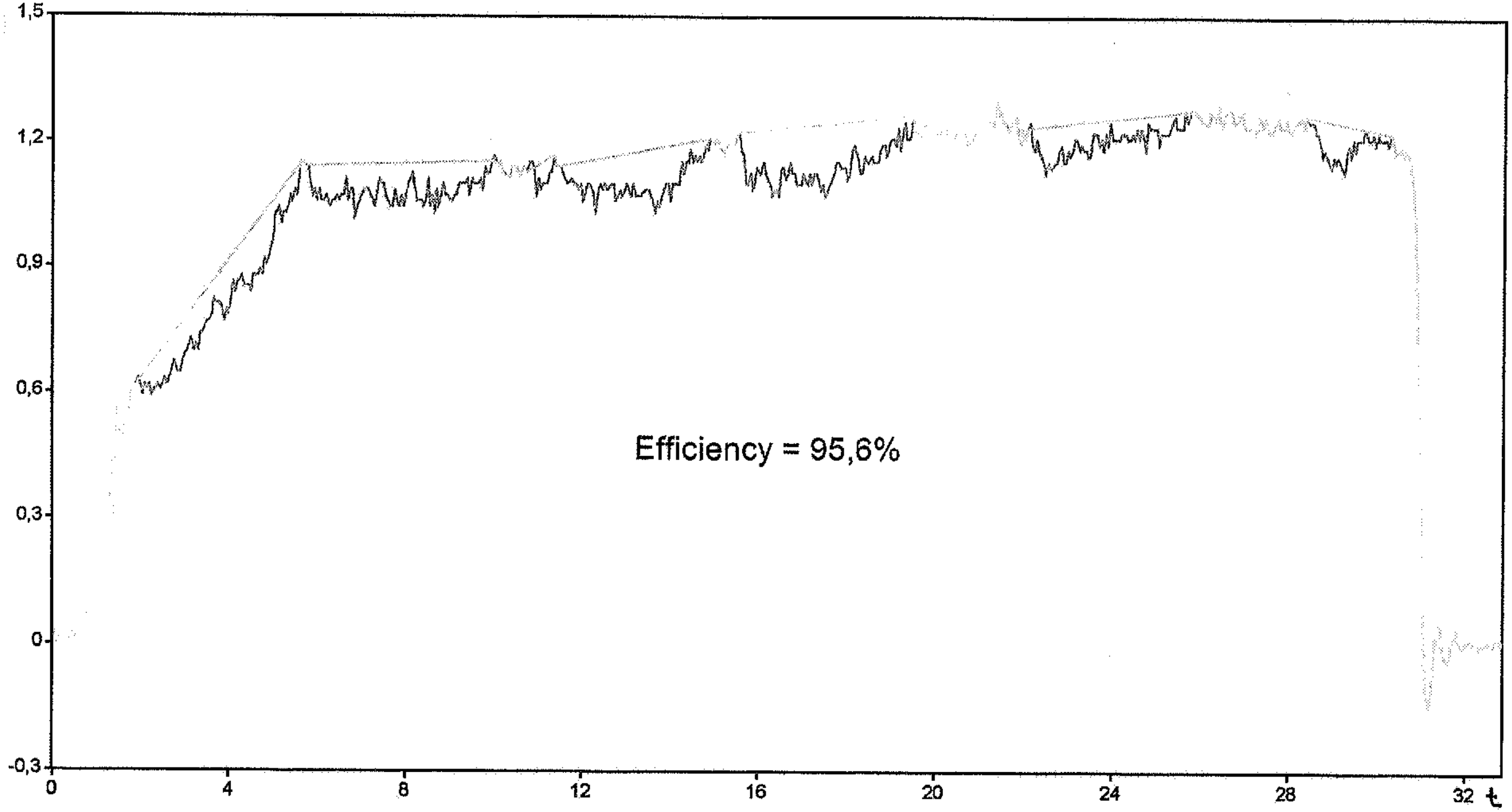
km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar18 (Emergency by MC no MTB) - M4 axle 3 - GM > 35%
train speed
SpeedRefM4
M4_WSP3
90% of train speed



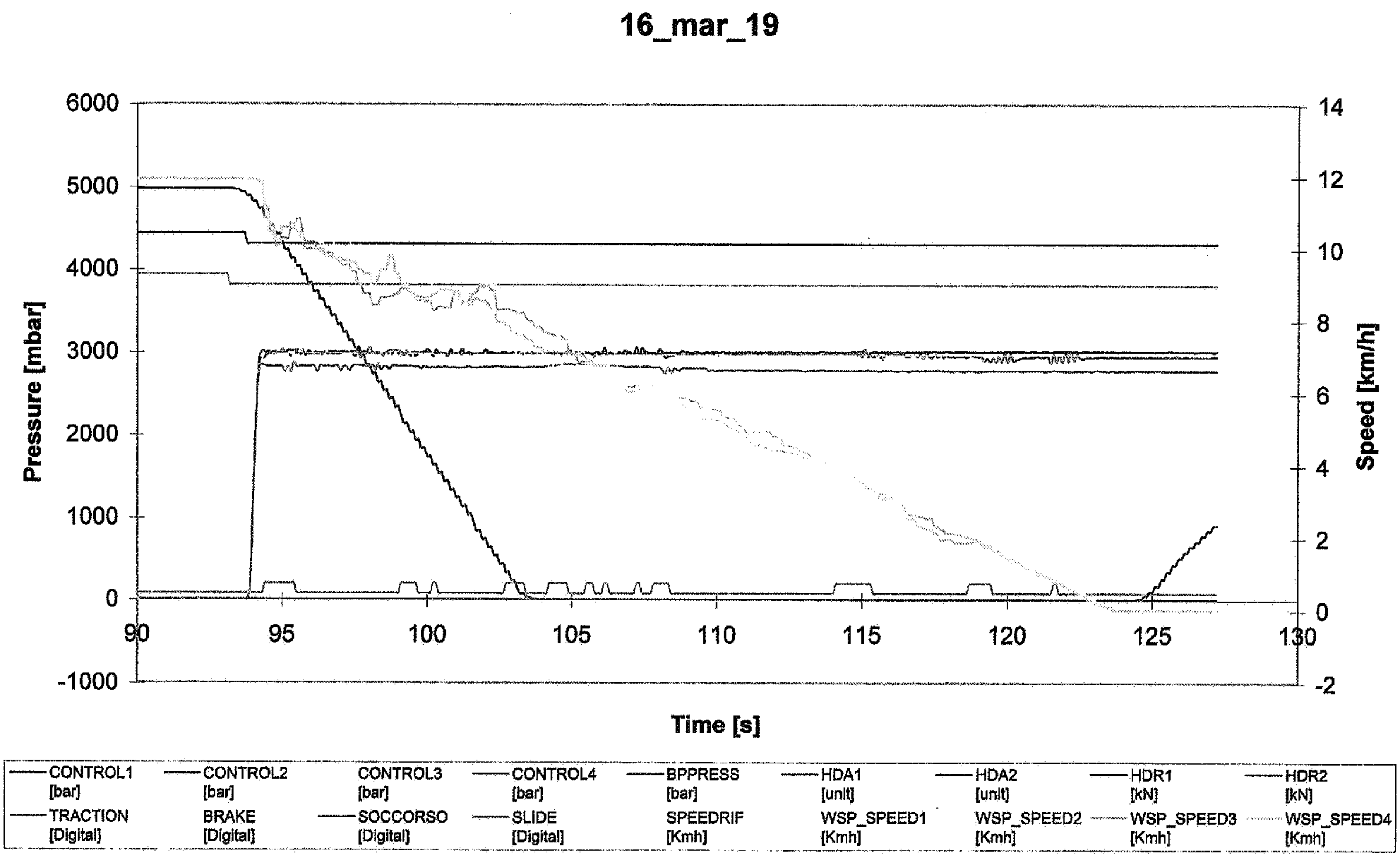
Emergency by Master Controller no MTB with soap; Vinit.= 120,09 Km/h; braking dist. = 555,74 m; M1; dec = 1,00 m/s/s; Effort Mode; File 16mar19

speed — brake line — slide flag M4 — slide flag M1

deceleration — distance — slide flag T3

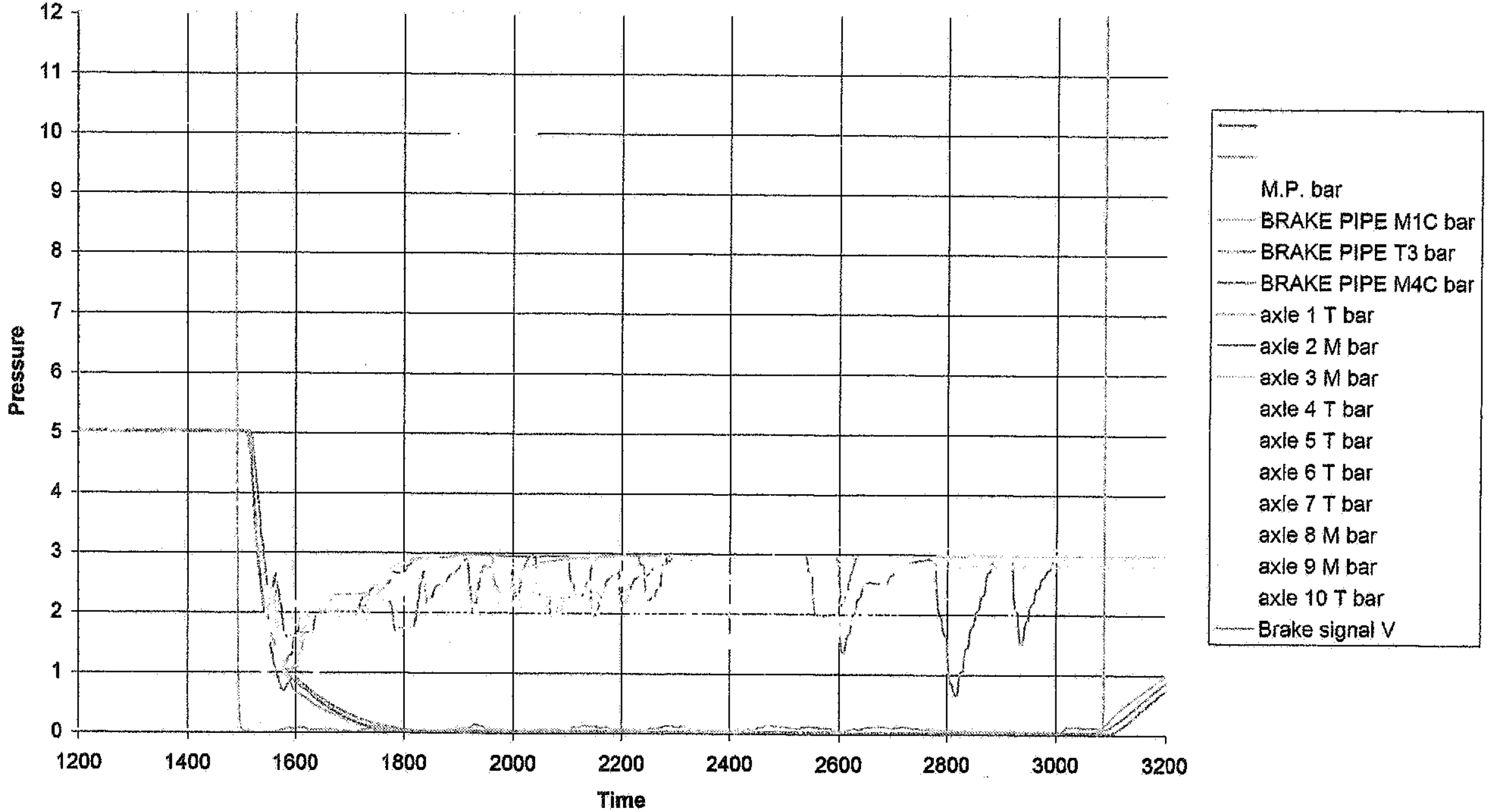


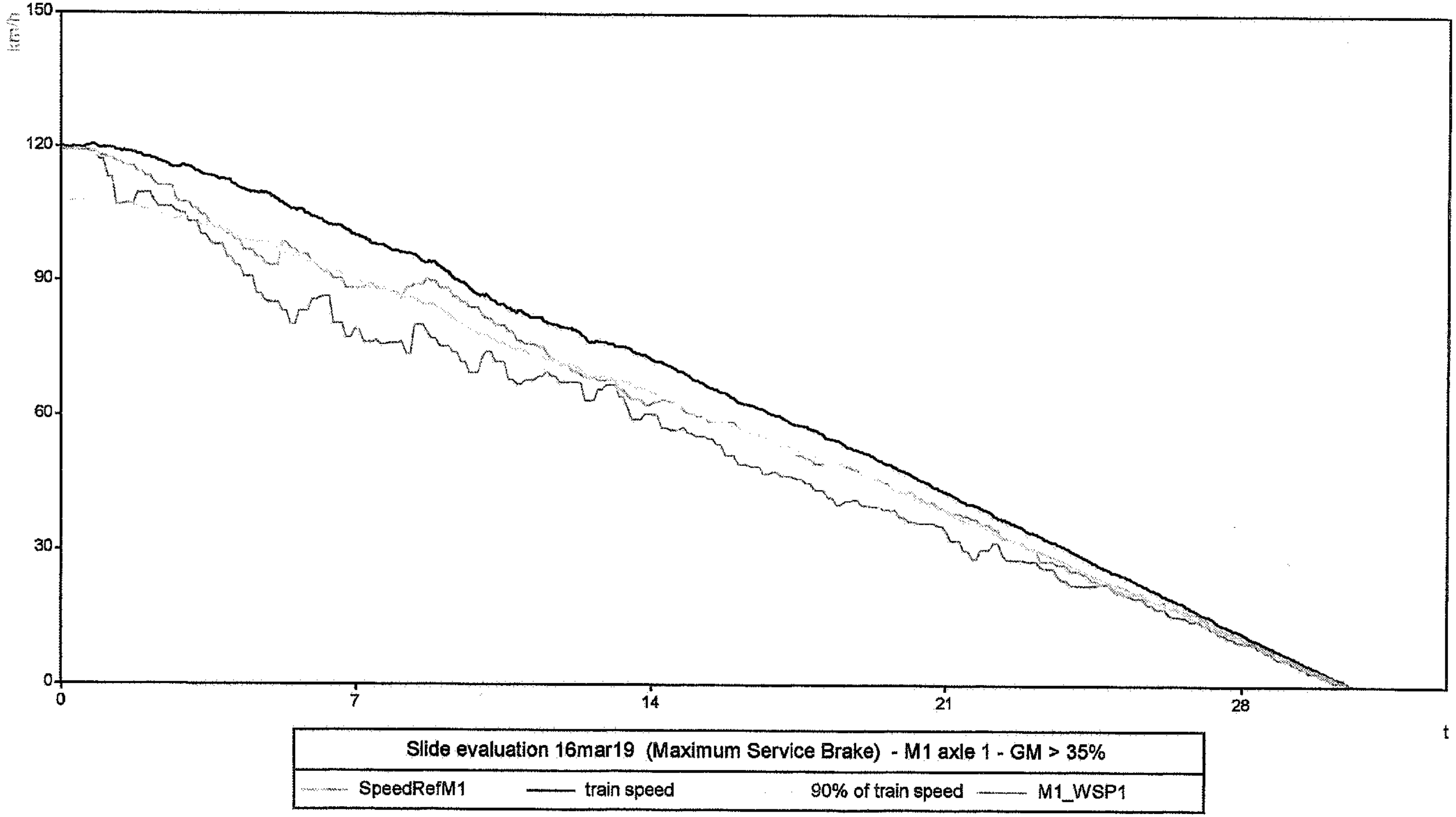
Antislide Efficiency Calculation 16mar19 Emergency Brake by Master Controller without MTB - Ta = 0,064 - Distance increase = 4,50%	
Train_Acceleration	PeaK Acceleration

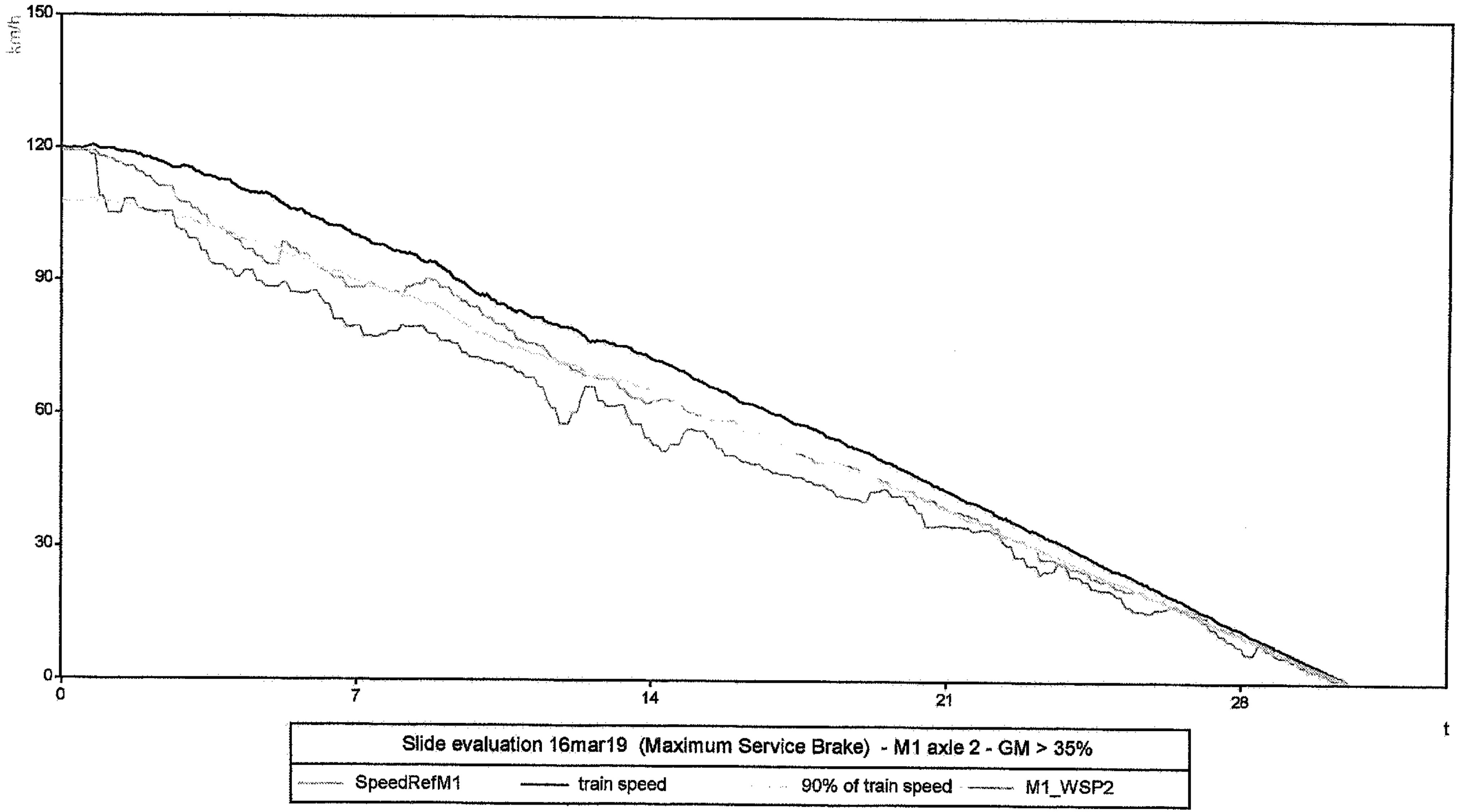


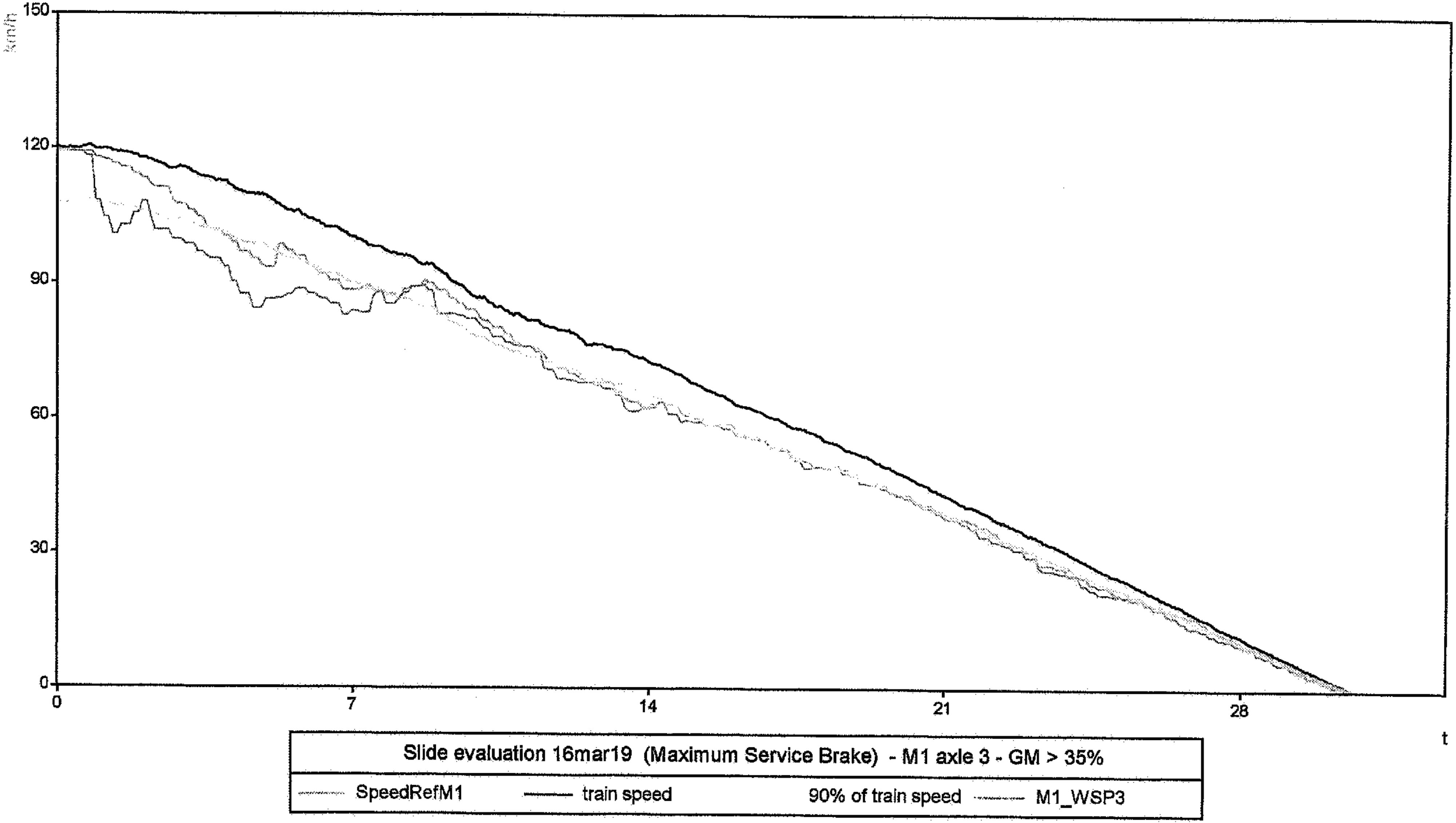
16_mar_19
Pressure [mbar]
Speed [km/h]
Time [s]
6000
5000
4000
3000
2000
1000
0
-1000
14
12
10
8
6
4
2
0
-2
90
95
100
105
110
115
120
125
130
CONTROL1 [bar]
CONTROL2 [bar]
CONTROL3 [bar]
CONTROL4 [bar]
BPPRESS [bar]
HDA1 [unit]
HDA2 [unit]
HDR1 [kN]
HDR2 [kN]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]

16 March test 19

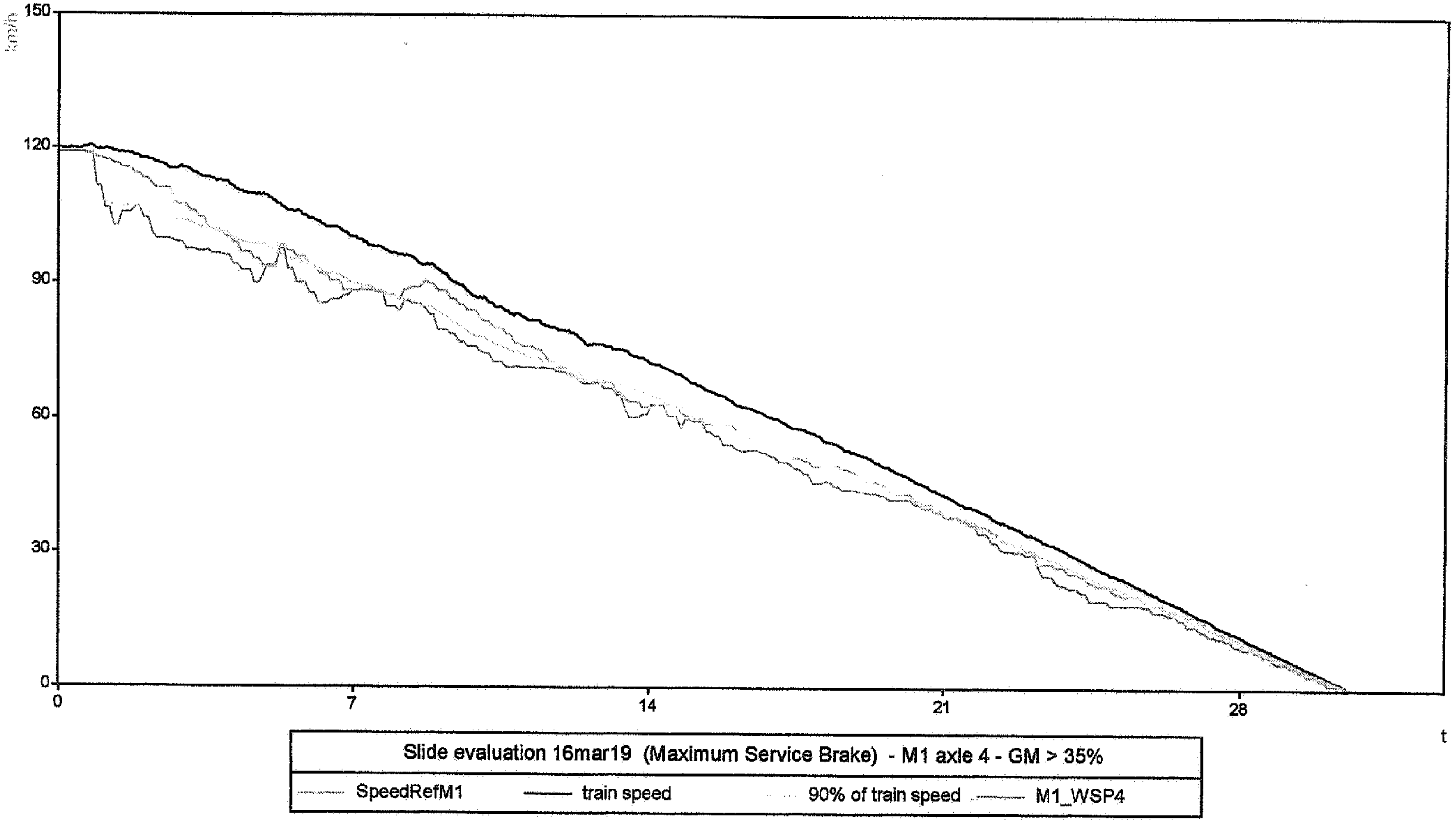



km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar19 (Maximum Service Brake) - M1 axle 1 - GM > 35%
SpeedRefM1
train speed
90% of train speed
M1_WSP1

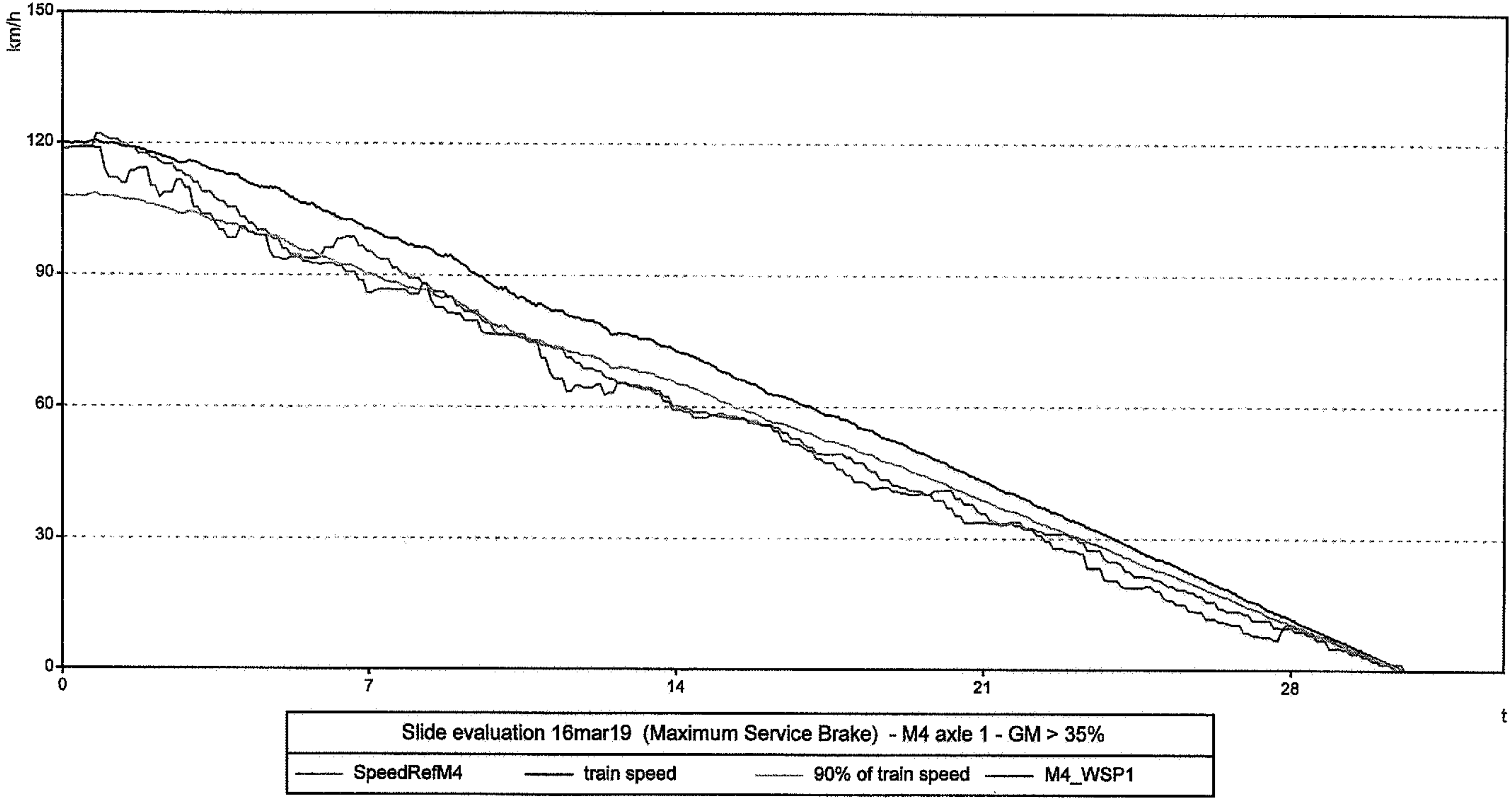

km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar19 (Maximum Service Brake) - M1 axle 2 - GM > 35%
SpeedRefM1
train speed
90% of train speed
M1_WSP2



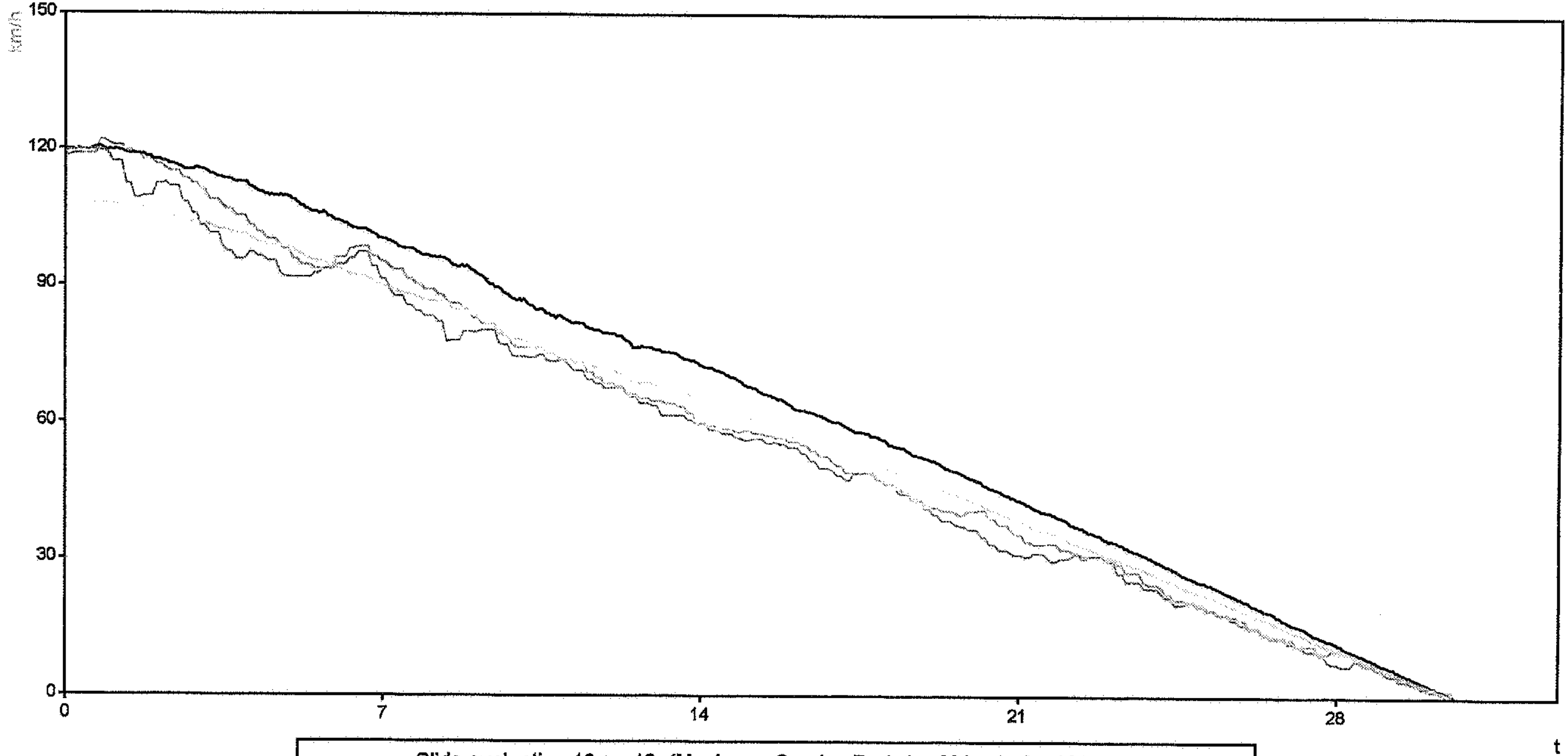
km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar19 (Maximum Service Brake) - M1 axle 3 - GM > 35%
SpeedRefM1
train speed
90% of train speed
M1_WSP3



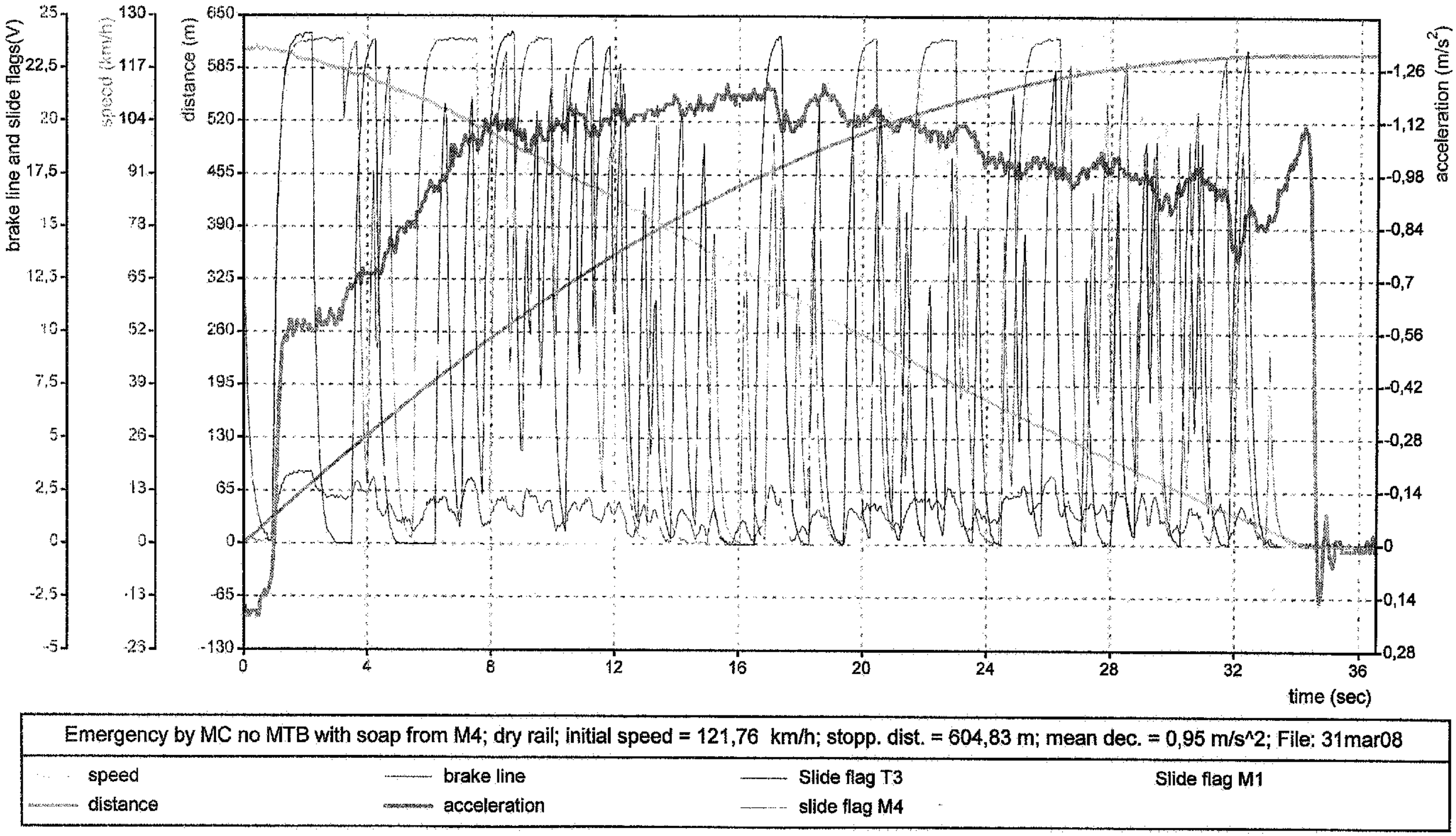
km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar19 (Maximum Service Brake) - M1 axle 4 - GM > 35%
SpeedRefM1
train speed
90% of train speed
M1_WSP4

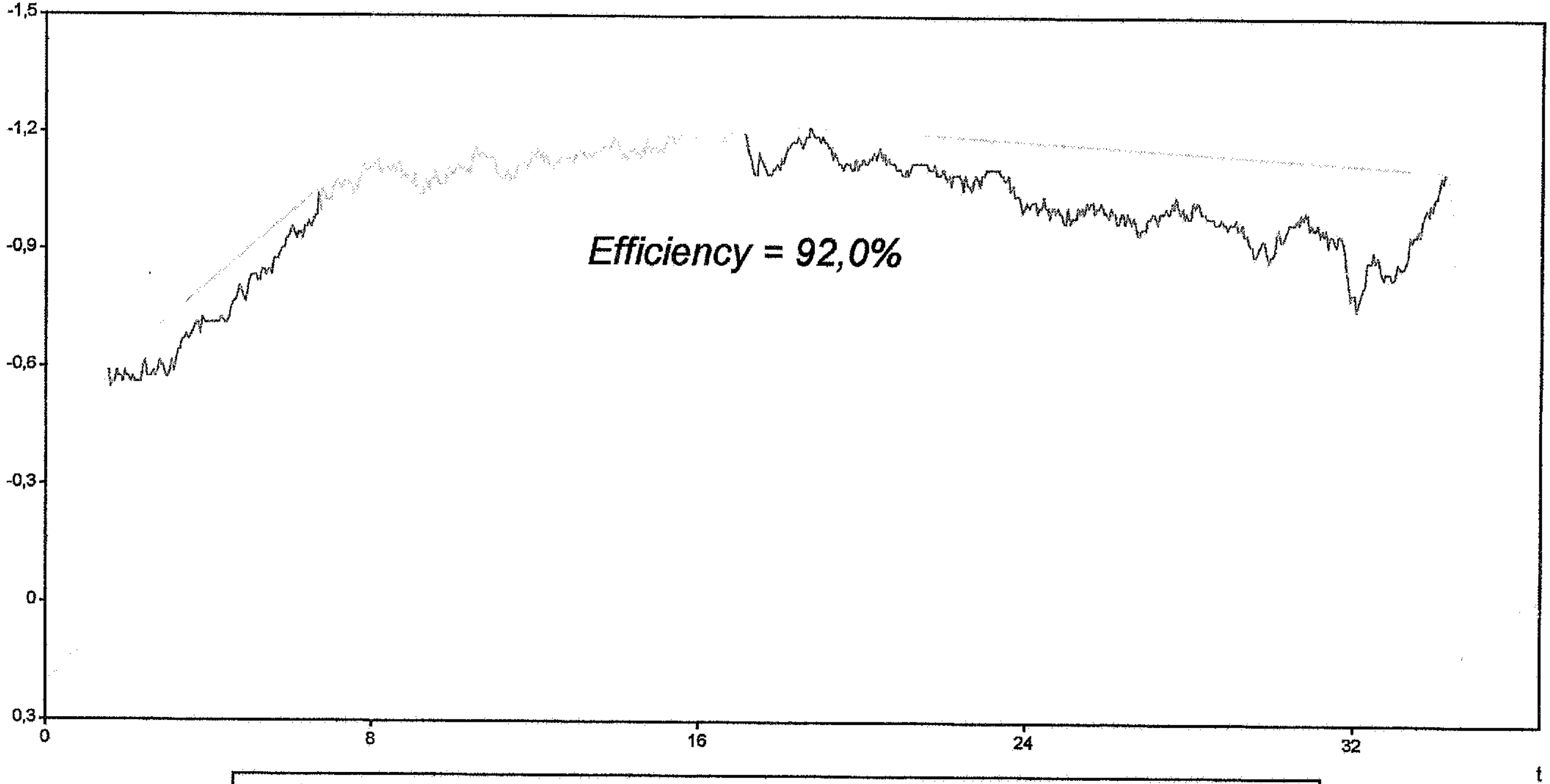


km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 16mar19 (Maximum Service Brake) - M4 axle 1 - GM > 35%
SpeedRefM4
train speed
90% of train speed
M4_WSP1



Slide evaluation 16mar19 (Maximum Service Brake) - M4 axle 2 - GM > 35%

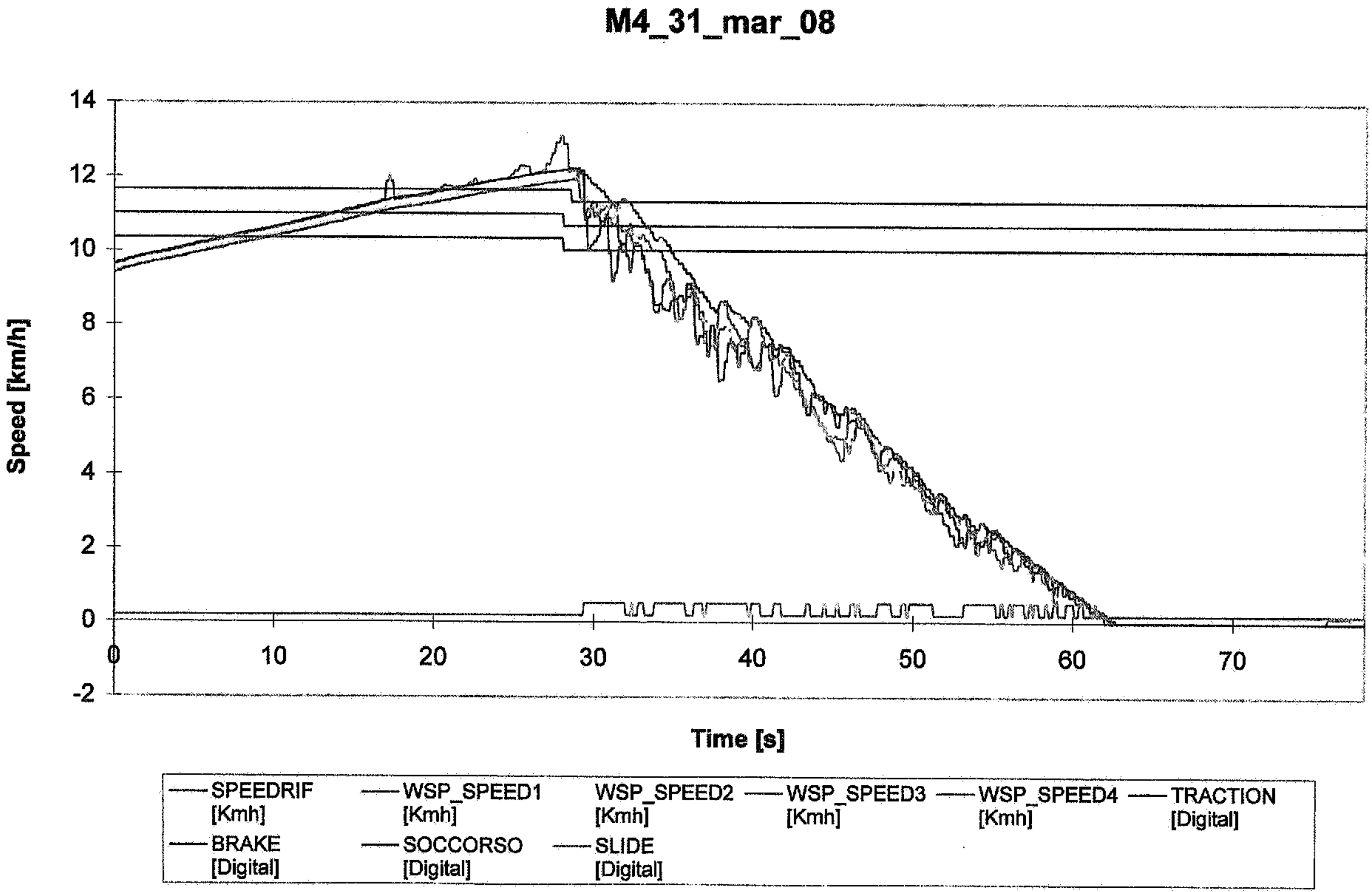

brake line and slide flags(V)
speed (km/h)
distance (m)
acceleration (m/s²)
time (sec)
Emergency by MC no MTB with soap from M4; dry rail; initial speed = 121,76 km/h; stopp. dist. = 604,83 m; mean dec. = 0,95 m/s^2; File: 31mar08
speed
distance
brake line
acceleration
Slide flag T3
slide flag M4
Slide flag M1

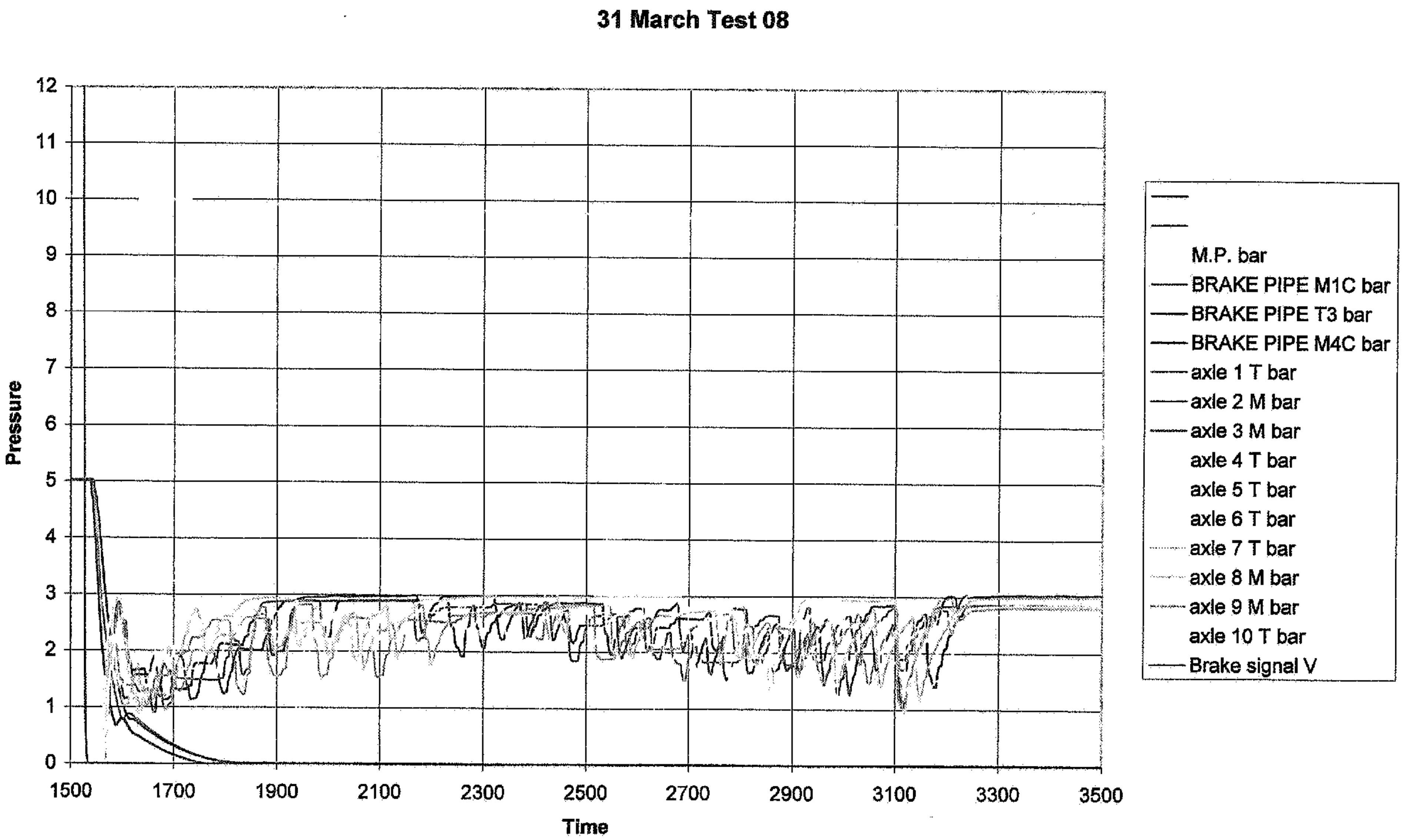


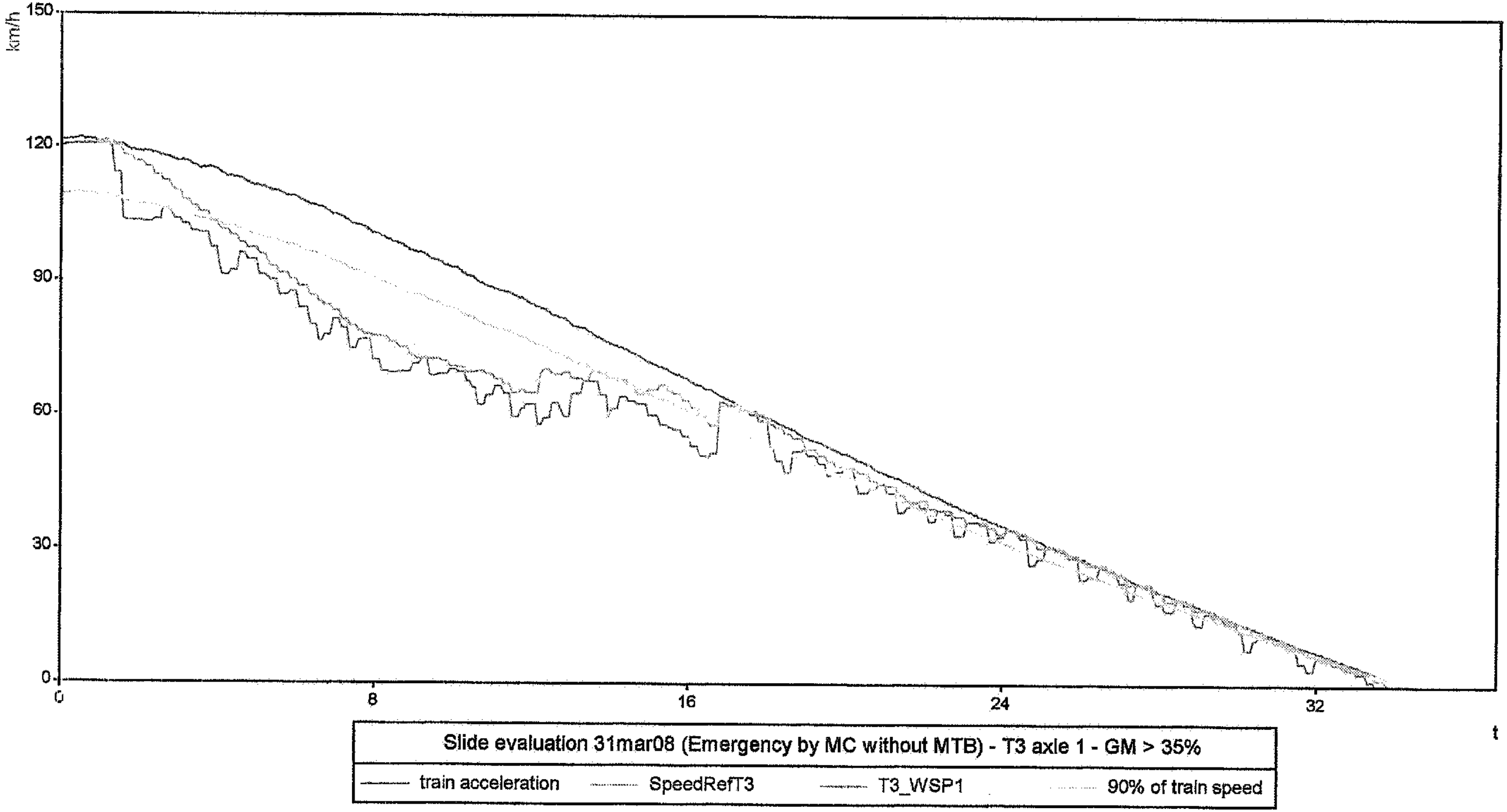
Antislide efficiency calculation 31mar08 (Emergency by MC no MTB) - Ta = 0,058 - Distance increase = 10,63%

train acceleration

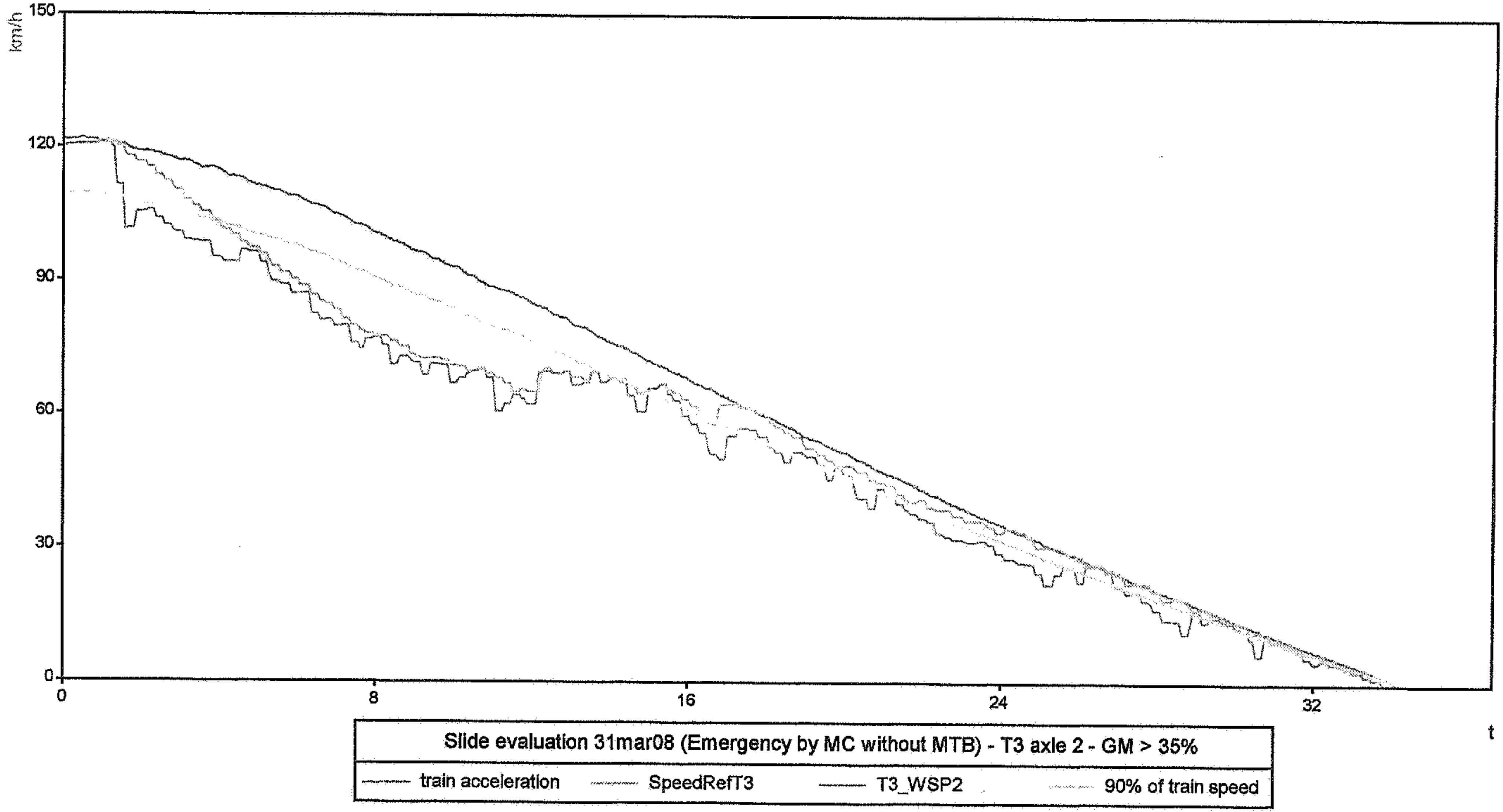
peak acceleration

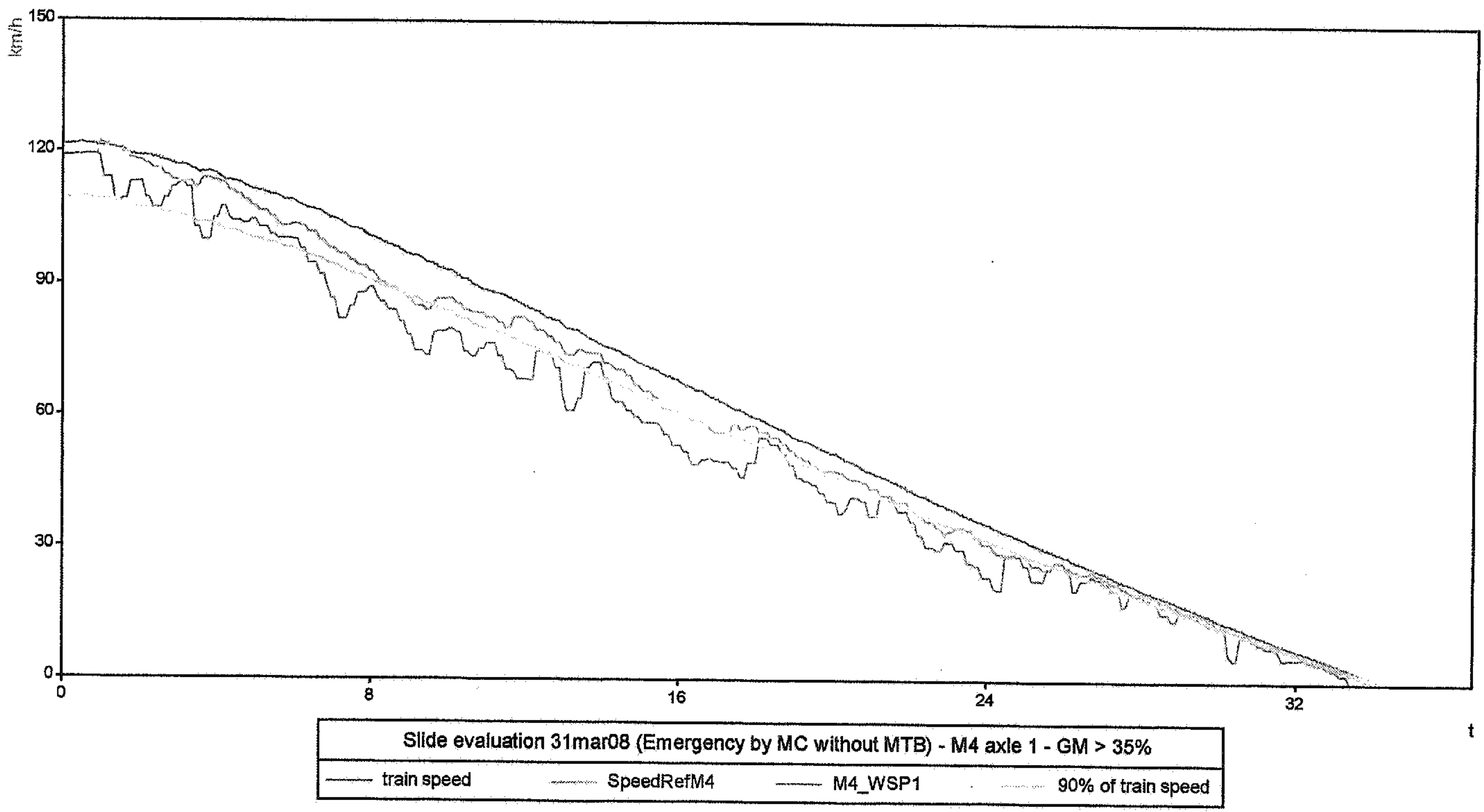

M4_31_mar_08
Speed [km/h]
Time [s]
14
12
10
8
6
4
2
0
-2
0
10
20
30
40
50
60
70
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]


31 March Test 08
Pressure
Time
12
11
10
9
8
7
6
5
4
3
2
1
0
1500
1700
1900
2100
2300
2500
2700
2900
3100
3300
3500
M.P. bar
BRAKE PIPE M1C bar
BRAKE PIPE T3 bar
BRAKE PIPE M4C bar
axle 1 T bar
axle 2 M bar
axle 3 M bar
axle 4 T bar
axle 5 T bar
axle 6 T bar
axle 7 T bar
axle 8 M bar
axle 9 M bar
axle 10 T bar
Brake signal V

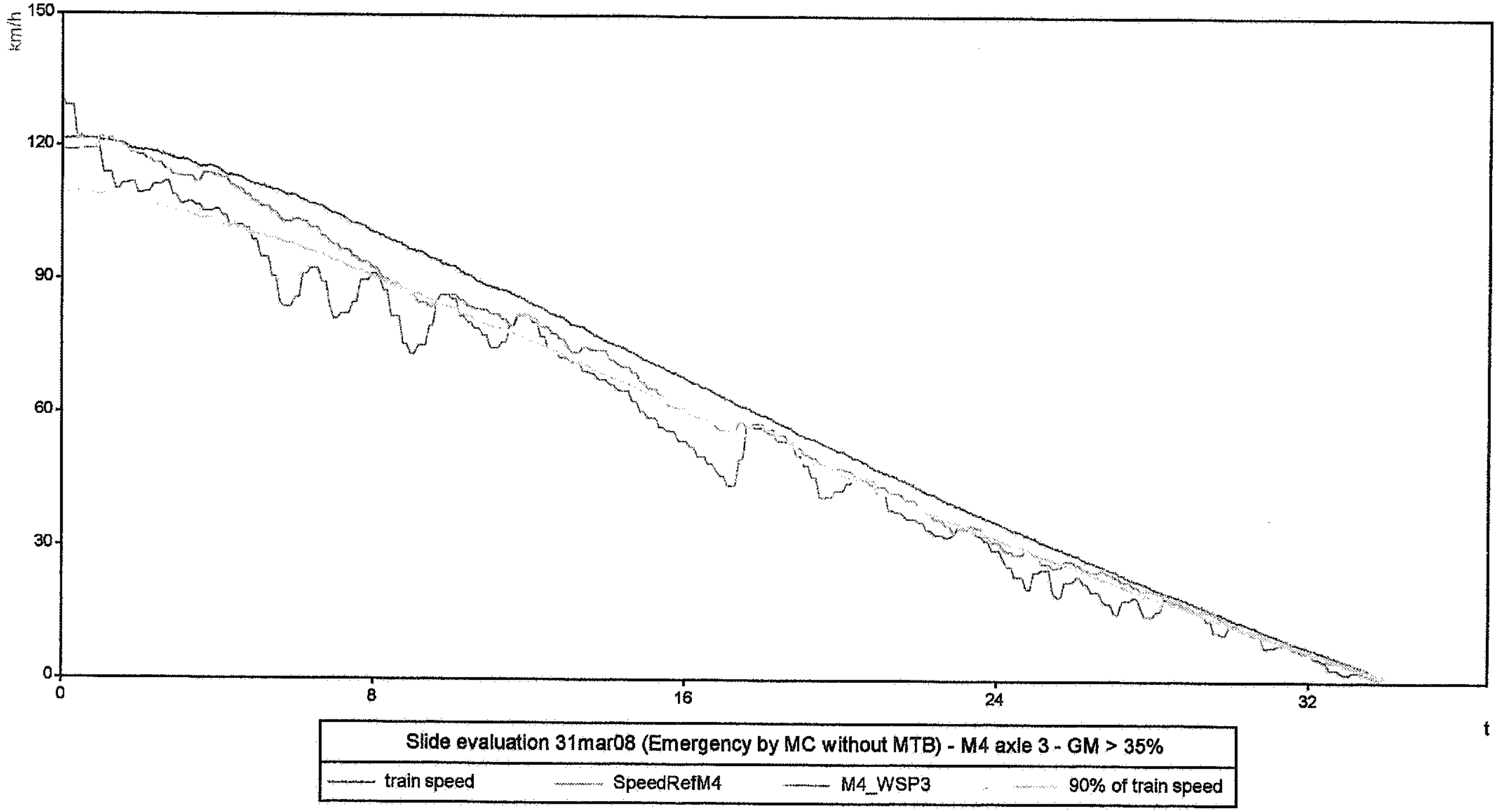


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 31mar08 (Emergency by MC without MTB) - T3 axle 1 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP1
90% of train speed

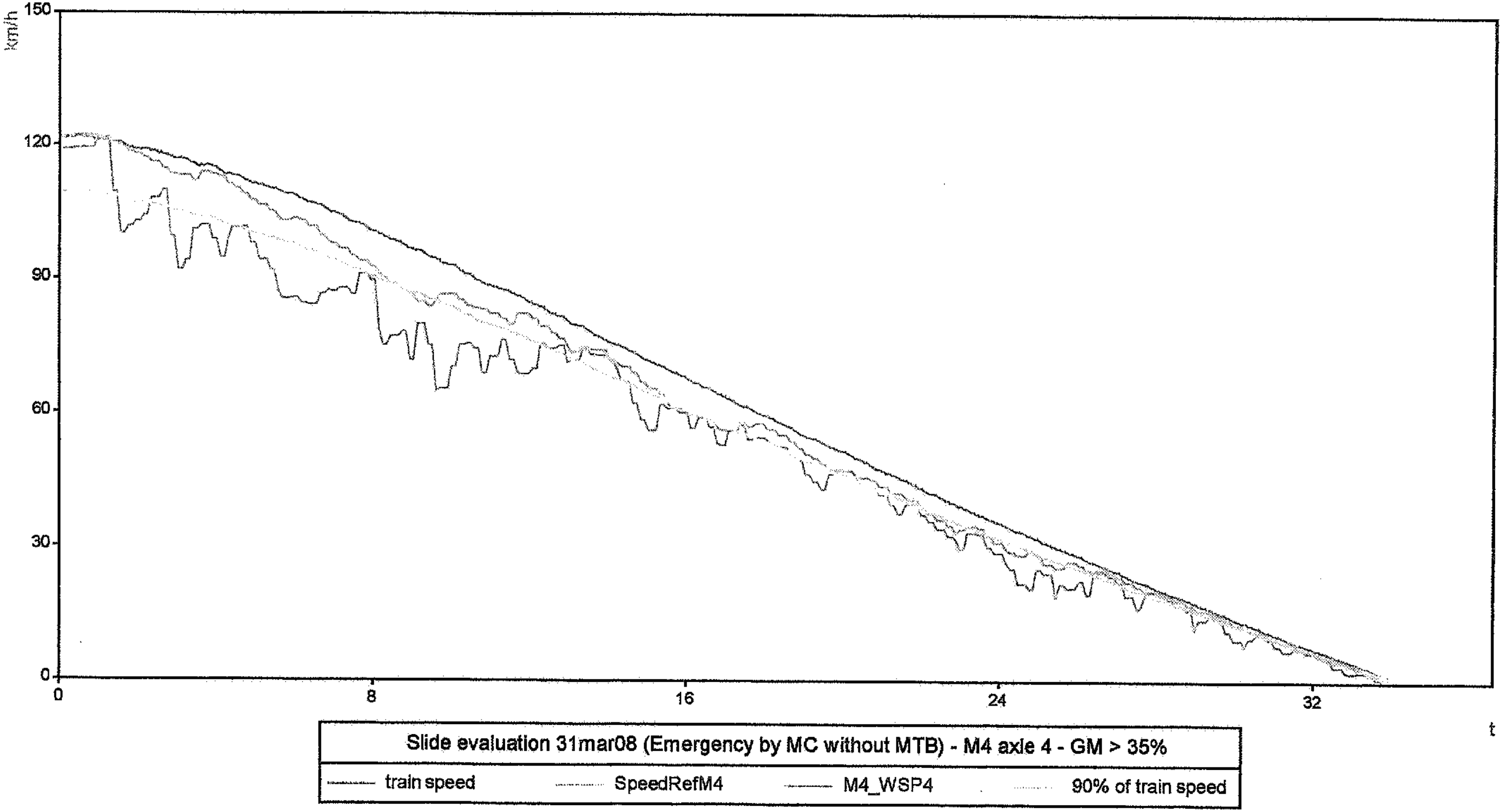

km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 31mar08 (Emergency by MC without MTB) - T3 axle 2 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP2
90% of train speed

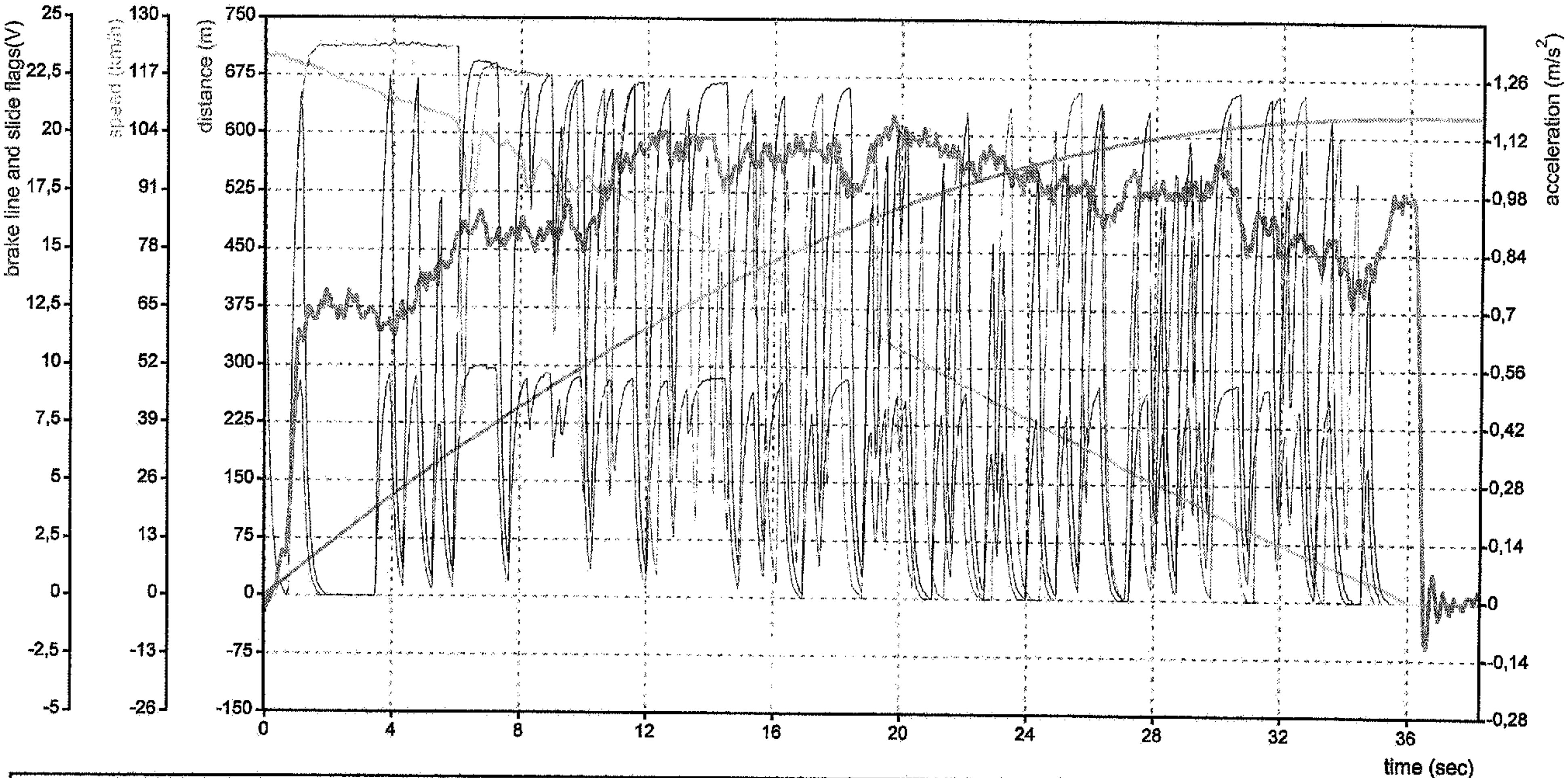


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 31mar08 (Emergency by MC without MTB) - M4 axle 1 - GM > 35%
train speed
SpeedRefM4
M4_WSP1
90% of train speed

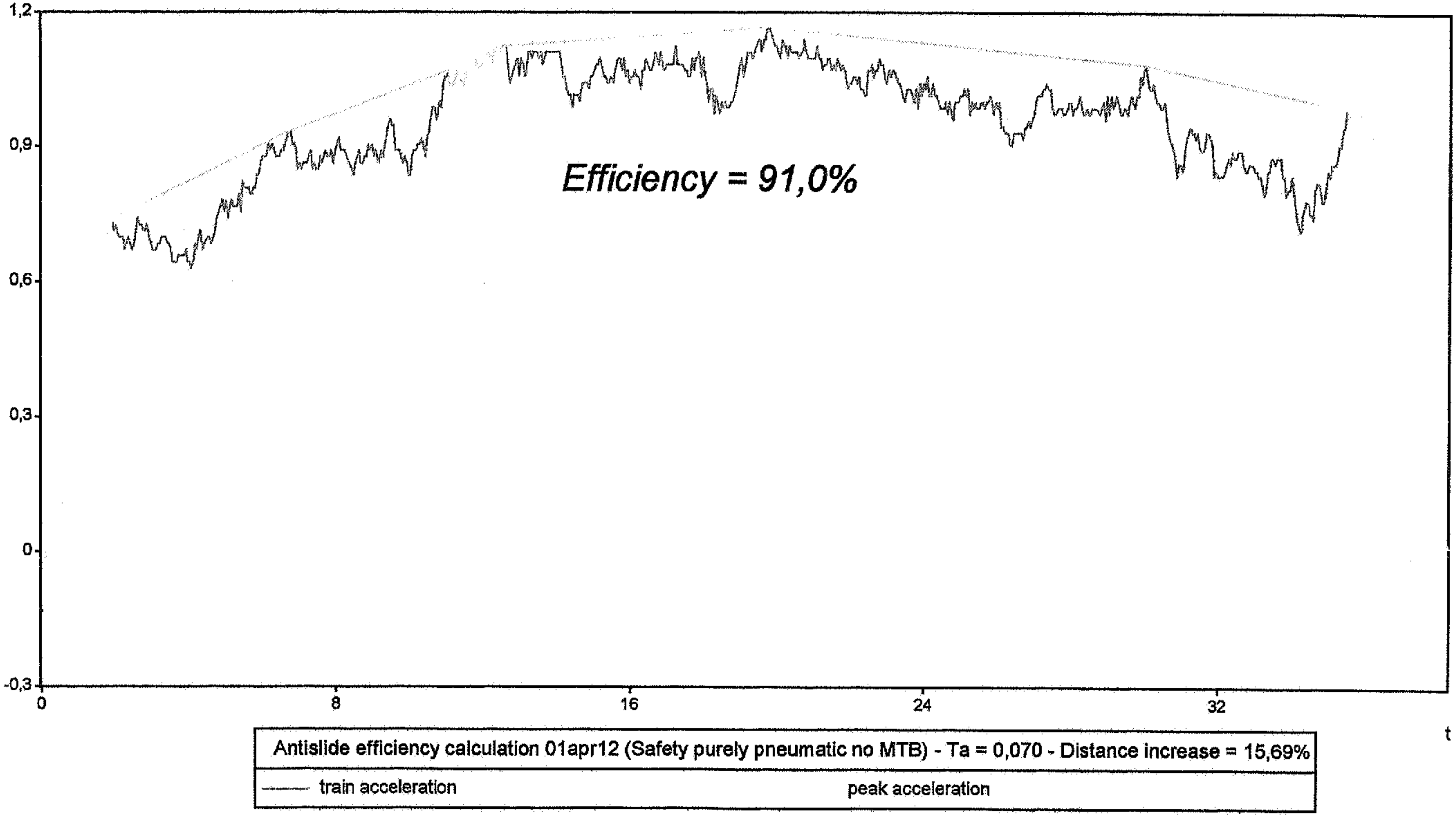


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 31mar08 (Emergency by MC without MTB) - M4 axle 3 - GM > 35%
train speed
SpeedRefM4
M4_WSP3
90% of train speed

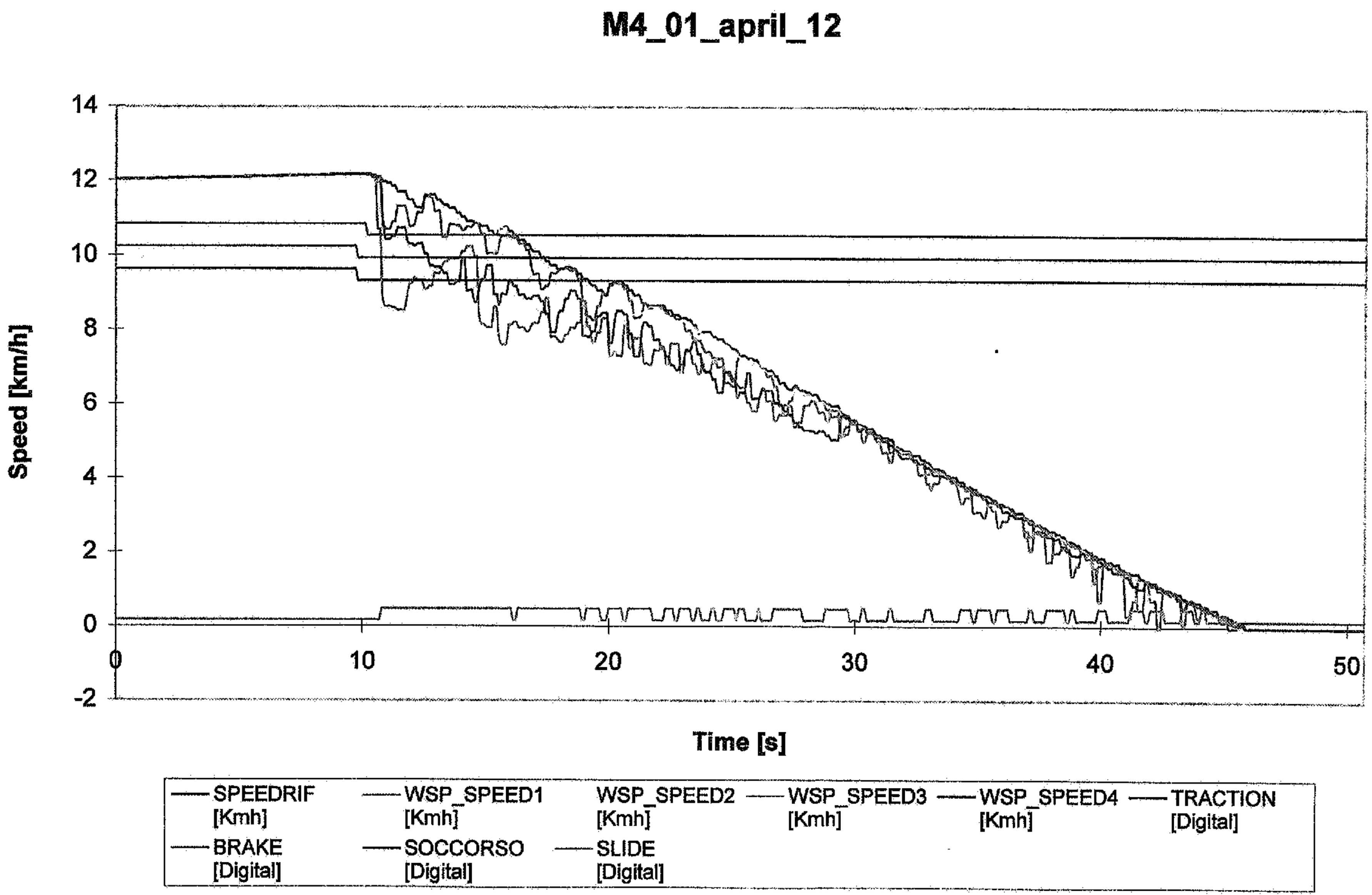

km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 31mar08 (Emergency by MC without MTB) - M4 axle 4 - GM > 35%
train speed
SpeedRefM4
M4_WSP4
90% of train speed

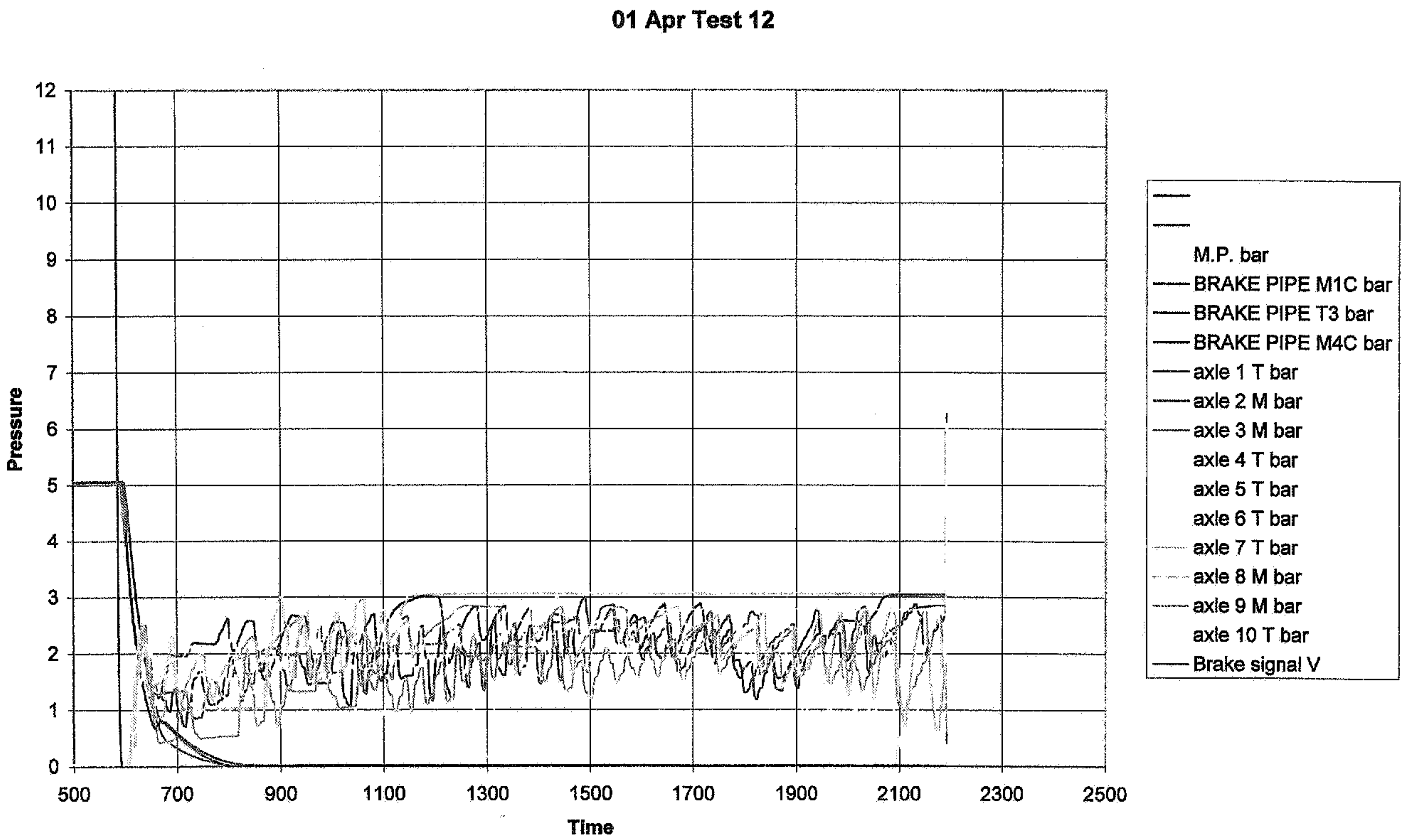


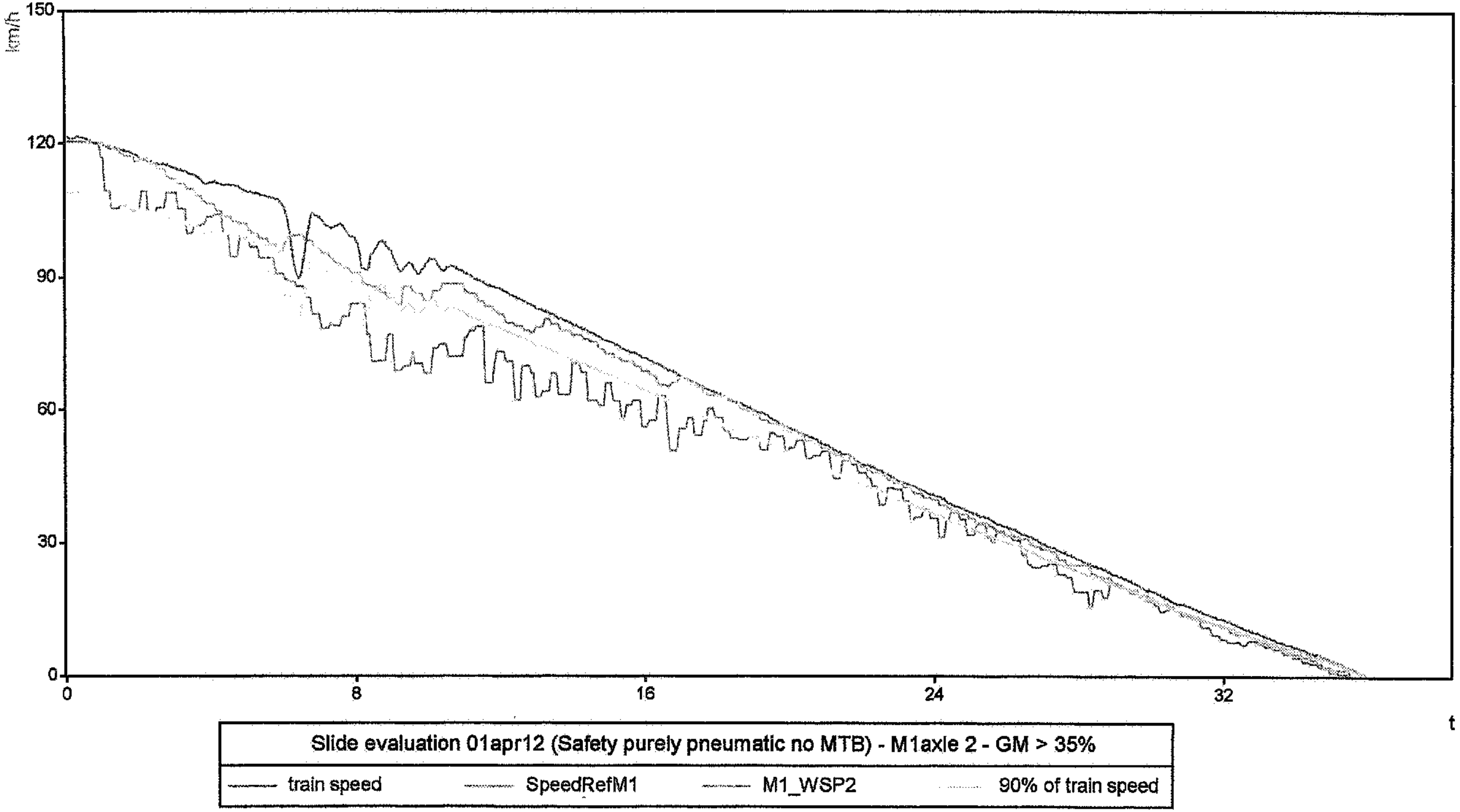
Safety purely pneumatic no MTB with soap from M1; initial speed = 121,28 km/h; stopp. distance = 627,49 m; mean dec = 0,90 m/s^2; File: 01apr12			
speed	brake line	Slide flag T3	Slide flag M1
distance	acceleration	slide flag M4	

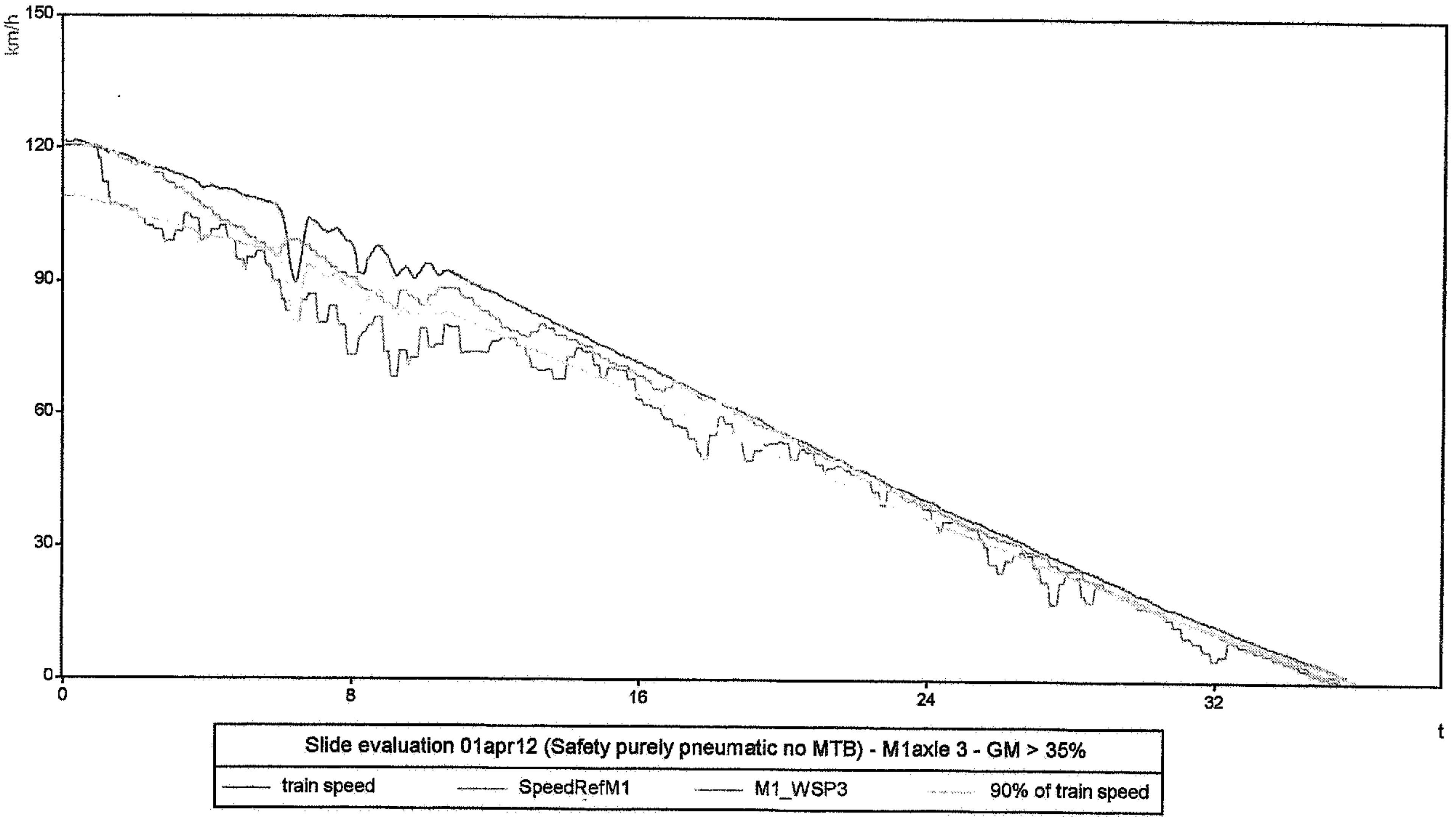


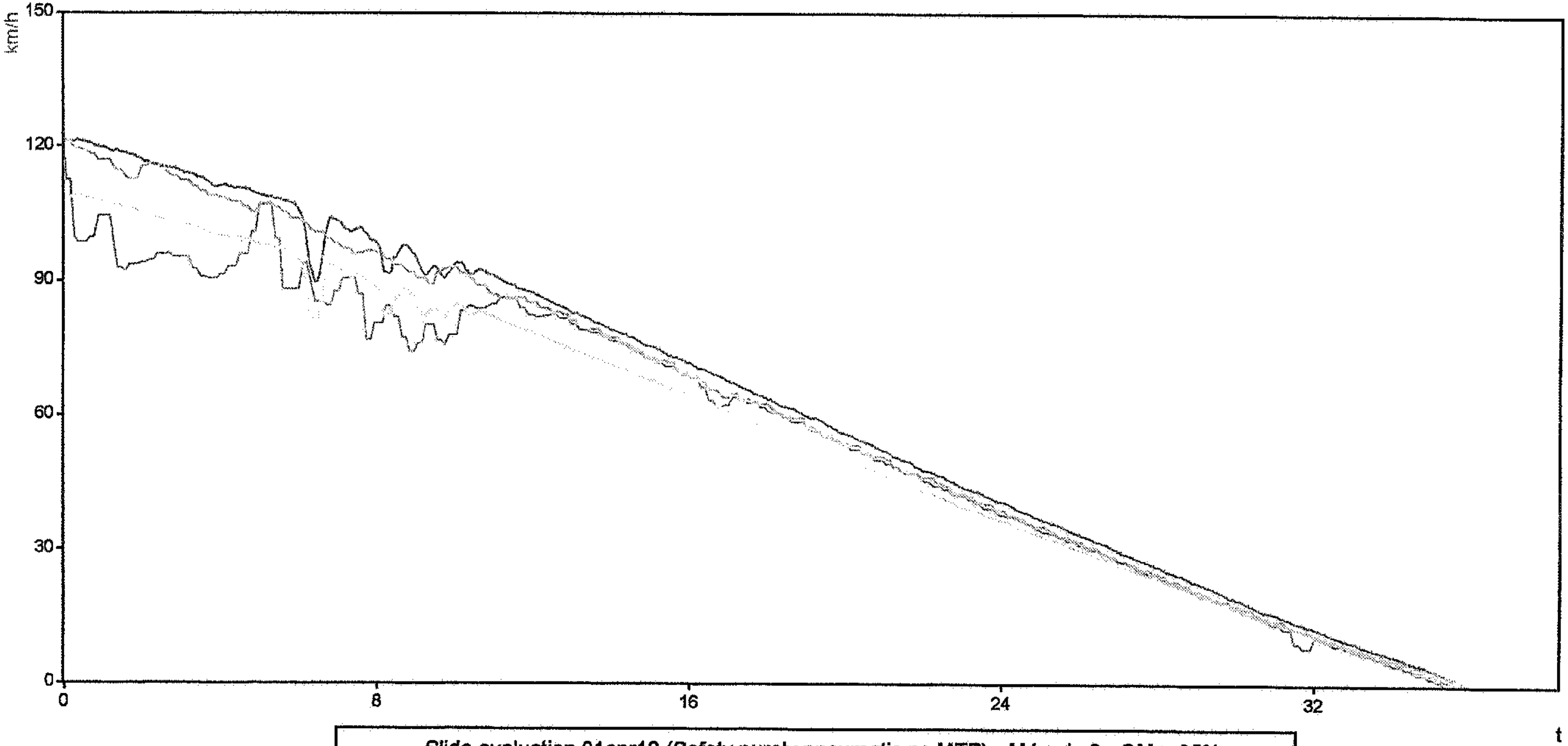
1,2
0,9
0,6
0,3
0
-0,3
0
8
16
24
32
t
Efficiency = 91,0%
Antislide efficiency calculation 01apr12 (Safety purely pneumatic no MTB) - Ta = 0,070 - Distance increase = 15,69%
train acceleration
peak acceleration


M4_01_april_12
Speed [km/h]
14
12
10
8
6
4
2
0
-2
0
10
20
30
40
50
Time [s]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]


01 Apr Test 12
Pressure
Time
12
11
10
9
8
7
6
5
4
3
2
1
0
500
700
900
1100
1300
1500
1700
1900
2100
2300
2500
M.P. bar
BRAKE PIPE M1C bar
BRAKE PIPE T3 bar
BRAKE PIPE M4C bar
axle 1 T bar
axle 2 M bar
axle 3 M bar
axle 4 T bar
axle 5 T bar
axle 6 T bar
axle 7 T bar
axle 8 M bar
axle 9 M bar
axle 10 T bar
Brake signal V

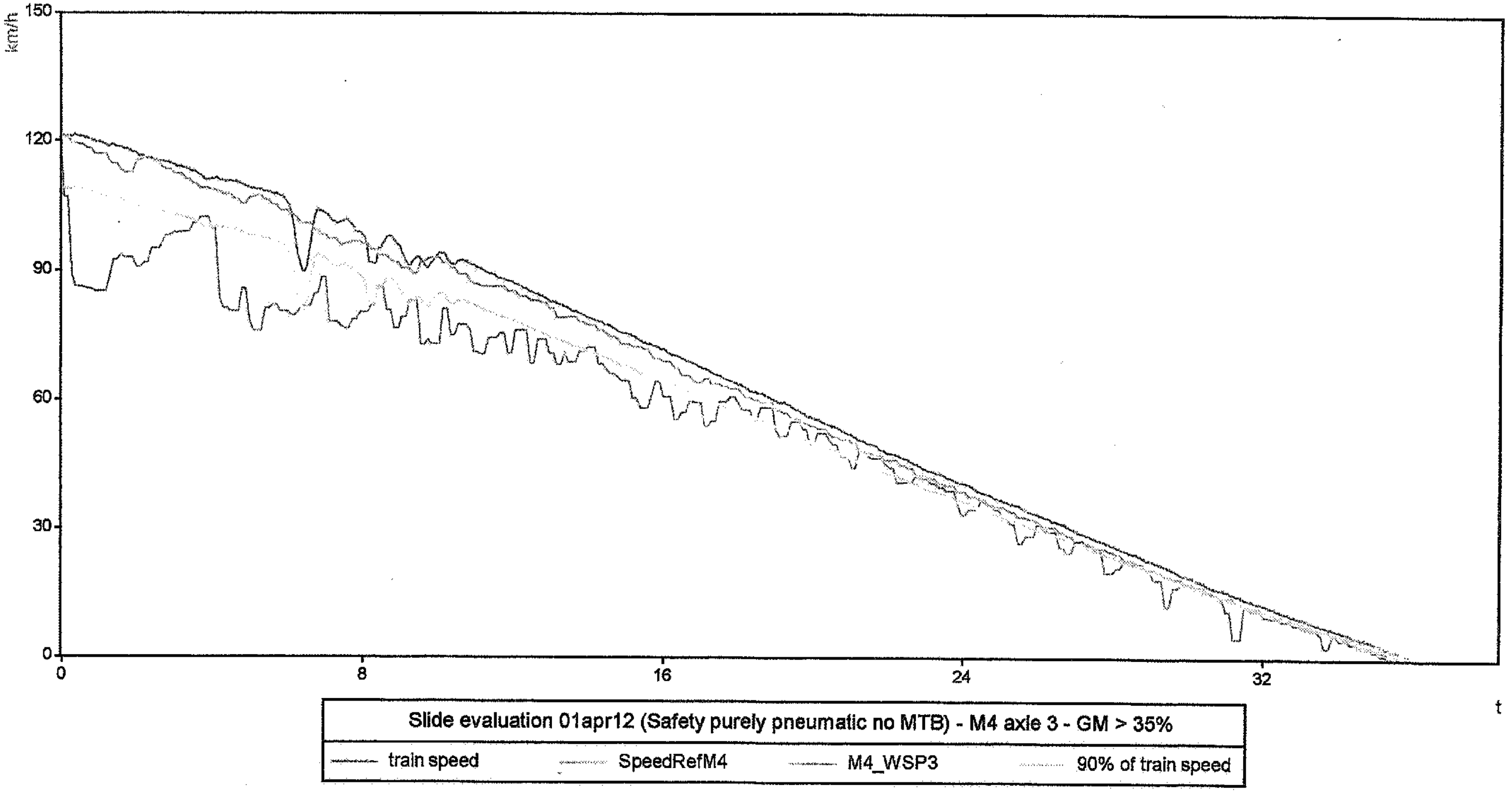

km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 01apr12 (Safety purely pneumatic no MTB) - M1axle 2 - GM > 35%
train speed
SpeedRefM1
M1_WSP2
90% of train speed


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 01apr12 (Safety purely pneumatic no MTB) - M1axle 3 - GM > 35%
train speed
SpeedRefM1
M1_WSP3
90% of train speed

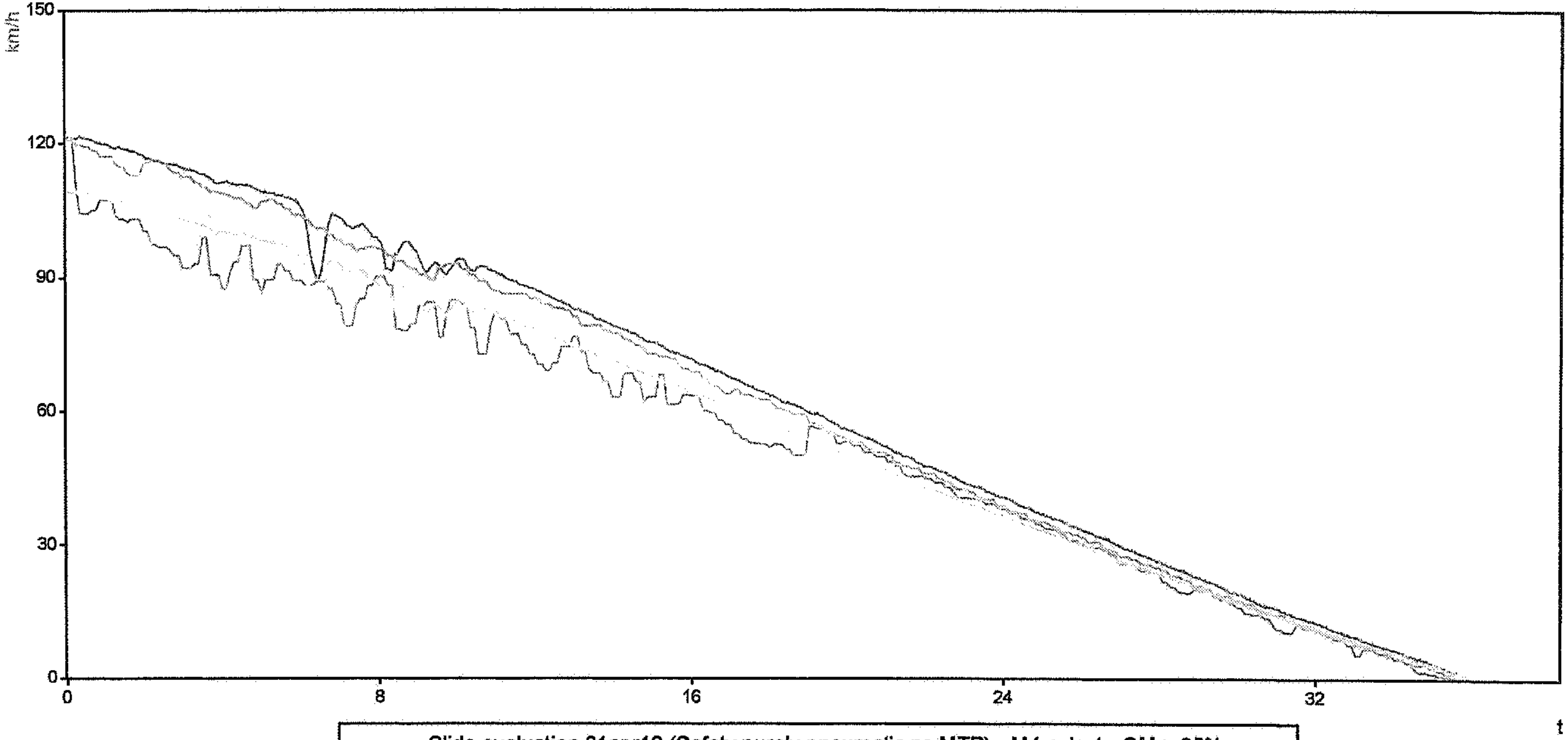


Slide evaluation 01apr12 (Safety purely pneumatic no MTB) - M4 axle 2 - GM > 35%

train speed
SpeedRefM4
M4_WSP2
90% of train speed

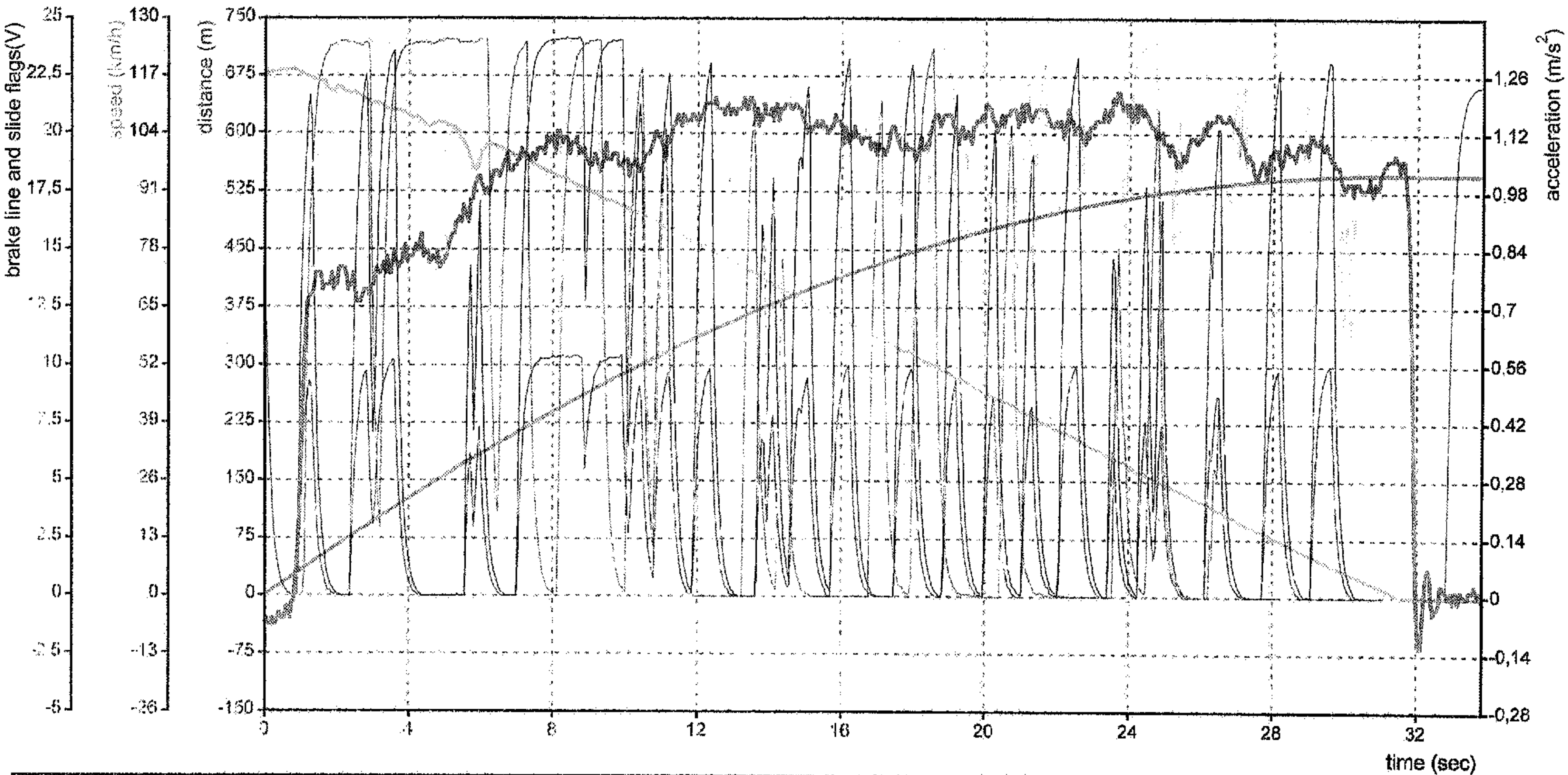


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 01apr12 (Safety purely pneumatic no MTB) - M4 axle 3 - GM > 35%
train speed
SpeedRefM4
M4_WSP3
90% of train speed



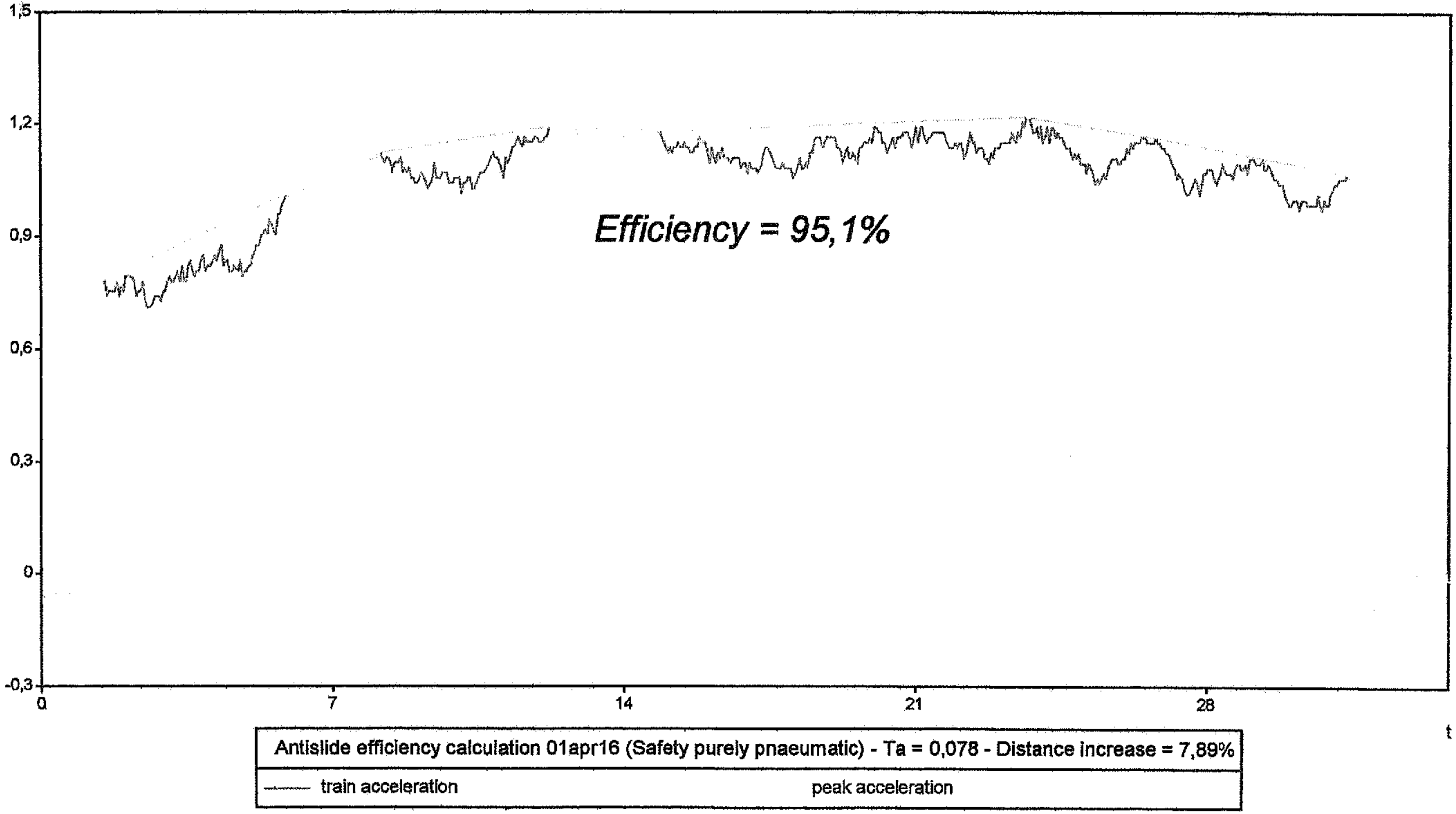
Slide evaluation 01apr12 (Safety purely pneumatic no MTB) - M4 axle 4 - GM > 35%

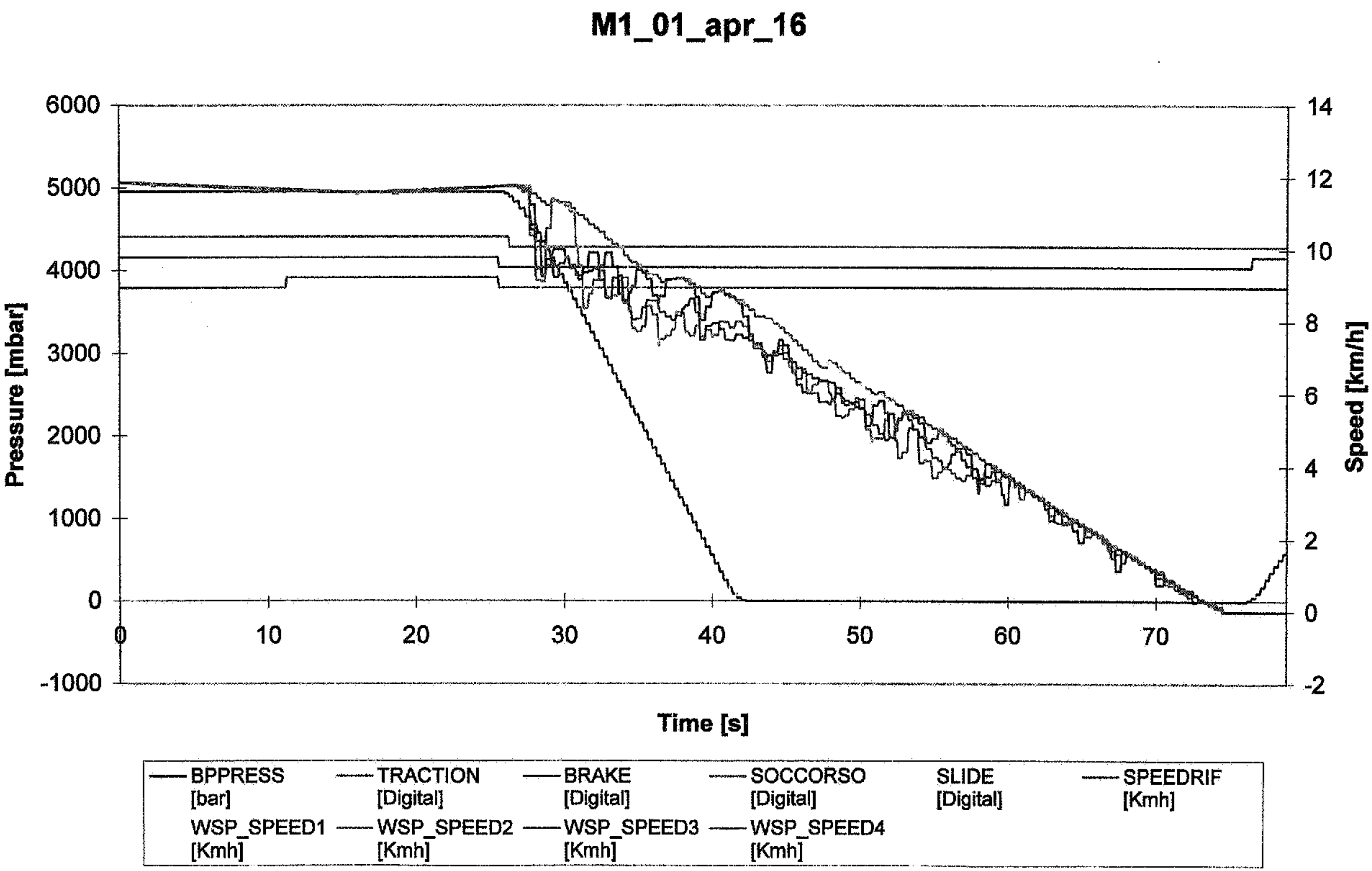
train speed	SpeedRefM4	M4_WSP4	90% of train speed



Safety purely pneumatic no MTB with soap from M1; initial speed = 117,33 km/h; stopp. distance = 547,66 m; mean dec = 0,97 m/s^2; File: 01apr16

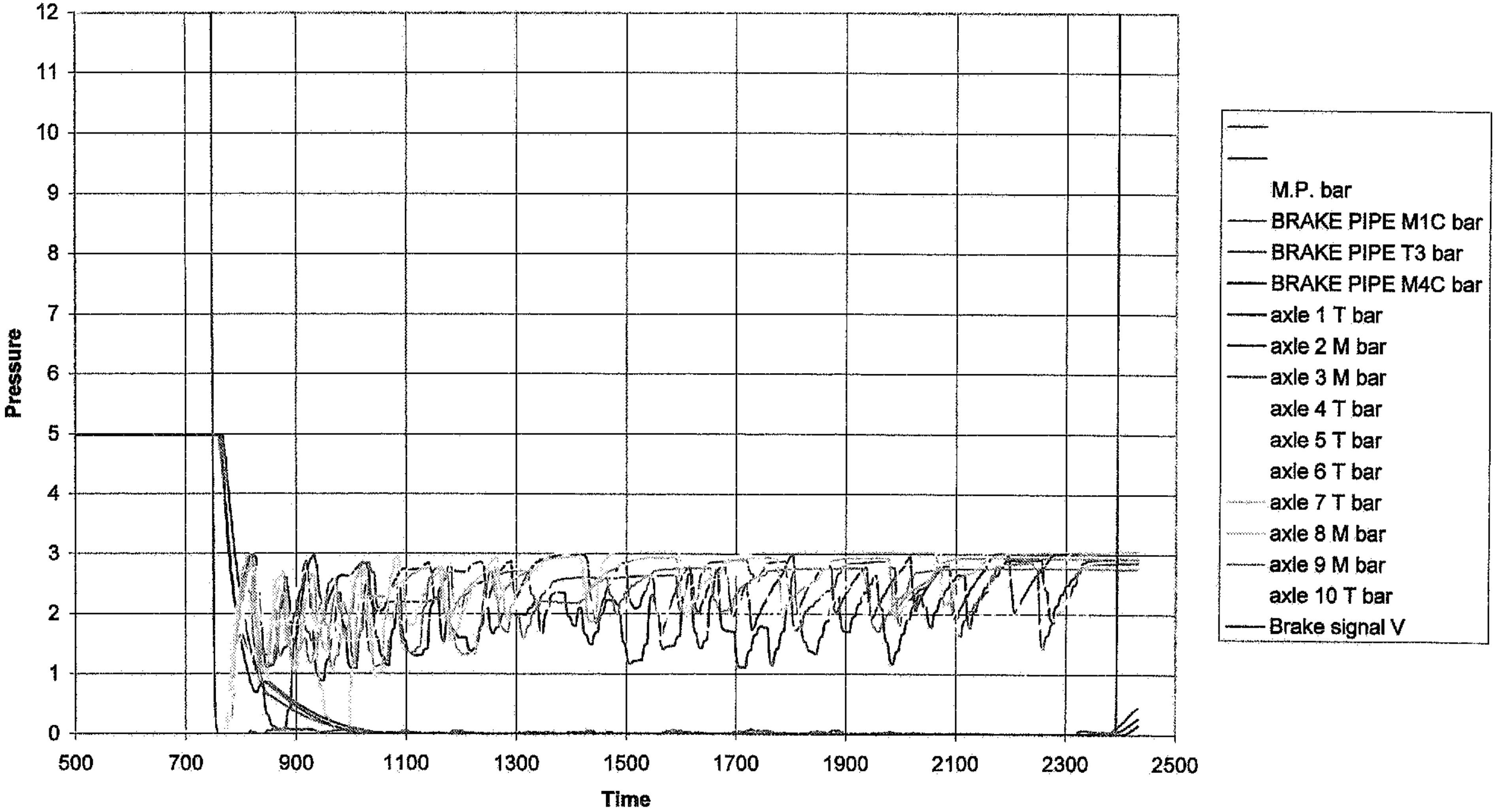
speed	brake line	Slide flag T3	Slide flag M1
distance	acceleration	slide flag M4	

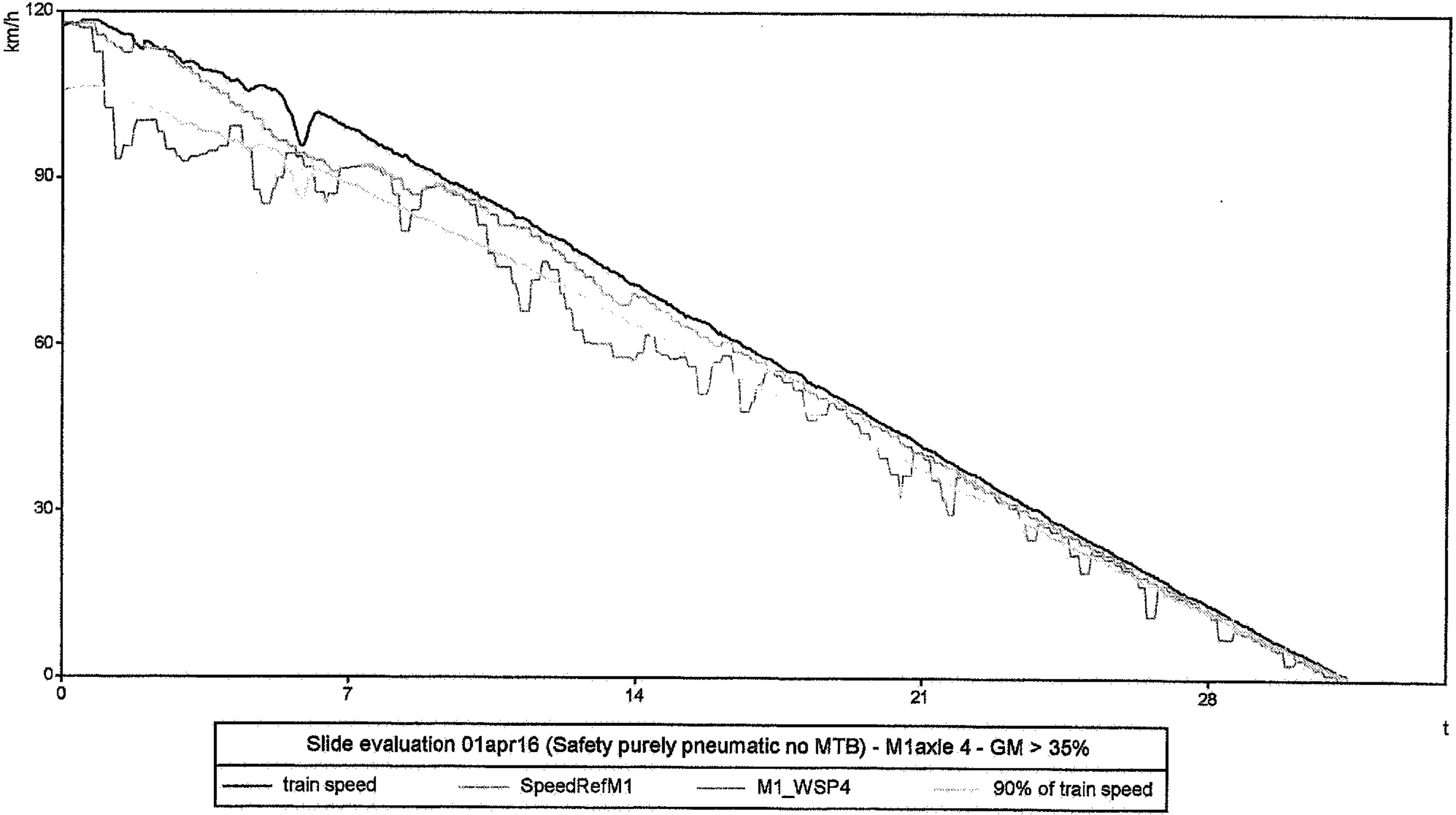

1,5
1,2
0,9
0,6
0,3
0
-0,3
0
7
14
21
28
t
Efficiency = 95,1%
Antislide efficiency calculation 01apr16 (Safety purely pnaeumatic) - Ta = 0,078 - Distance increase = 7,89%
train acceleration
peak acceleration

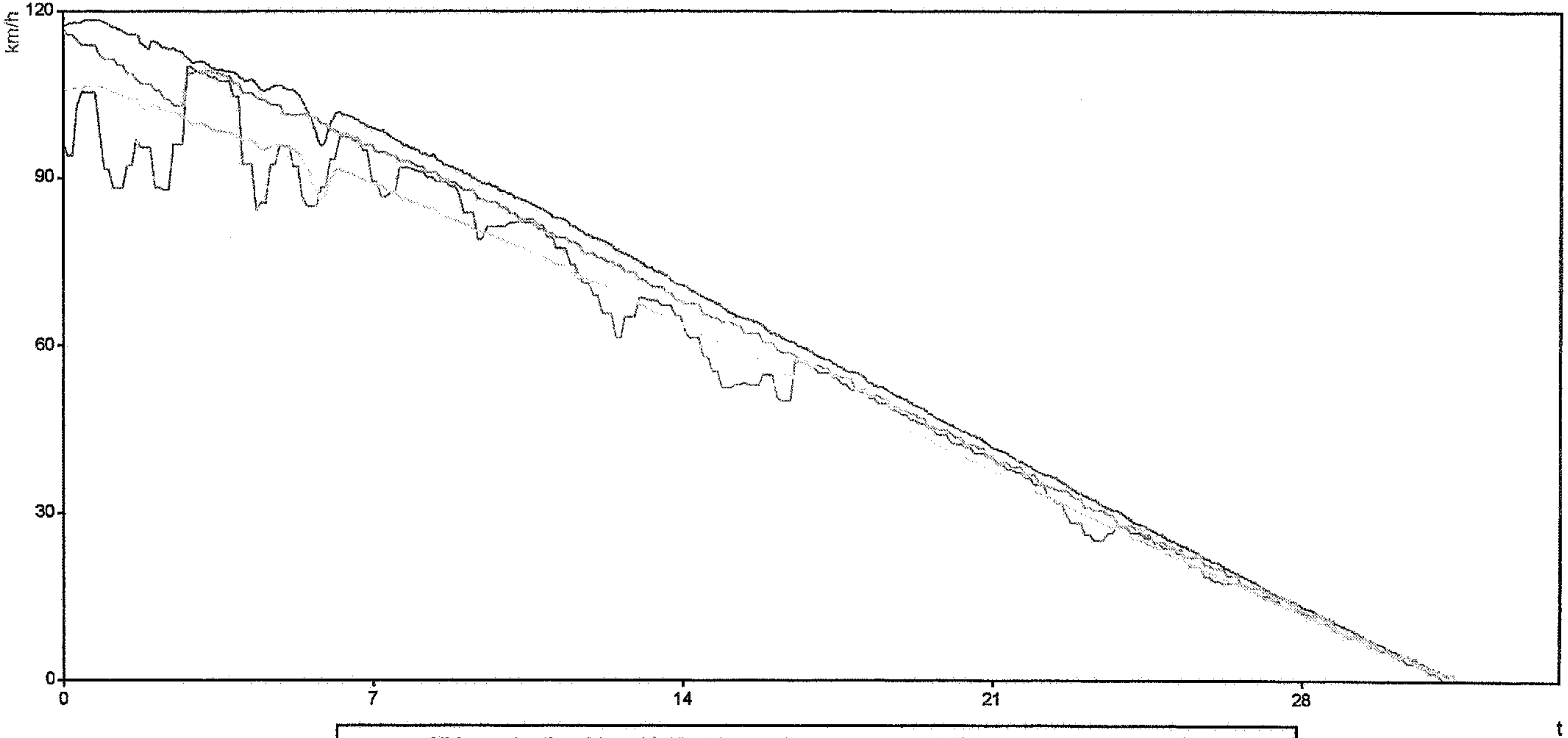


M1_01_apr_16
Pressure [mbar]
Speed [km/h]
Time [s]
6000
5000
4000
3000
2000
1000
0
-1000
14
12
10
8
6
4
2
0
-2
0
10
20
30
40
50
60
70
BPPRESS [bar]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]

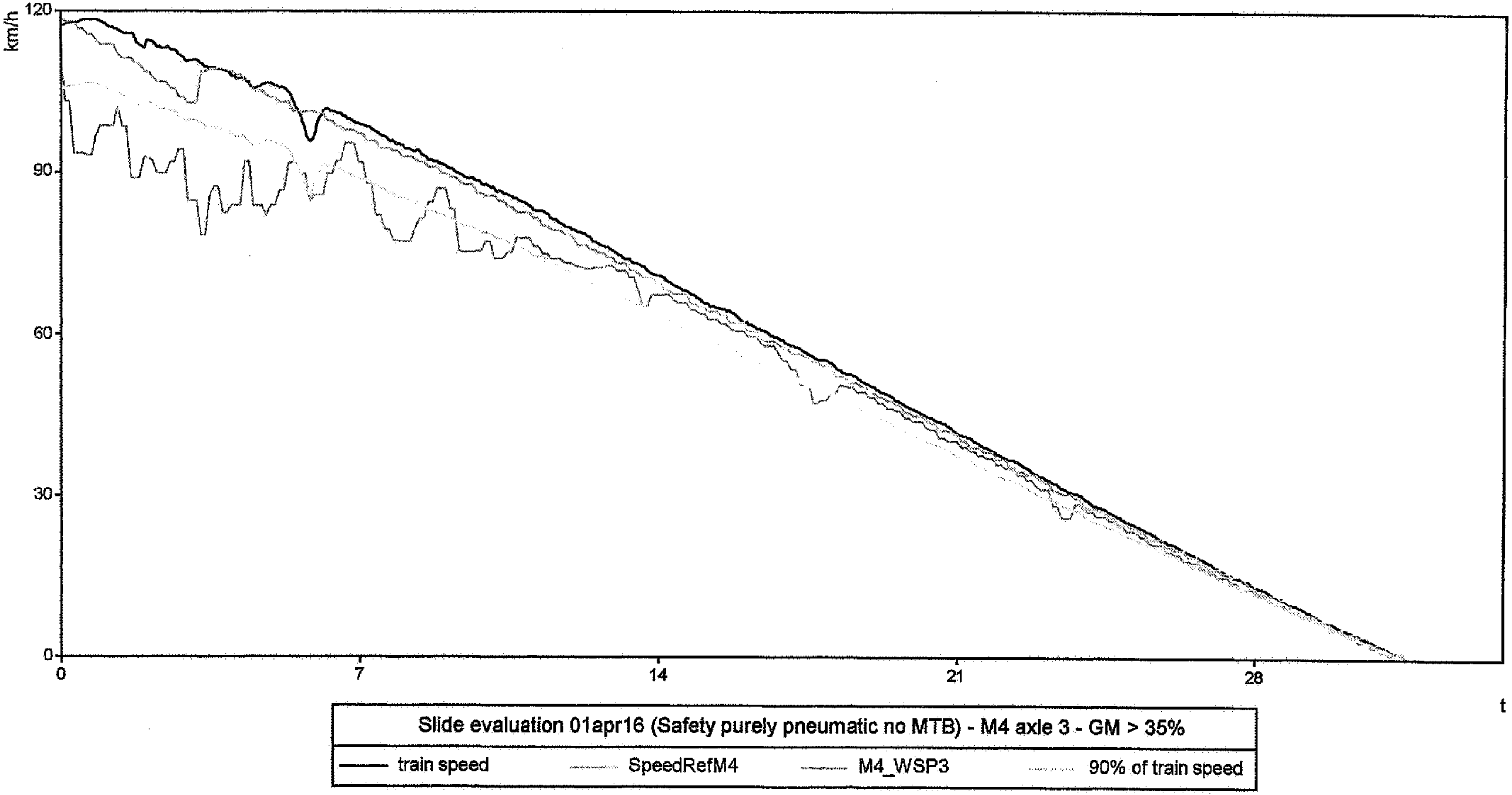
01 Apr Test 16



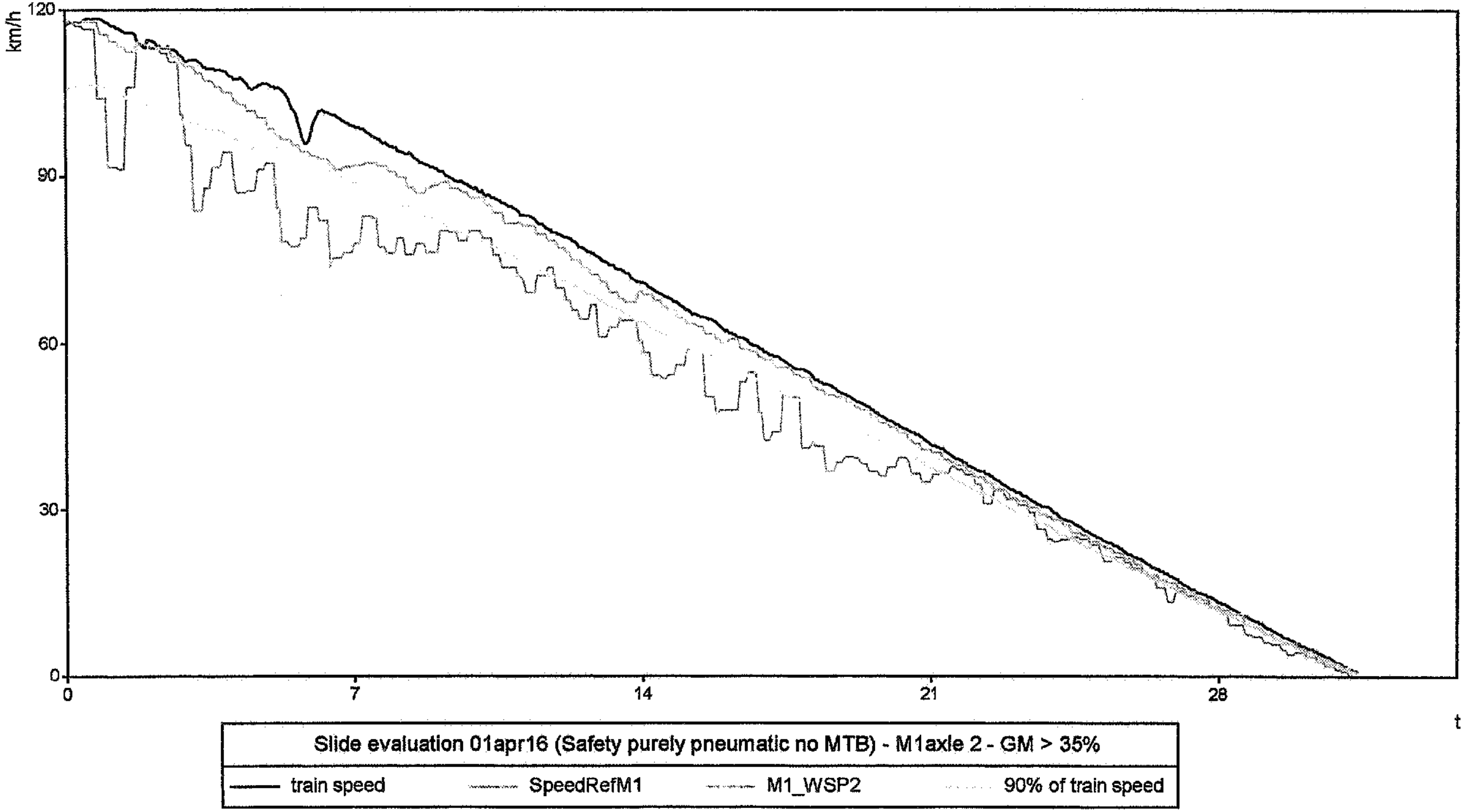

km/h
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 01apr16 (Safety purely pneumatic no MTB) - M1axle 4 - GM > 35%
train speed
SpeedRefM1
M1_WSP4
90% of train speed

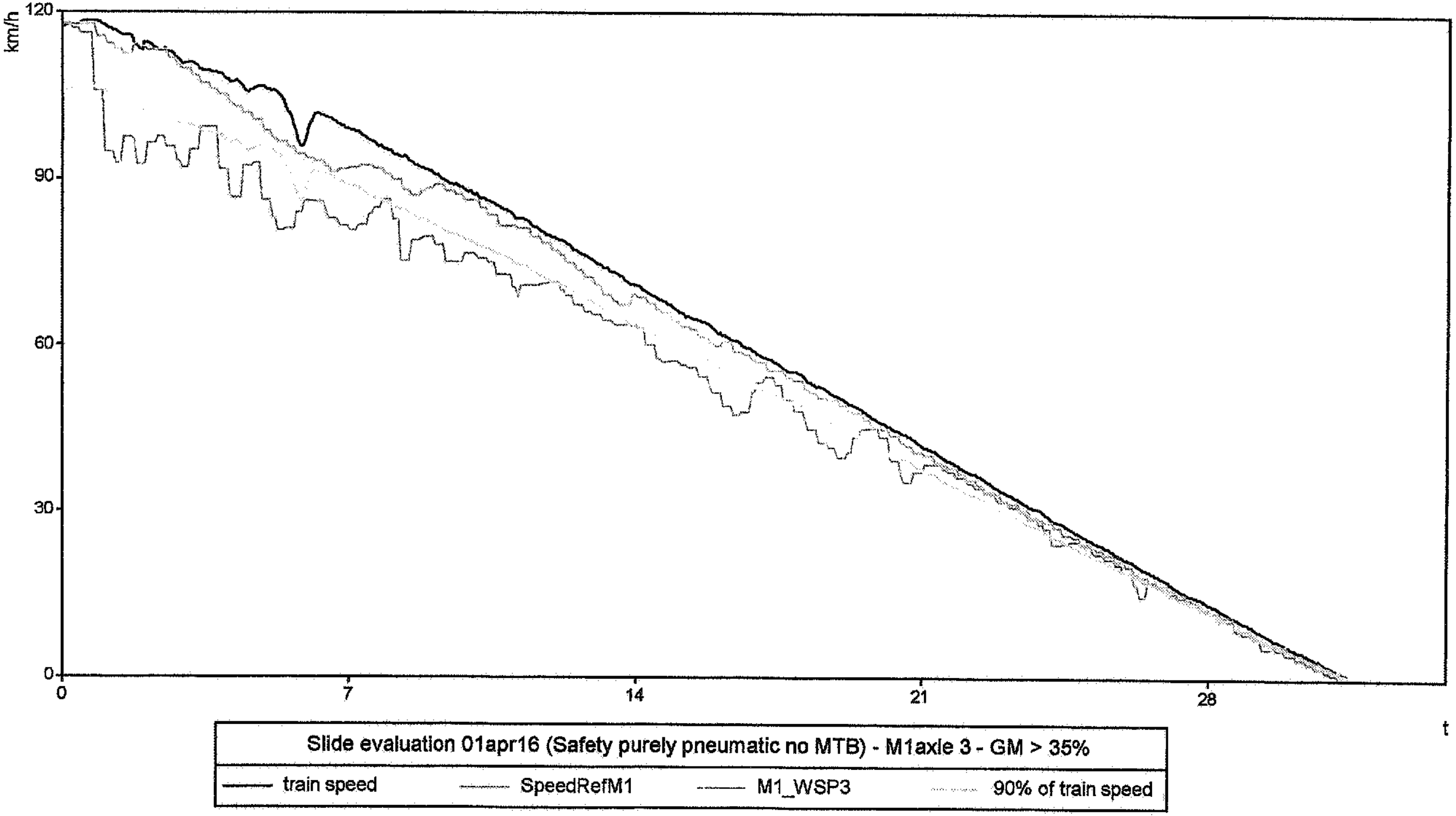


Slide evaluation 01apr16 (Safety purely pneumatic no MTB) - M4 axle 2 - GM > 35%			
train speed	SpeedRefM4	M4_WSP2	90% of train speed

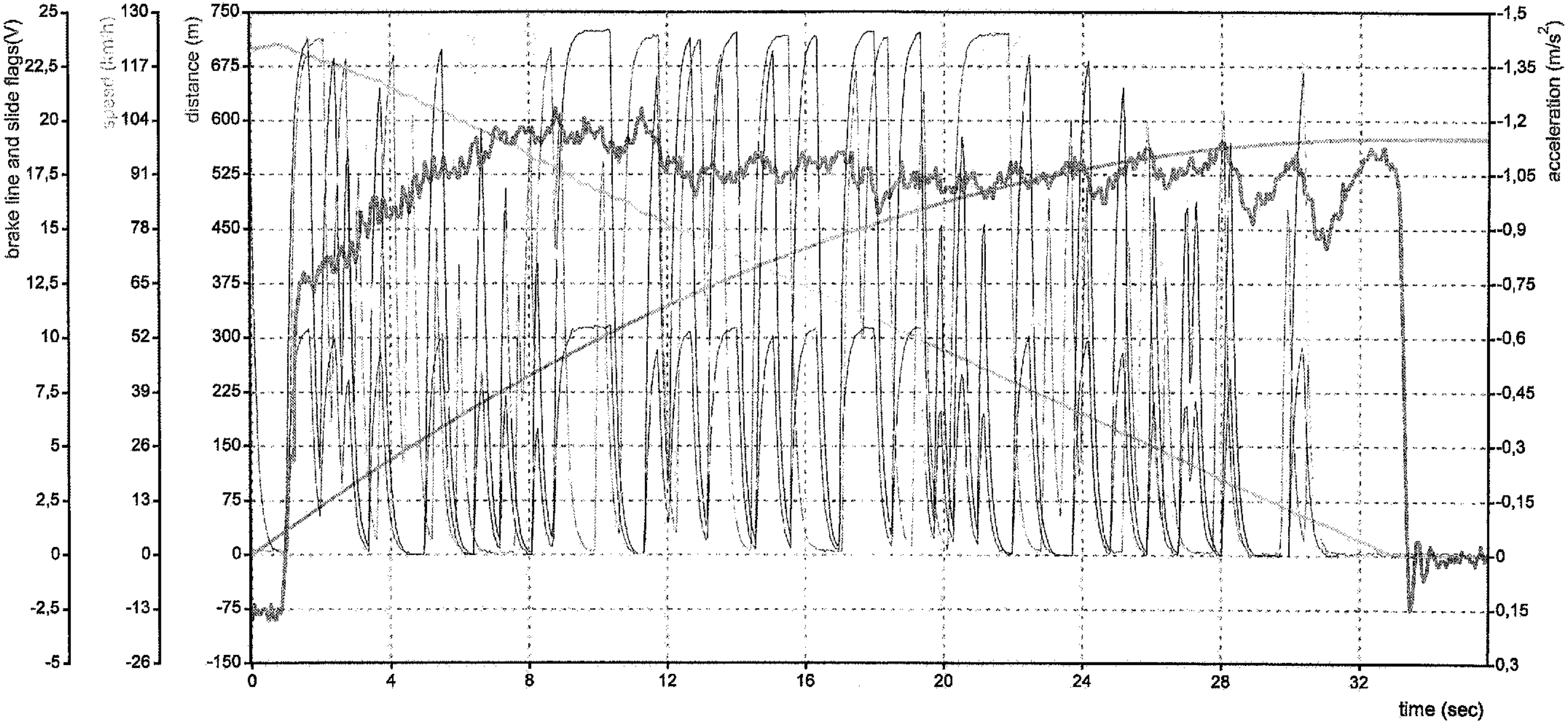


km/h
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 01apr16 (Safety purely pneumatic no MTB) - M4 axle 3 - GM > 35%
train speed
SpeedRefM4
M4_WSP3
90% of train speed


km/h
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 01apr16 (Safety purely pneumatic no MTB) - M1axle 2 - GM > 35%
train speed
SpeedRefM1
M1_WSP2
90% of train speed



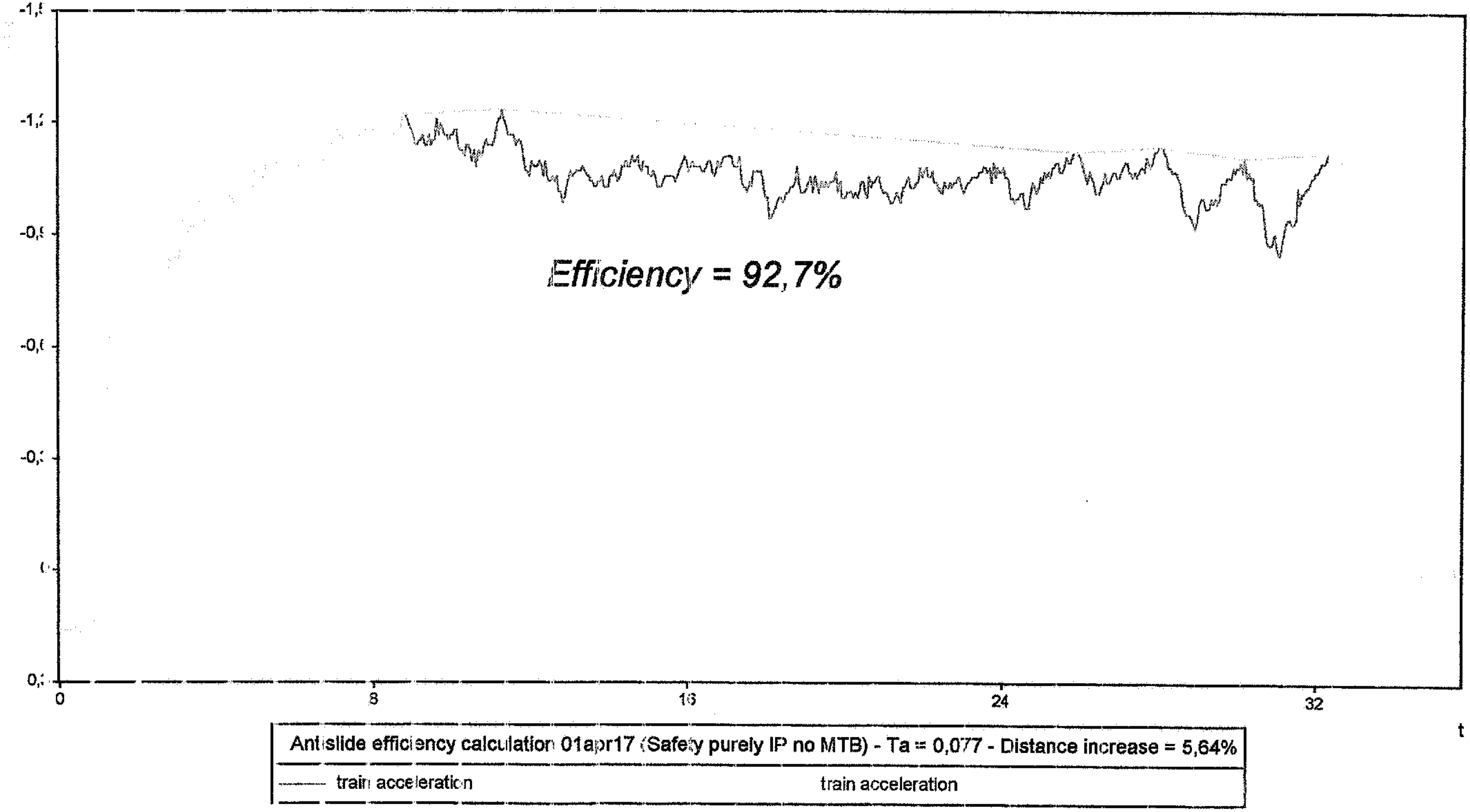
km/h
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 01apr16 (Safety purely pneumatic no MTB) - M1axle 3 - GM > 35%
train speed
SpeedRefM1
M1_WSP3
90% of train speed



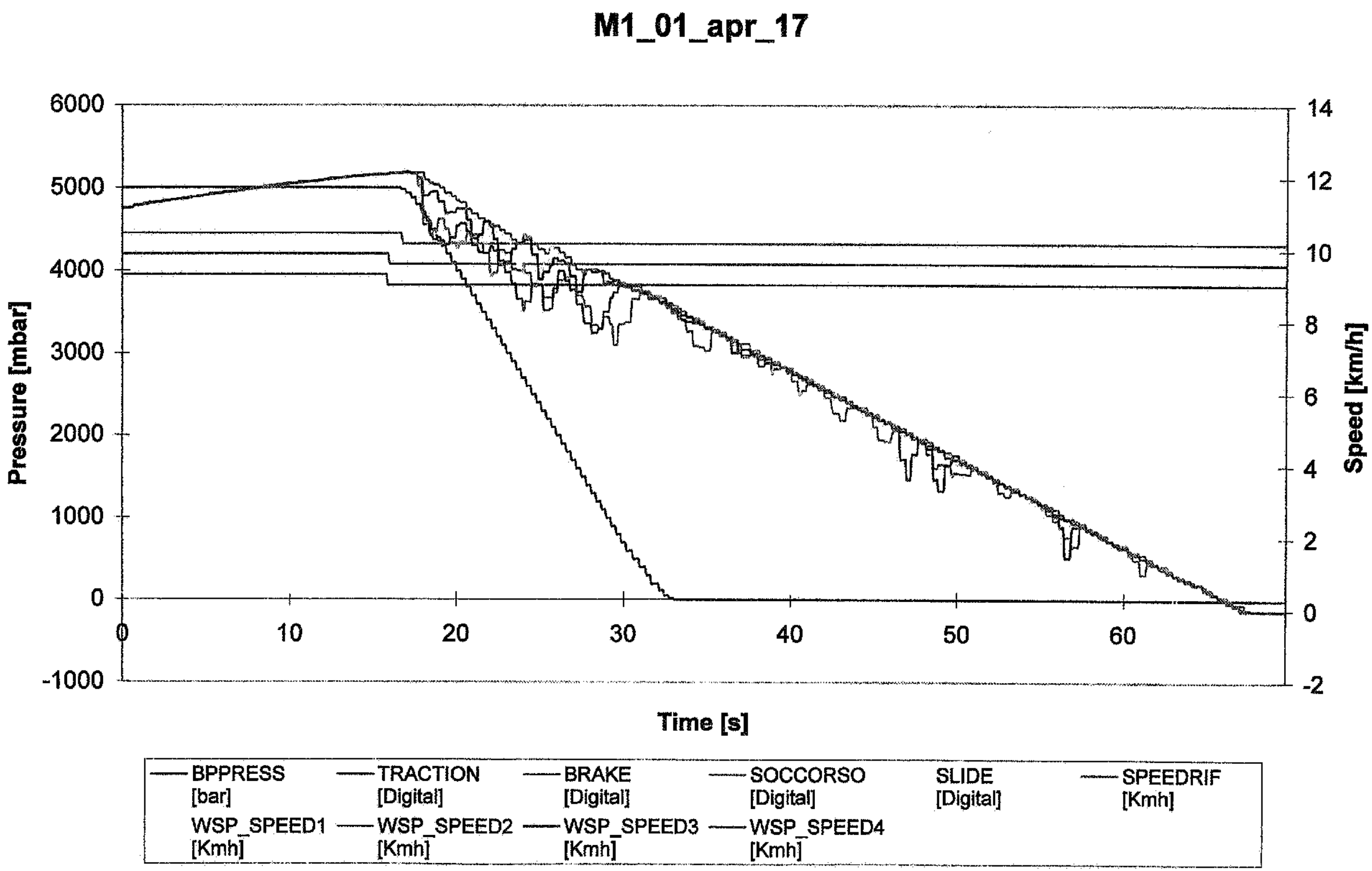
Safety purely pneumatic no MTB with soap from M4; initial speed = 121,45 km/h; stopp. distance = 574,59 m; mean dec = 0,99 m/s^2; File: 01apr17

speed — brake line — Slide flag T3 — Slide flag M1

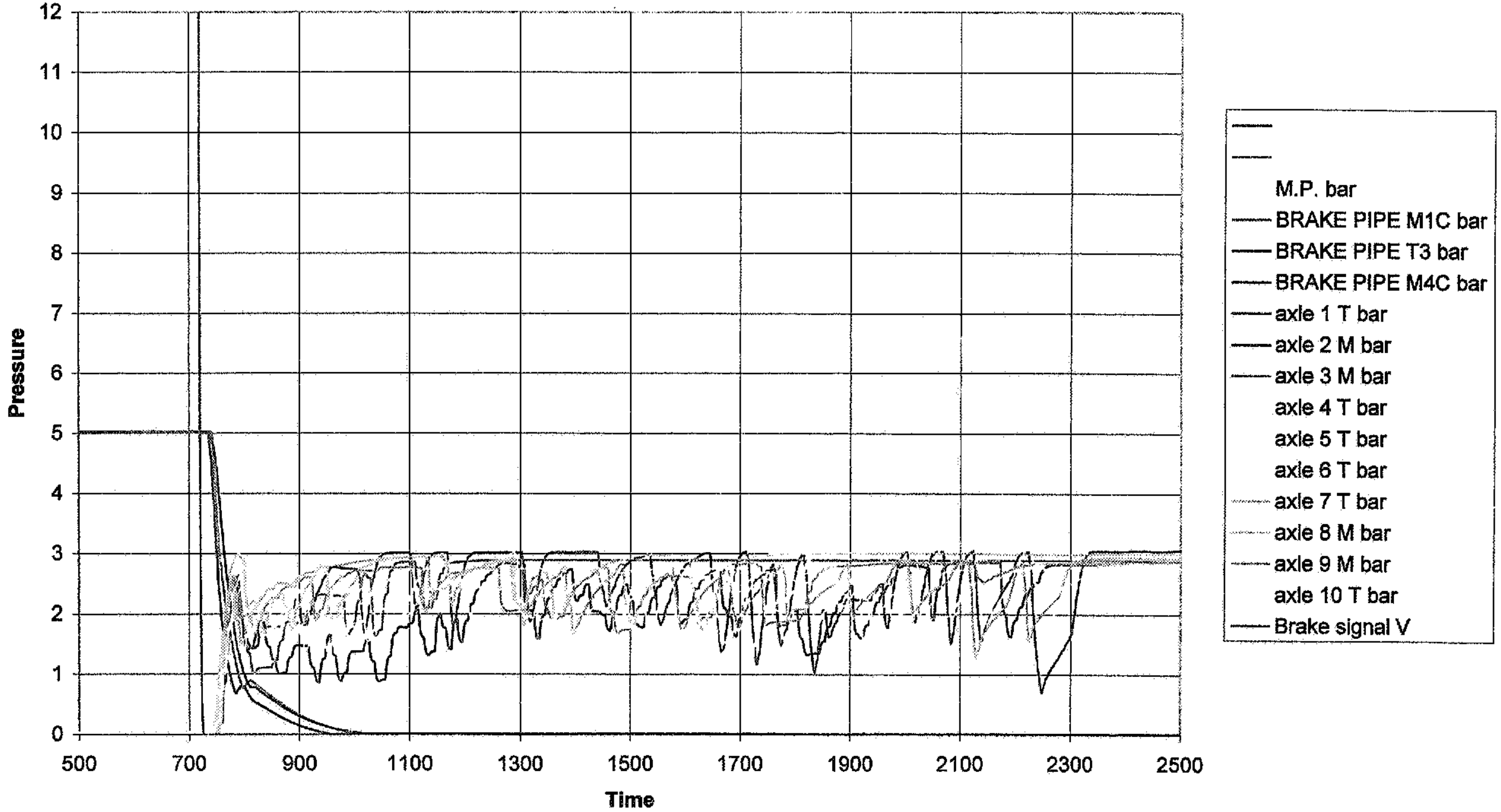
distance — acceleration — slide flag M4

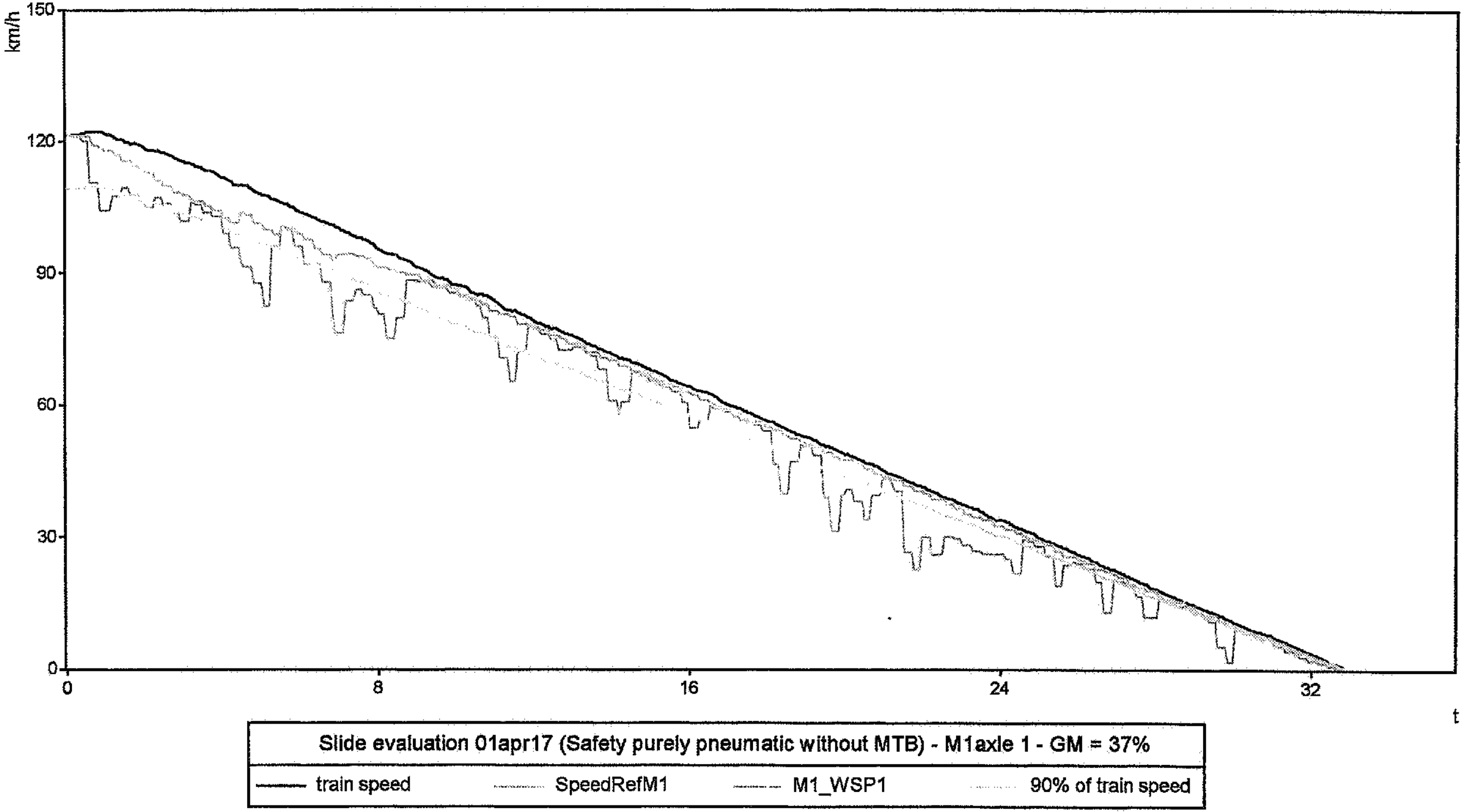


Efficiency = 92,7%
-1,5
-1,2
-0,9
-0,6
-0,3
0,3
0
8
16
24
32
t
Antislide efficiency calculation 01apr17 (Safety purely IP no MTB) - Ta = 0,077 - Distance increase = 5,64%
train acceleration
train acceleration

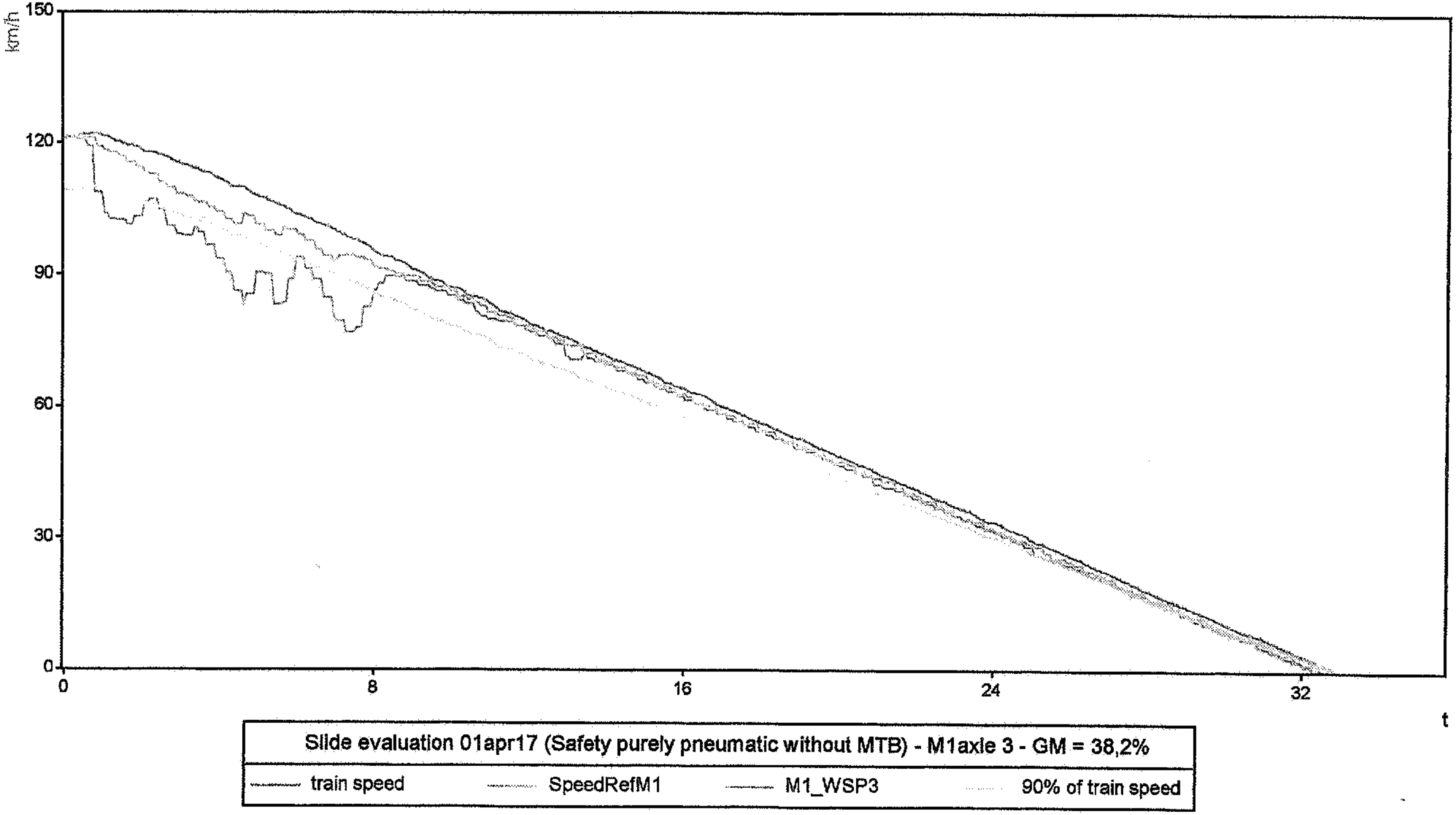

M1_01_apr_17
Pressure [mbar]
6000
5000
4000
3000
2000
1000
0
-1000
Speed [km/h]
14
12
10
8
6
4
2
0
-2
Time [s]
0
10
20
30
40
50
60
BPPRESS [bar]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]

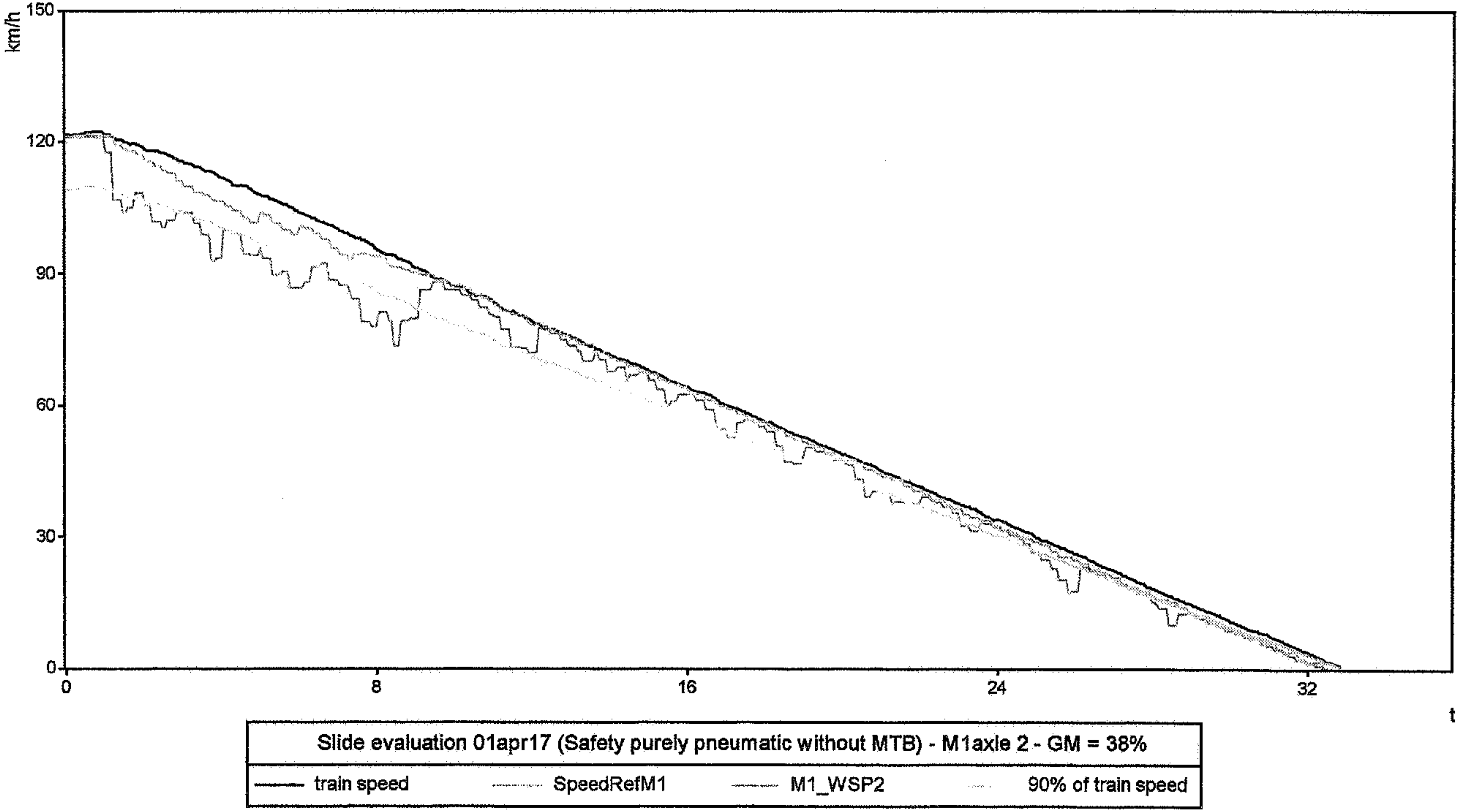
01 Apr Test 17

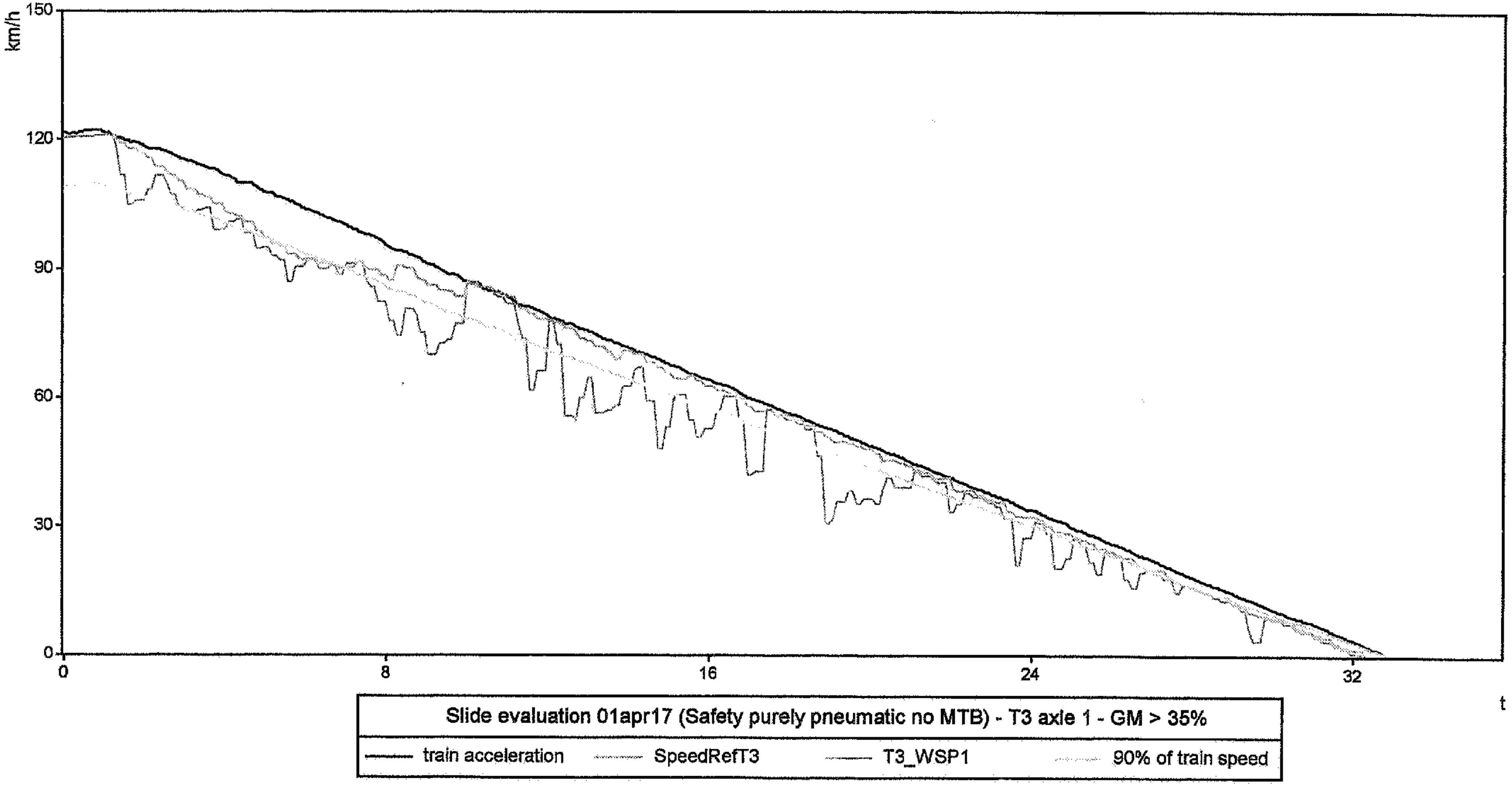


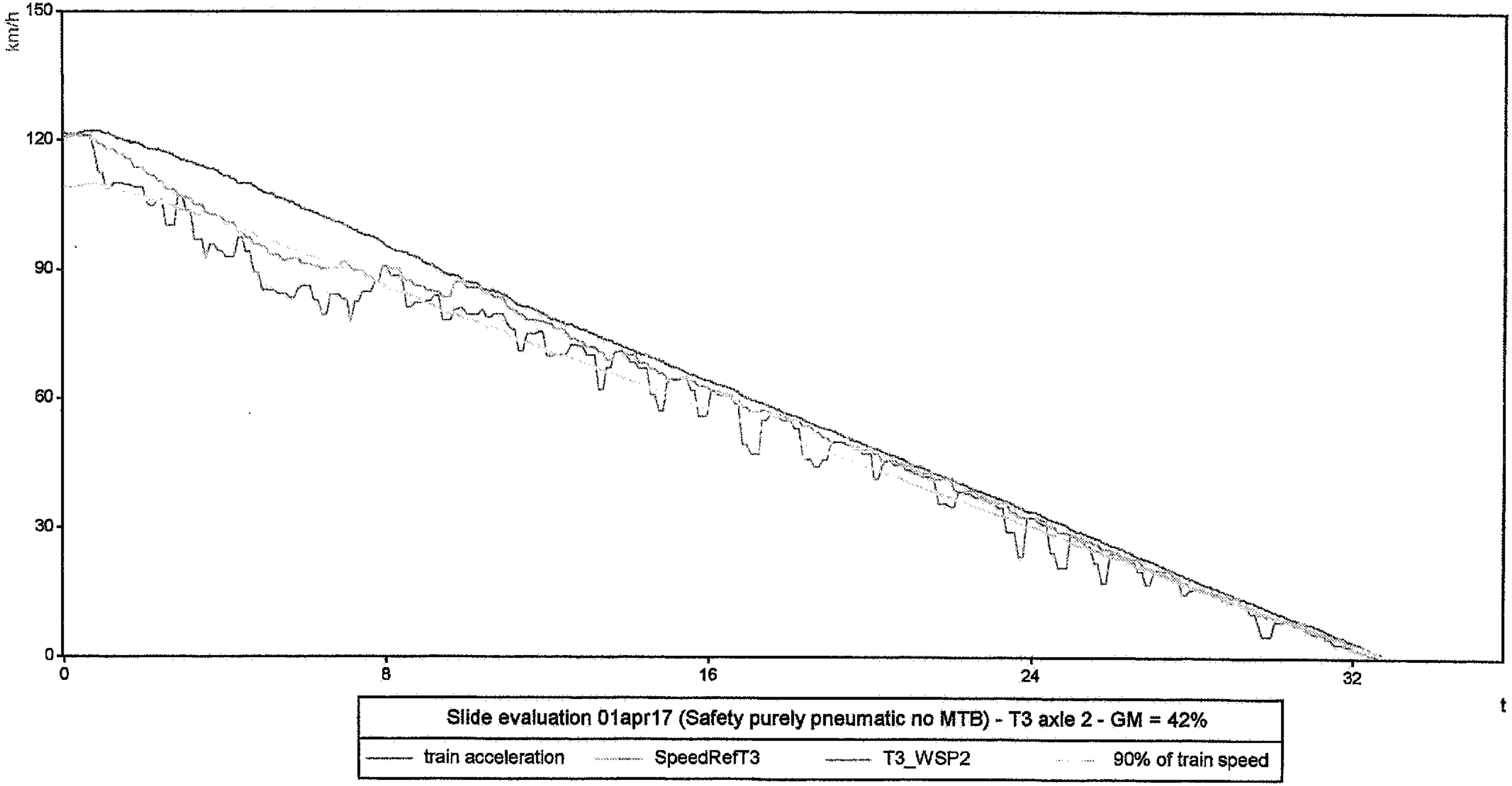


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 01apr17 (Safety purely pneumatic without MTB) - M1axle 1 - GM = 37%
train speed
SpeedRefM1
M1_WSP1
90% of train speed

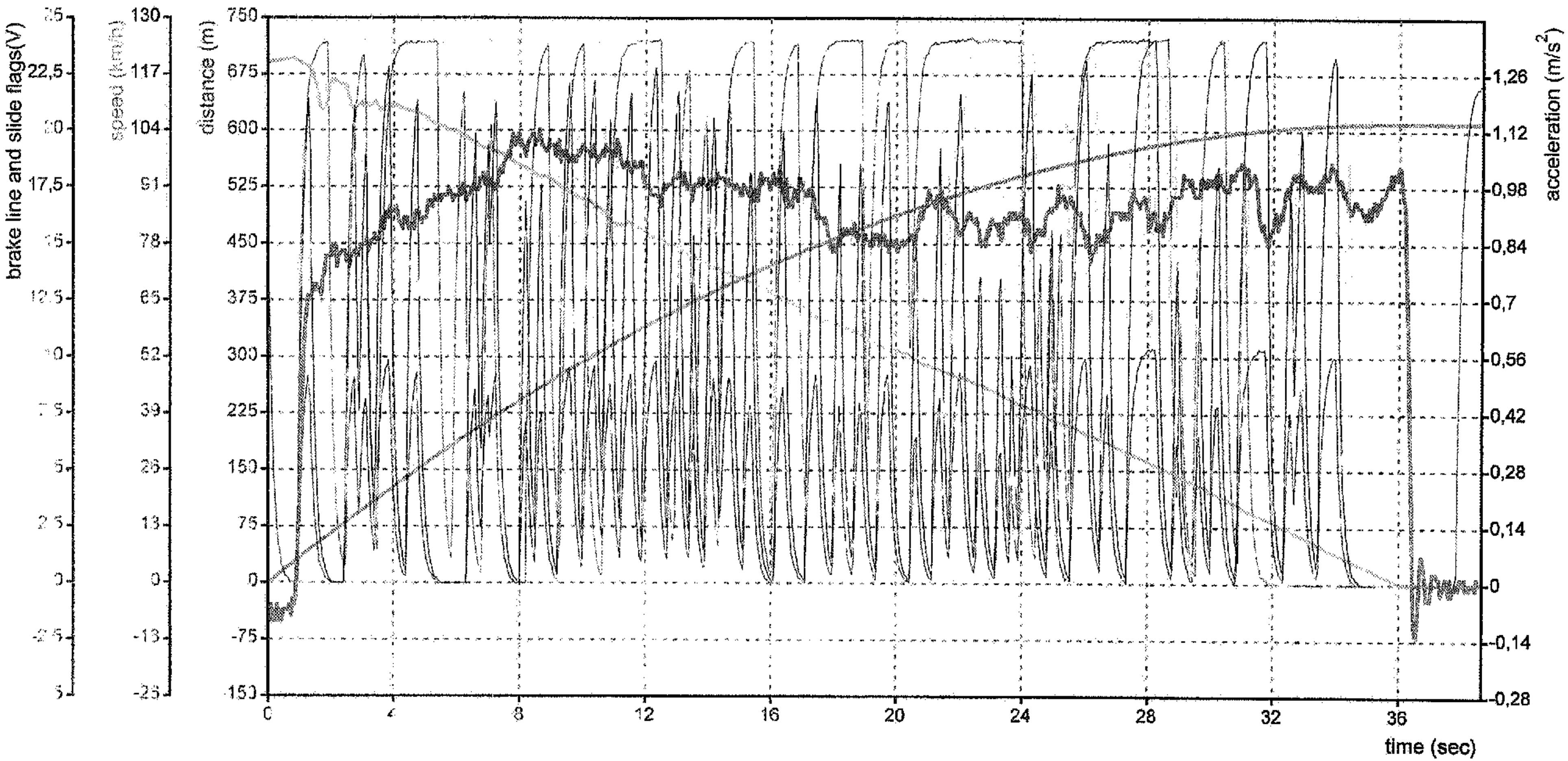

km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 01apr17 (Safety purely pneumatic without MTB) - M1axle 3 - GM = 38,2%
train speed
SpeedRefM1
M1_WSP3
90% of train speed


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 01apr17 (Safety purely pneumatic without MTB) - M1axle 2 - GM = 38%
train speed
SpeedRefM1
M1_WSP2
90% of train speed

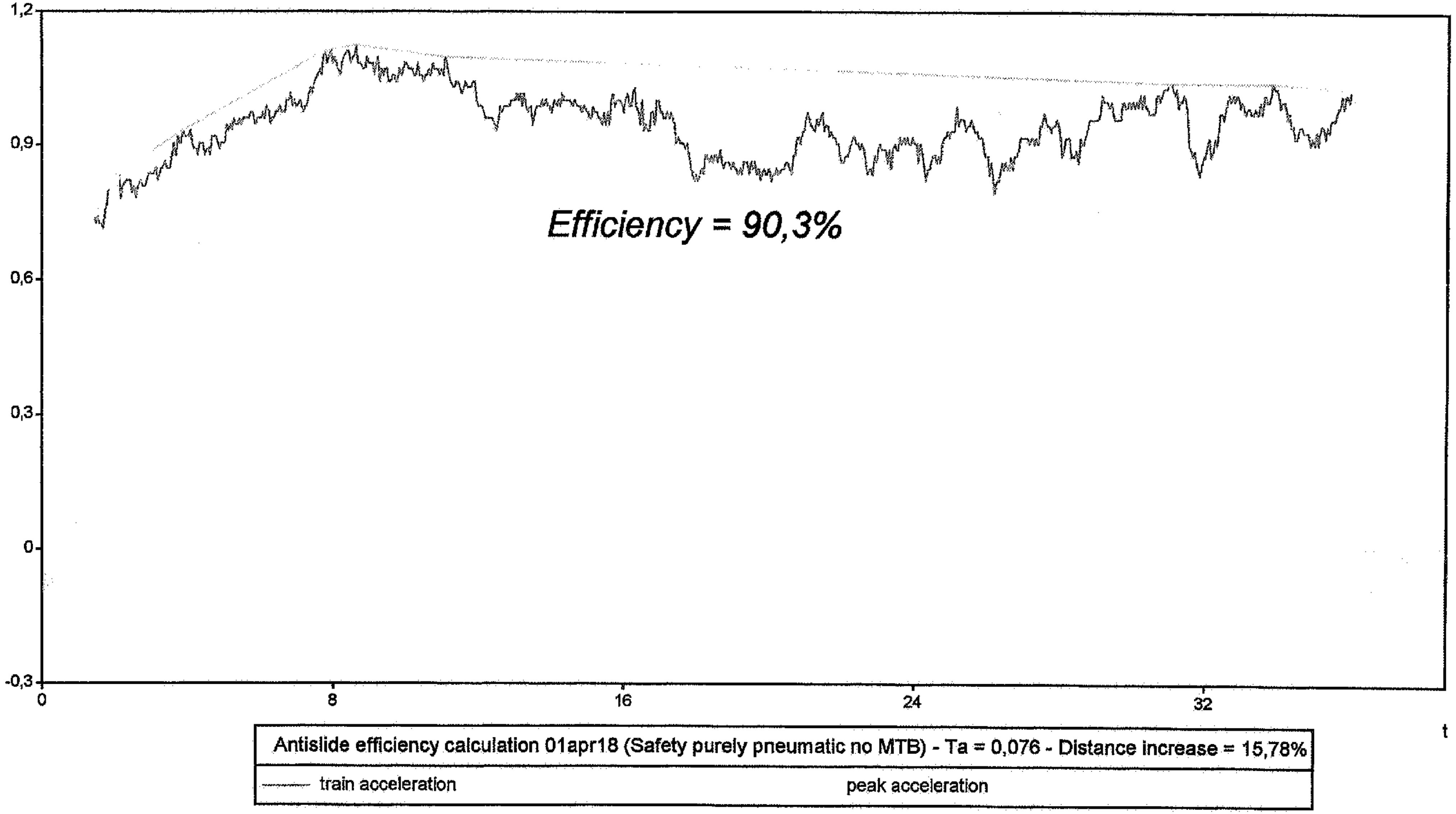

km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 01apr17 (Safety purely pneumatic no MTB) - T3 axle 1 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP1
90% of train speed

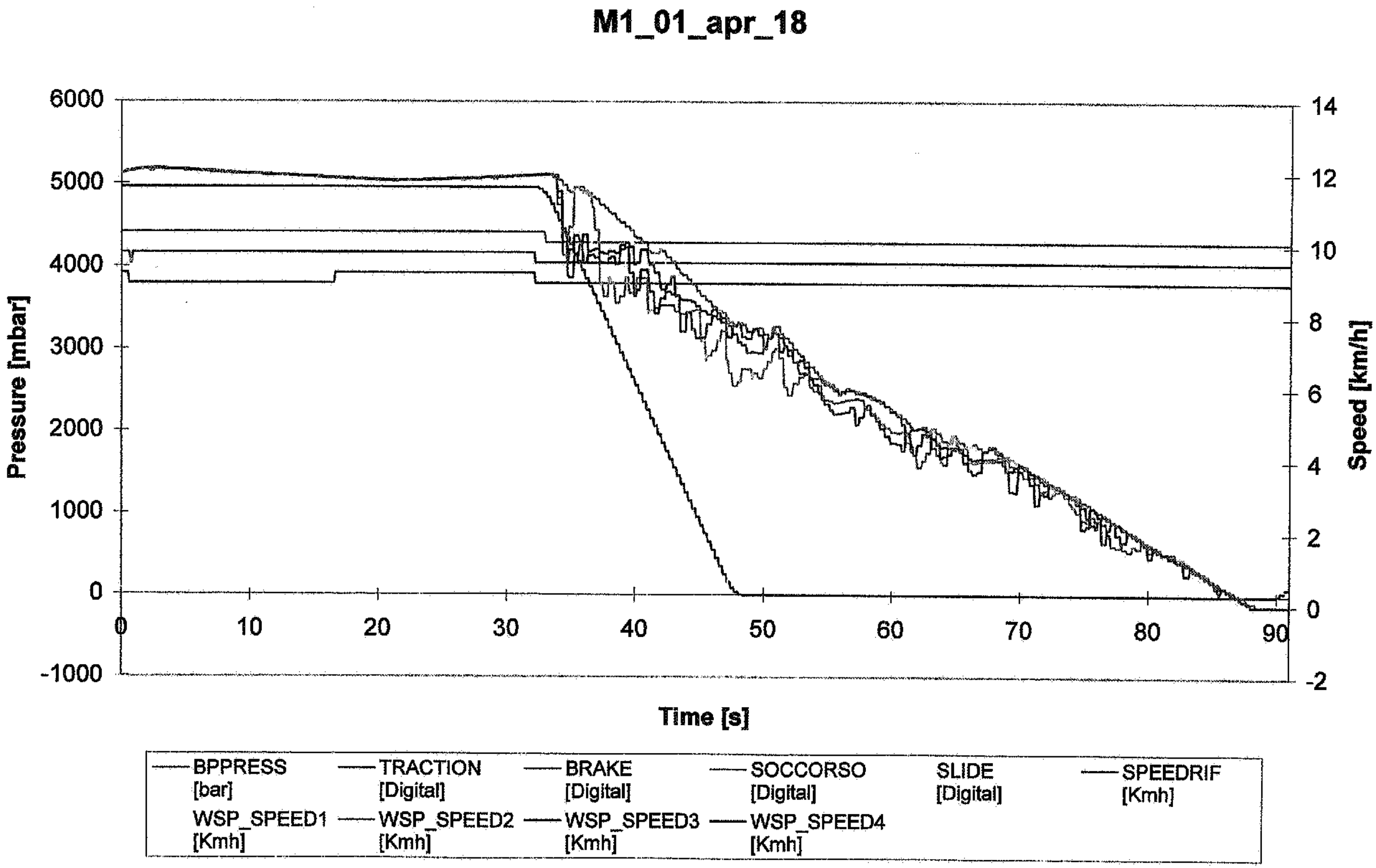


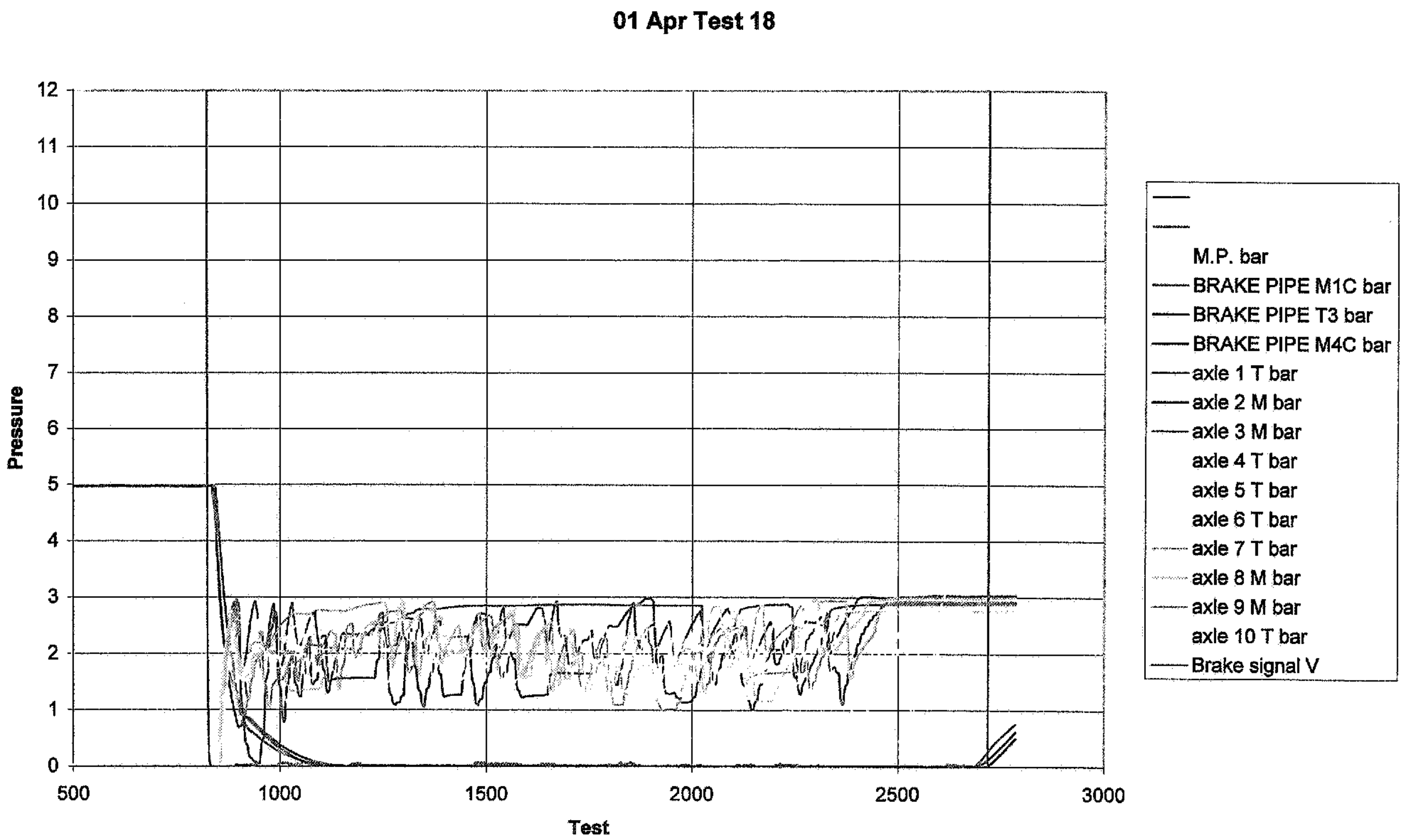
km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 01apr17 (Safety purely pneumatic no MTB) - T3 axle 2 - GM = 42%
train acceleration
SpeedRefT3
T3_WSP2
90% of train speed

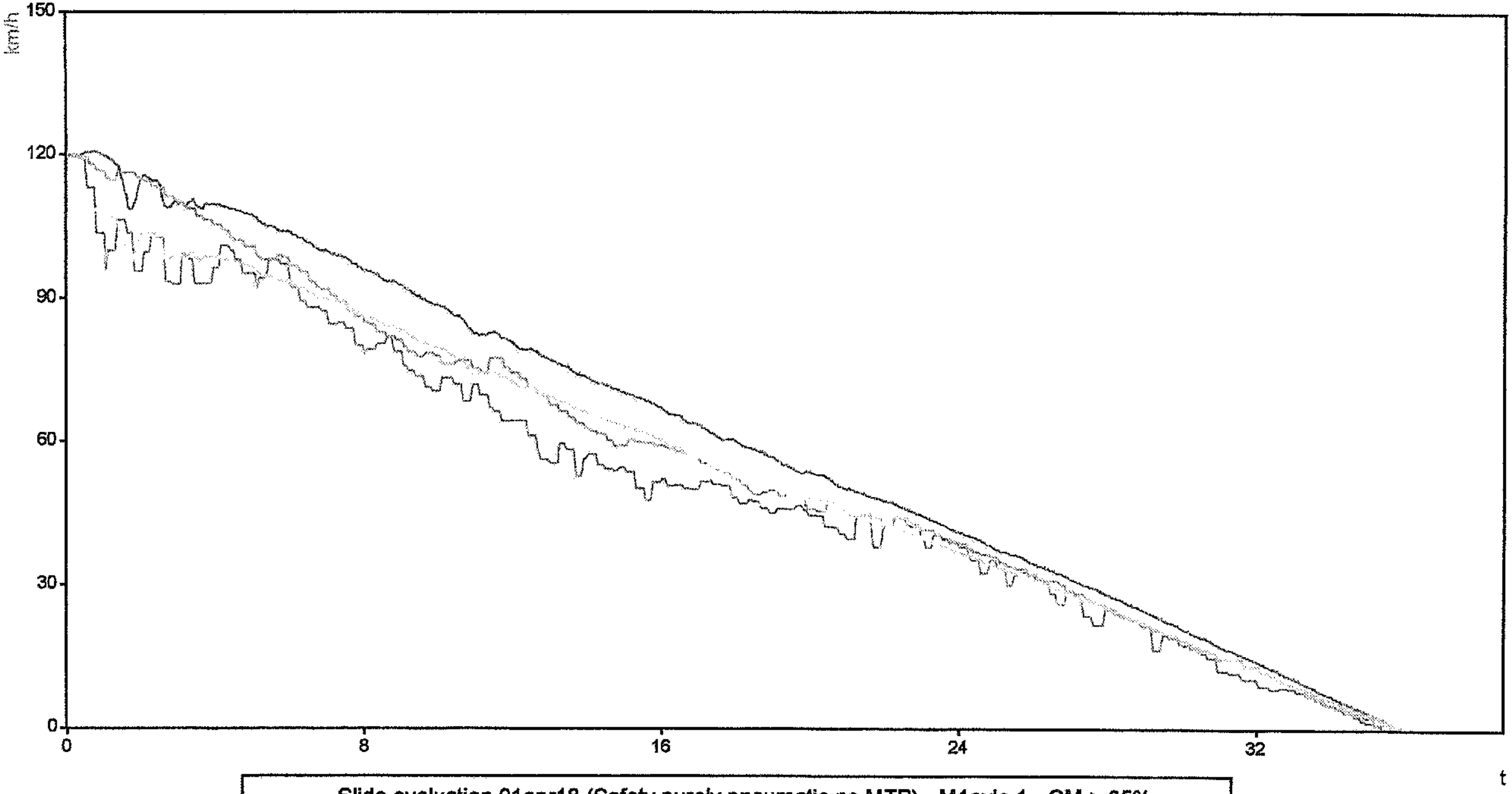


Safety purely pneumatic no MTB with soap from M4; initial speed = 119,59 km/h; stopp. distance = 610,62 m; mean dec = 0,90 m/s^2; File: 01apr18			
speed	brake line	Slide flag T3	Slide flag M1
distance	acceleration	slide flag M4	

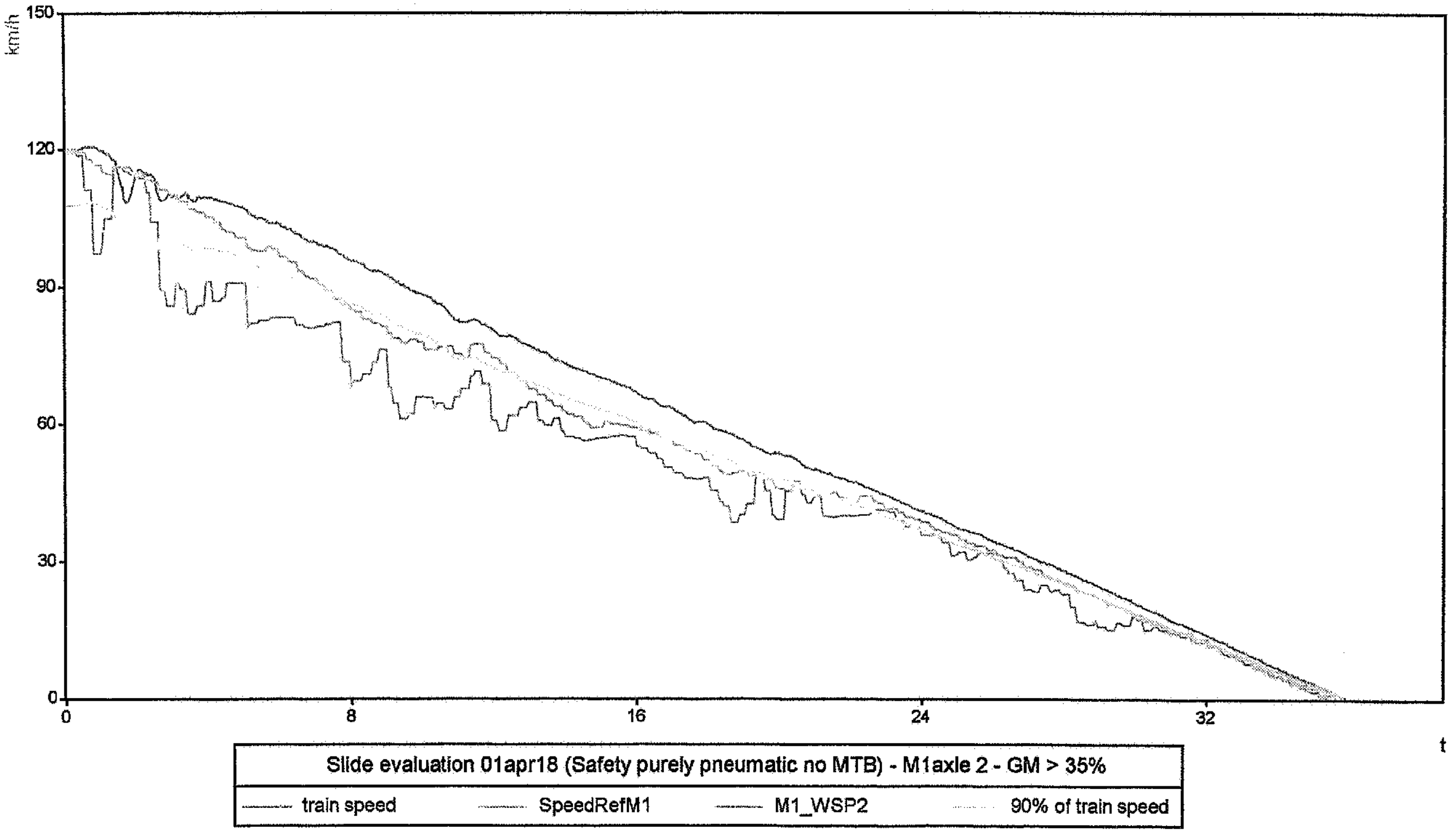

1,2
0,9
0,6
0,3
0
-0,3
0
8
16
24
32
t
Efficiency = 90,3%
Antislide efficiency calculation 01apr18 (Safety purely pneumatic no MTB) - Ta = 0,076 - Distance increase = 15,78%
train acceleration
peak acceleration

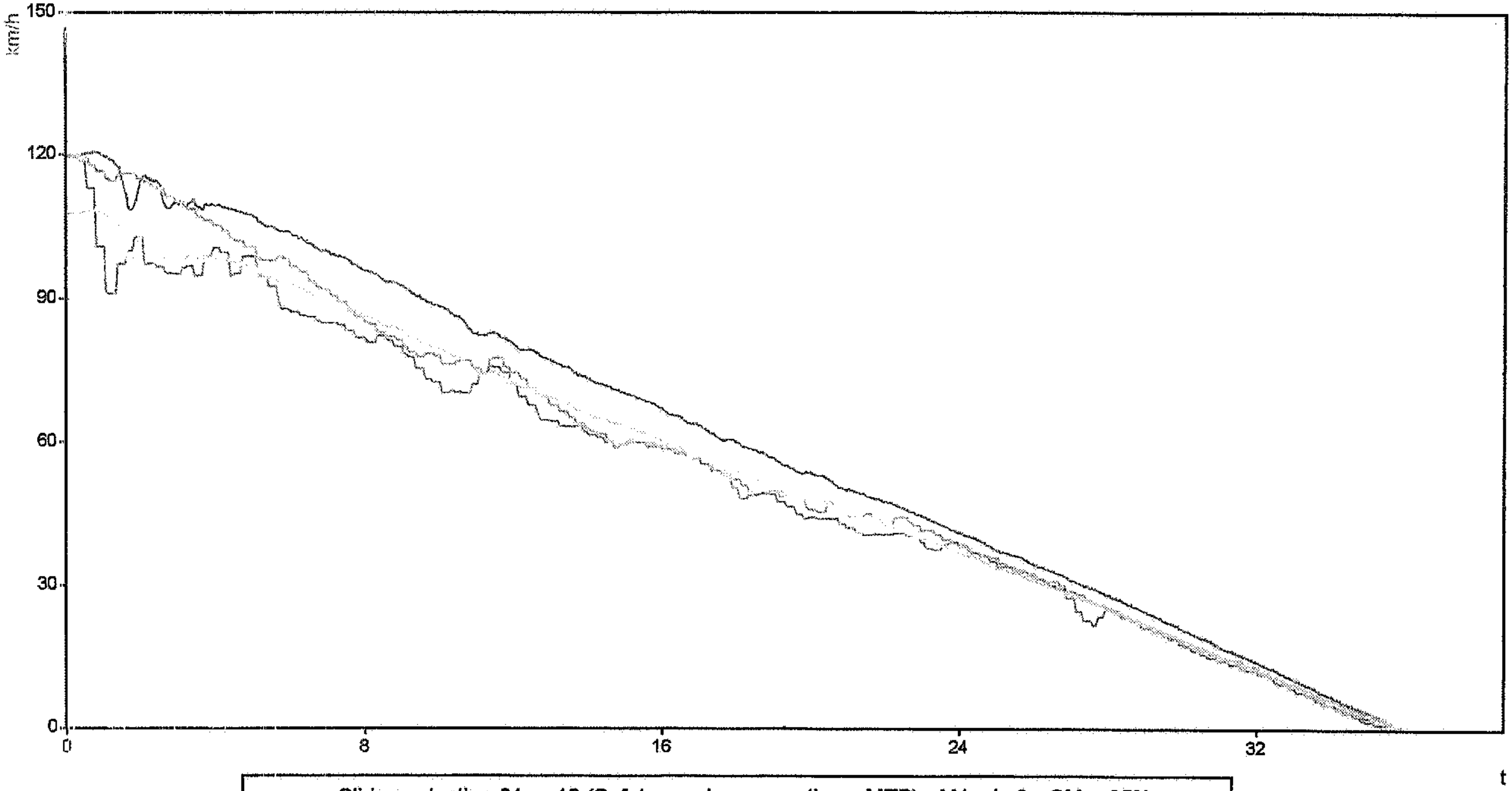

M1_01_apr_18
Pressure [mbar]
6000
5000
4000
3000
2000
1000
0
-1000
Speed [km/h]
14
12
10
8
6
4
2
0
-2
0
10
20
30
40
50
60
70
80
90
Time [s]
BPPRESS [bar]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]


01 Apr Test 18
Pressure
Test
0
1
2
3
4
5
6
7
8
9
10
11
12
500
1000
1500
2000
2500
3000
M.P. bar
BRAKE PIPE M1C bar
BRAKE PIPE T3 bar
BRAKE PIPE M4C bar
axle 1 T bar
axle 2 M bar
axle 3 M bar
axle 4 T bar
axle 5 T bar
axle 6 T bar
axle 7 T bar
axle 8 M bar
axle 9 M bar
axle 10 T bar
Brake signal V



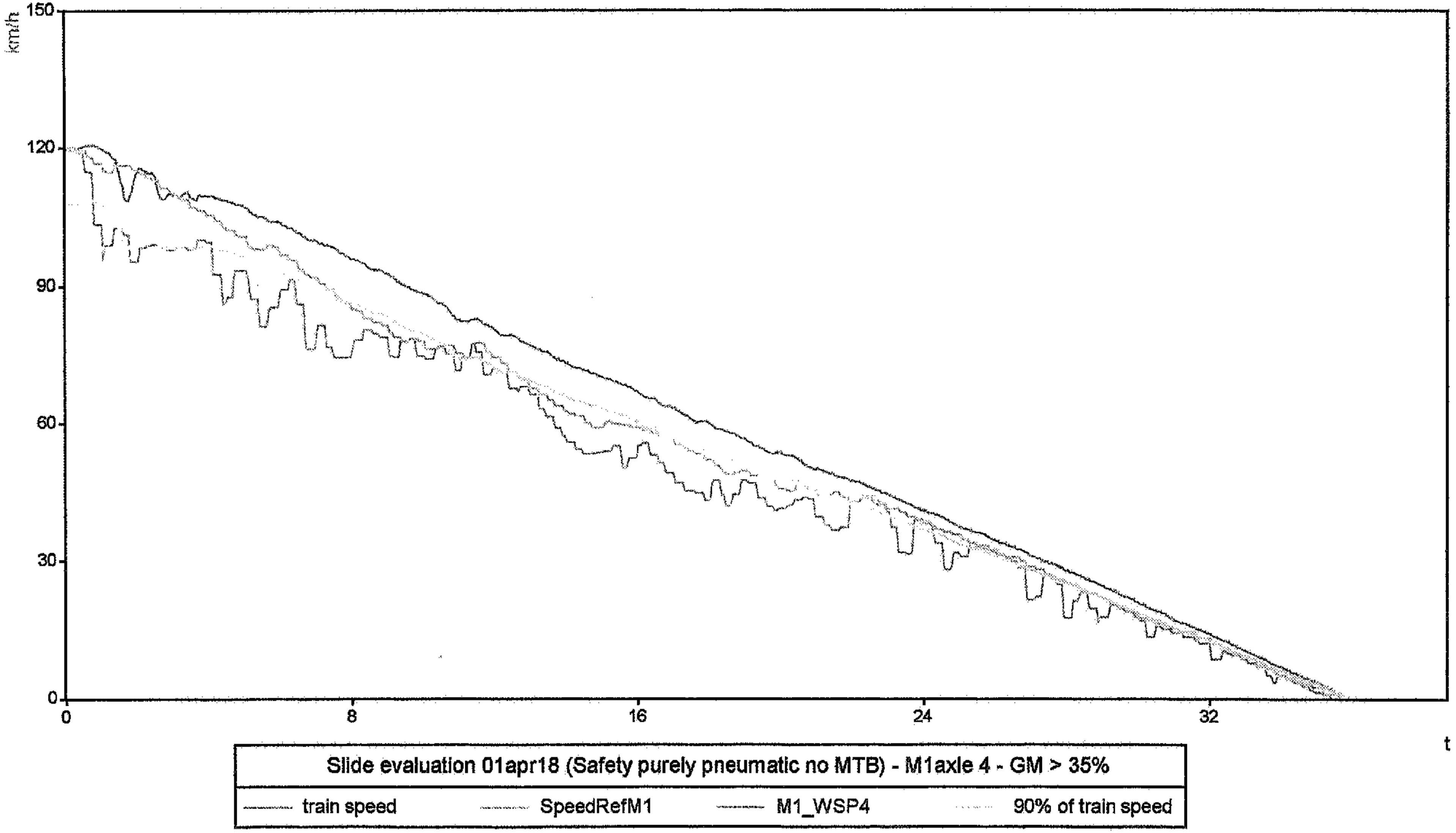
Slide evaluation 01apr18 (Safety purely pneumatic no MTB) - M1axle 1 - GM > 35%

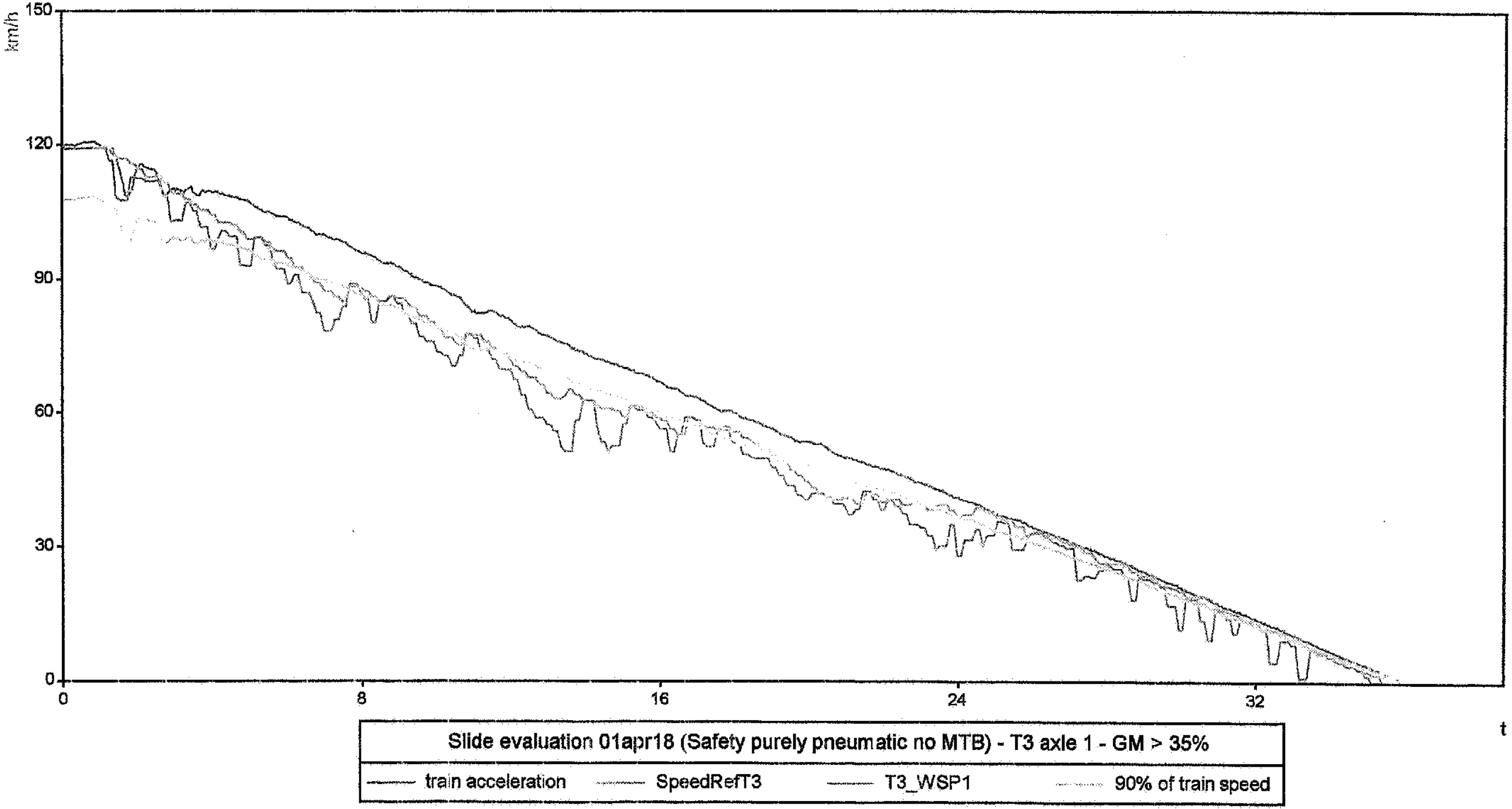

km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 01apr18 (Safety purely pneumatic no MTB) - M1axle 2 - GM > 35%
train speed
SpeedRefM1
M1_WSP2
90% of train speed

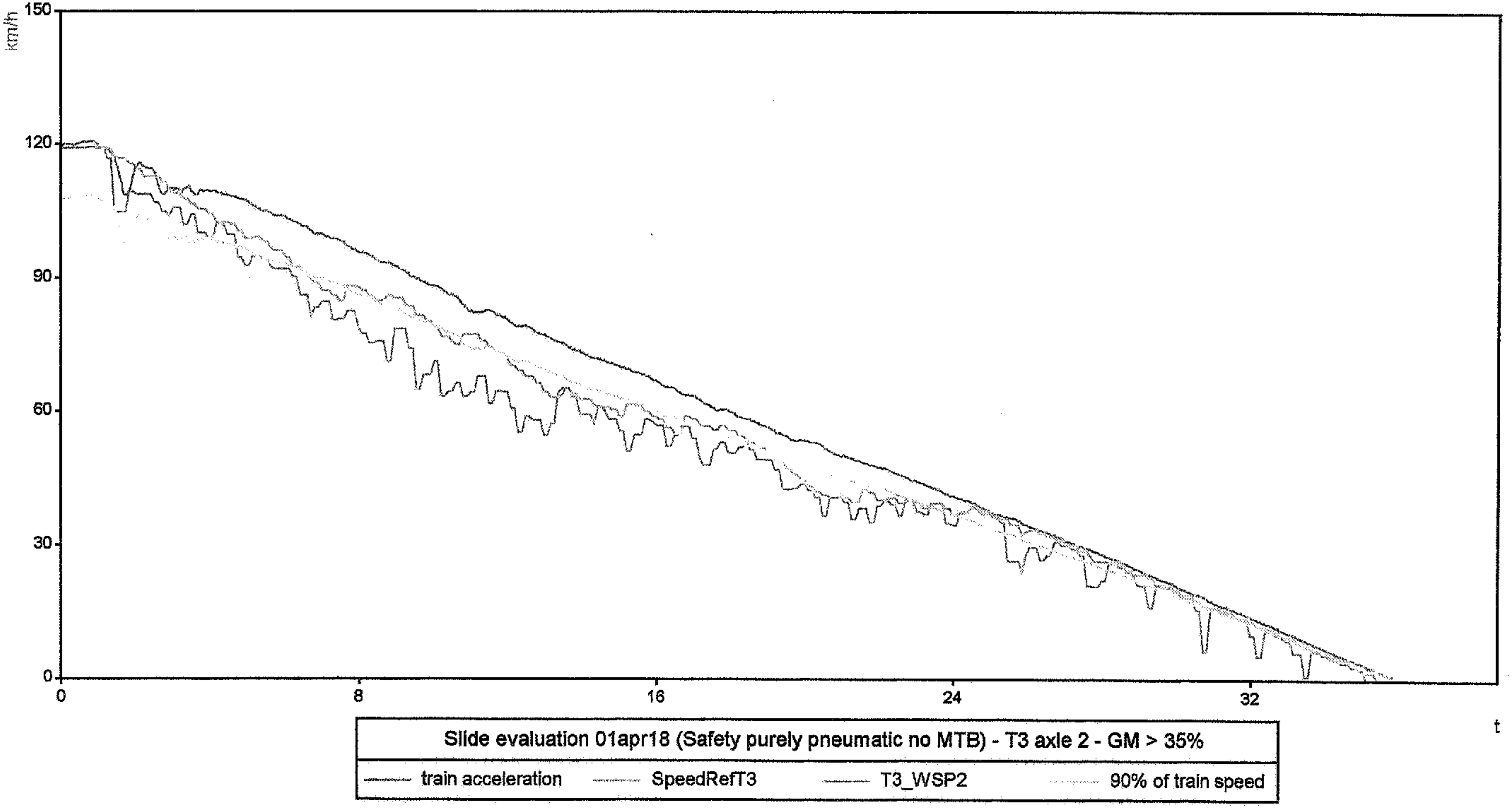


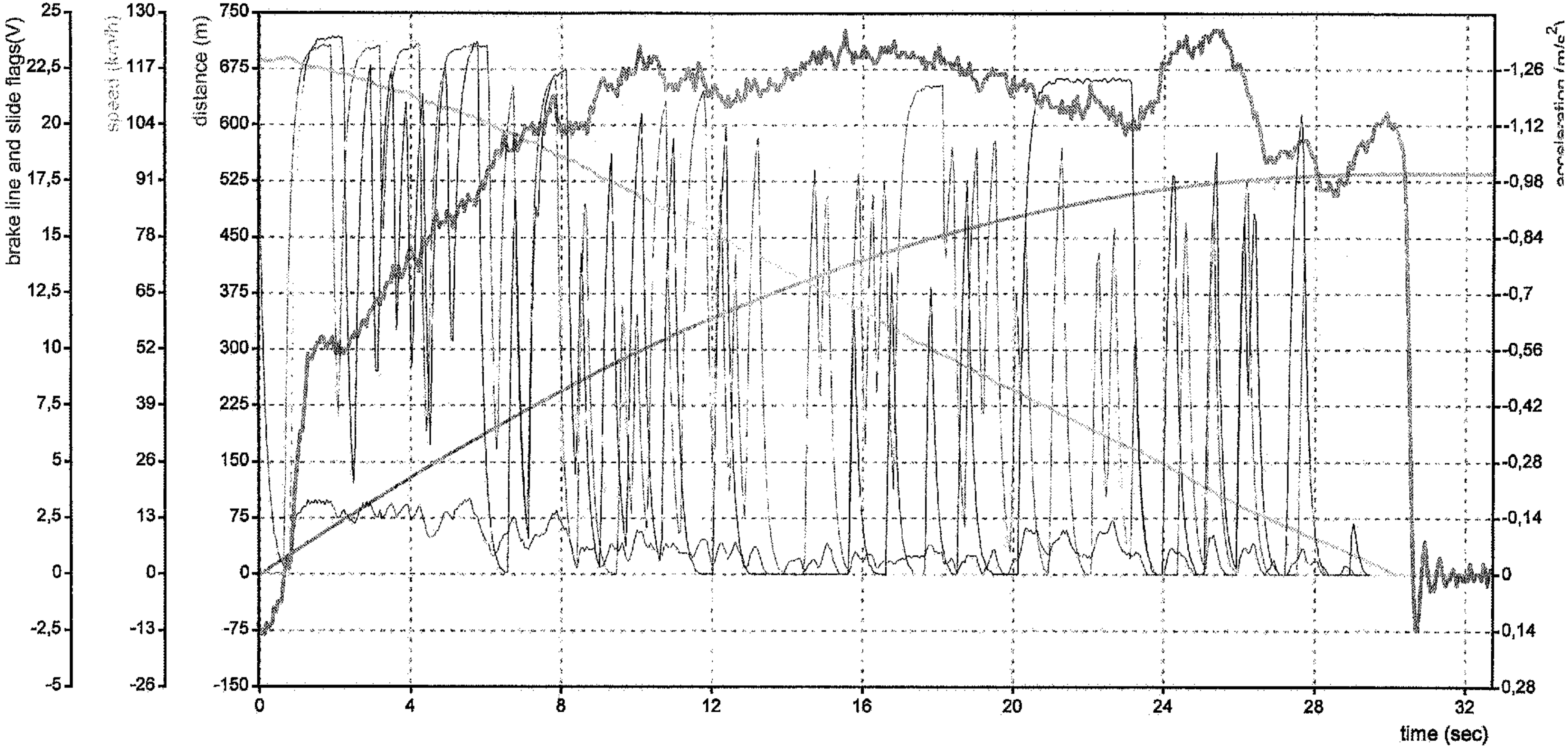
Slide evaluation 01apr18 (Safety purely pneumatic no MTB) - M1axle 3 - GM > 35%

train speed | SpeedRefM1 | M1_WSP3 | 90% of train speed


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 01apr18 (Safety purely pneumatic no MTB) - M1axle 4 - GM > 35%
train speed
SpeedRefM1
M1_WSP4
90% of train speed


km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 01apr18 (Safety purely pneumatic no MTB) - T3 axle 1 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP1
90% of train speed

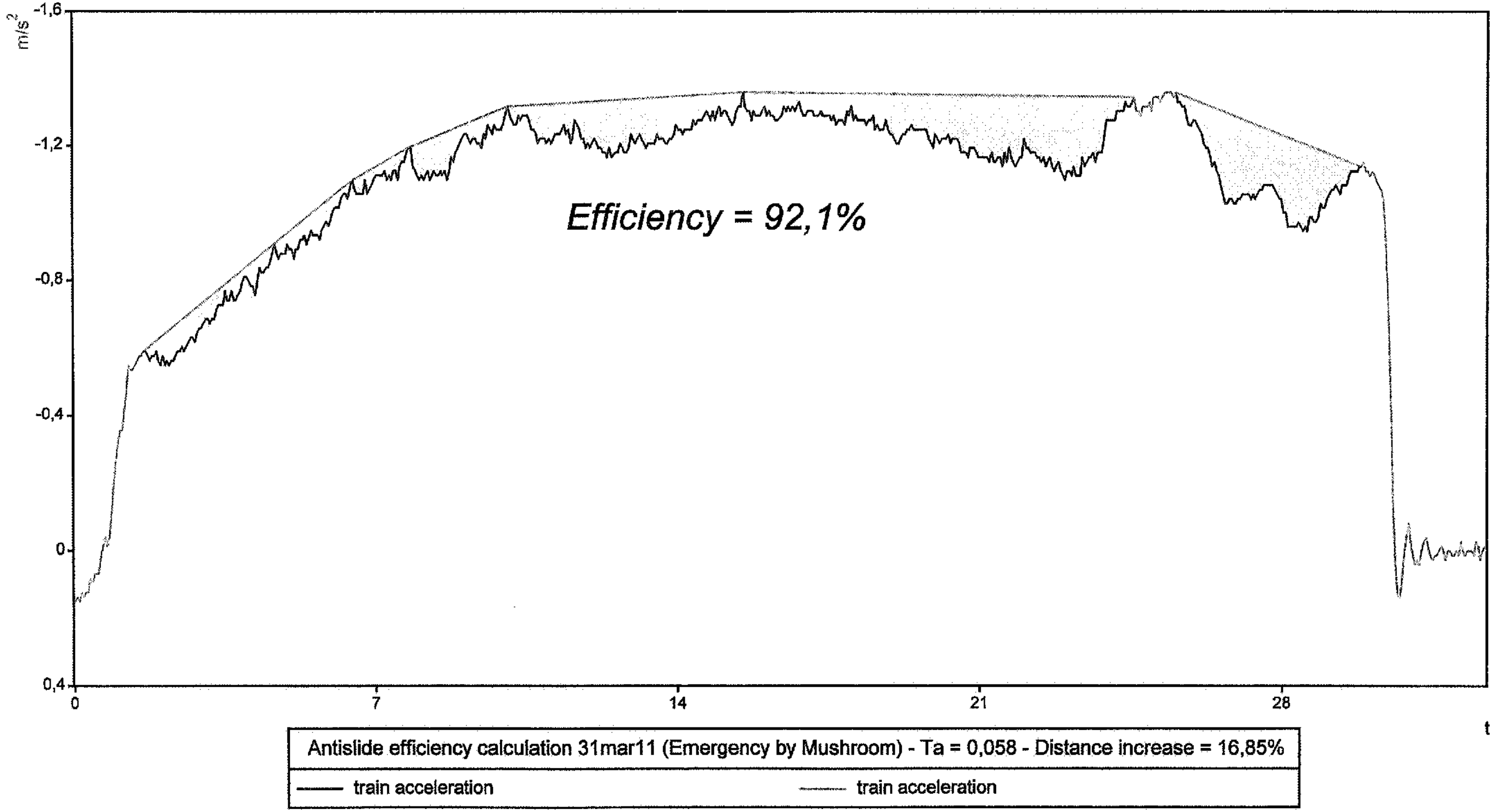

km/h
150
120
90
60
30
0
0
8
16
24
32
t
Slide evaluation 01apr18 (Safety purely pneumatic no MTB) - T3 axle 2 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP2
90% of train speed

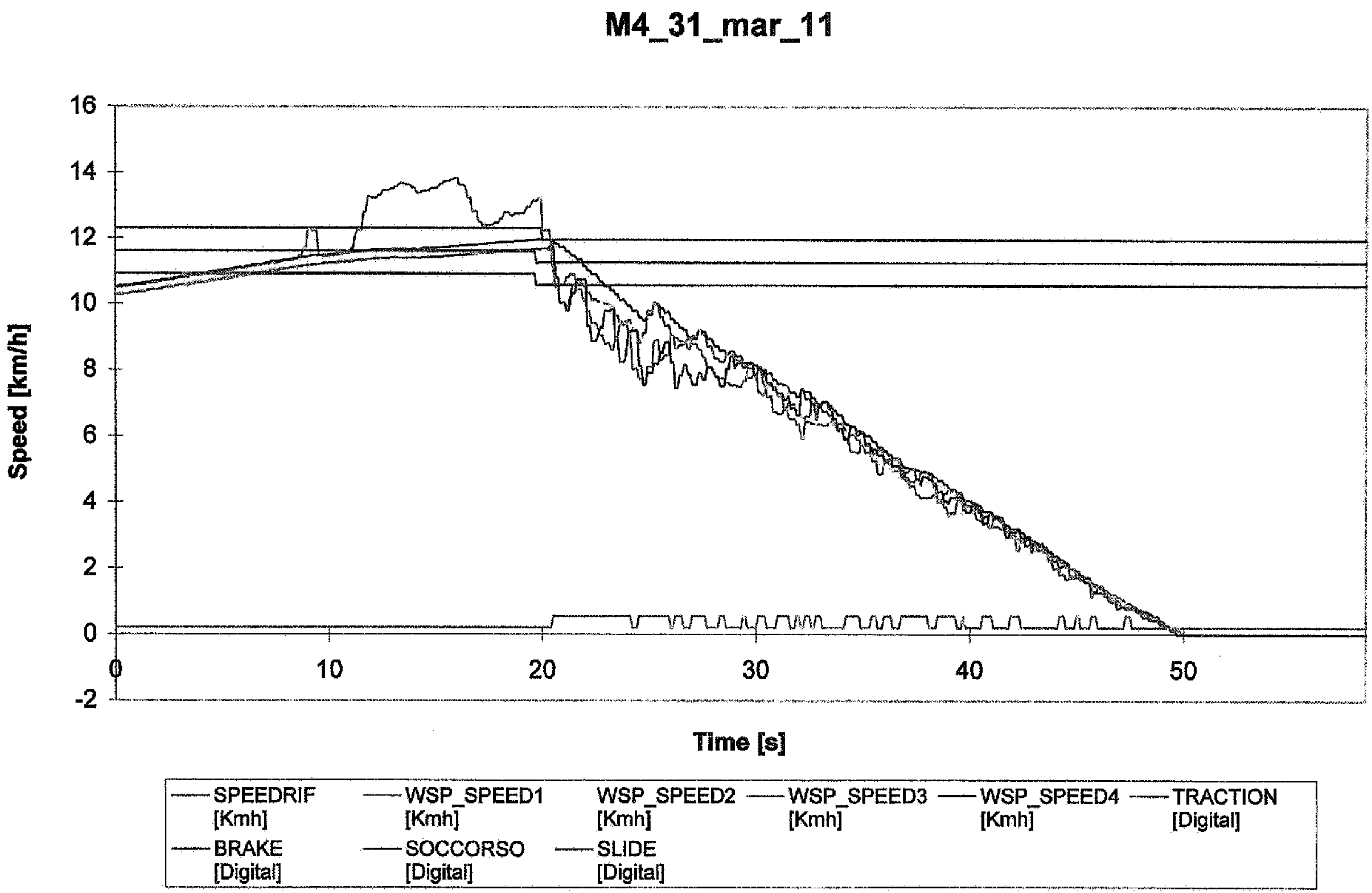


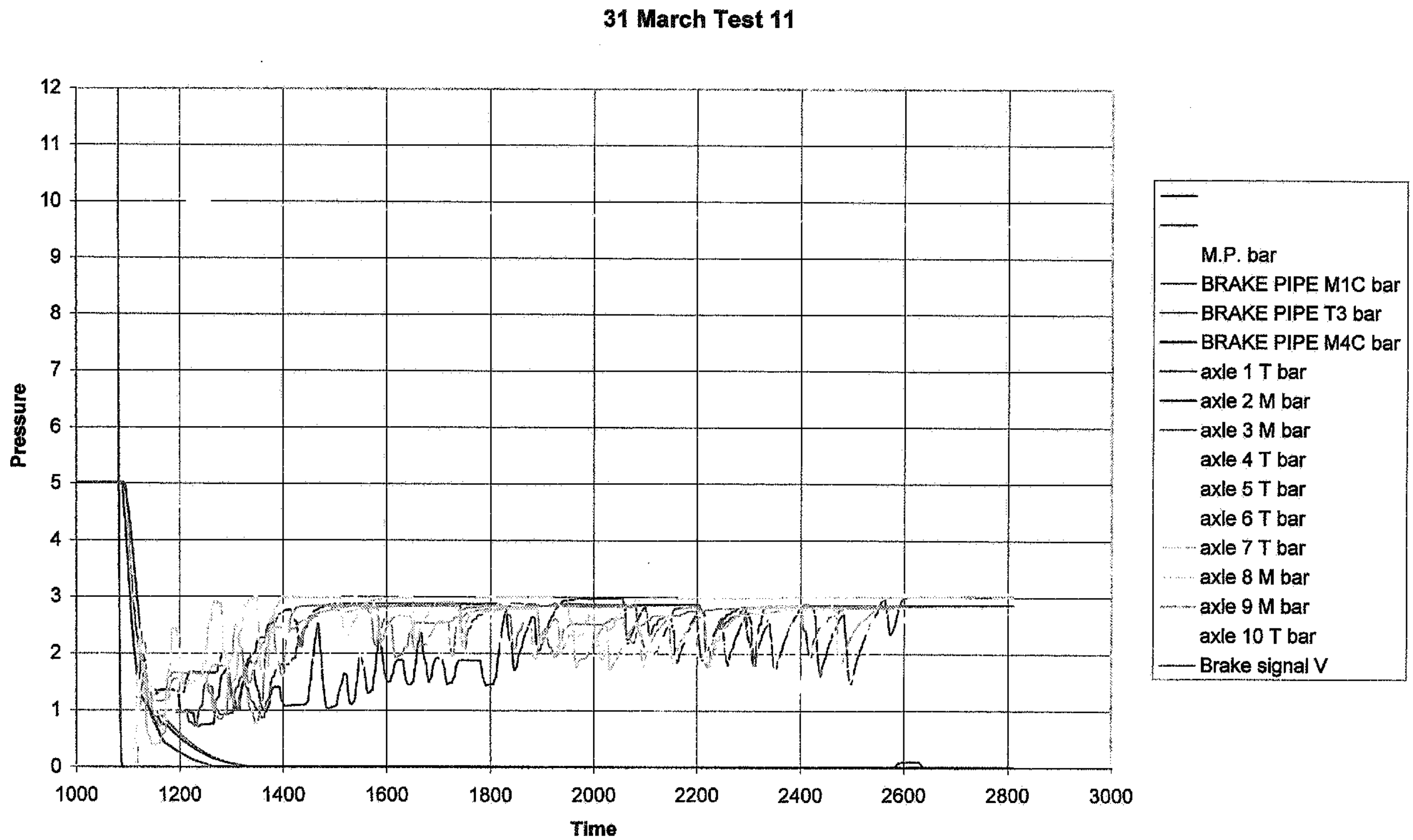
Emergencyby Mushroom with soap from M4; initial speed = 119,05 km/h; stopp. distance = 535,92 m; mean deceleration = 1,02 m/s^2; File: 31mar11

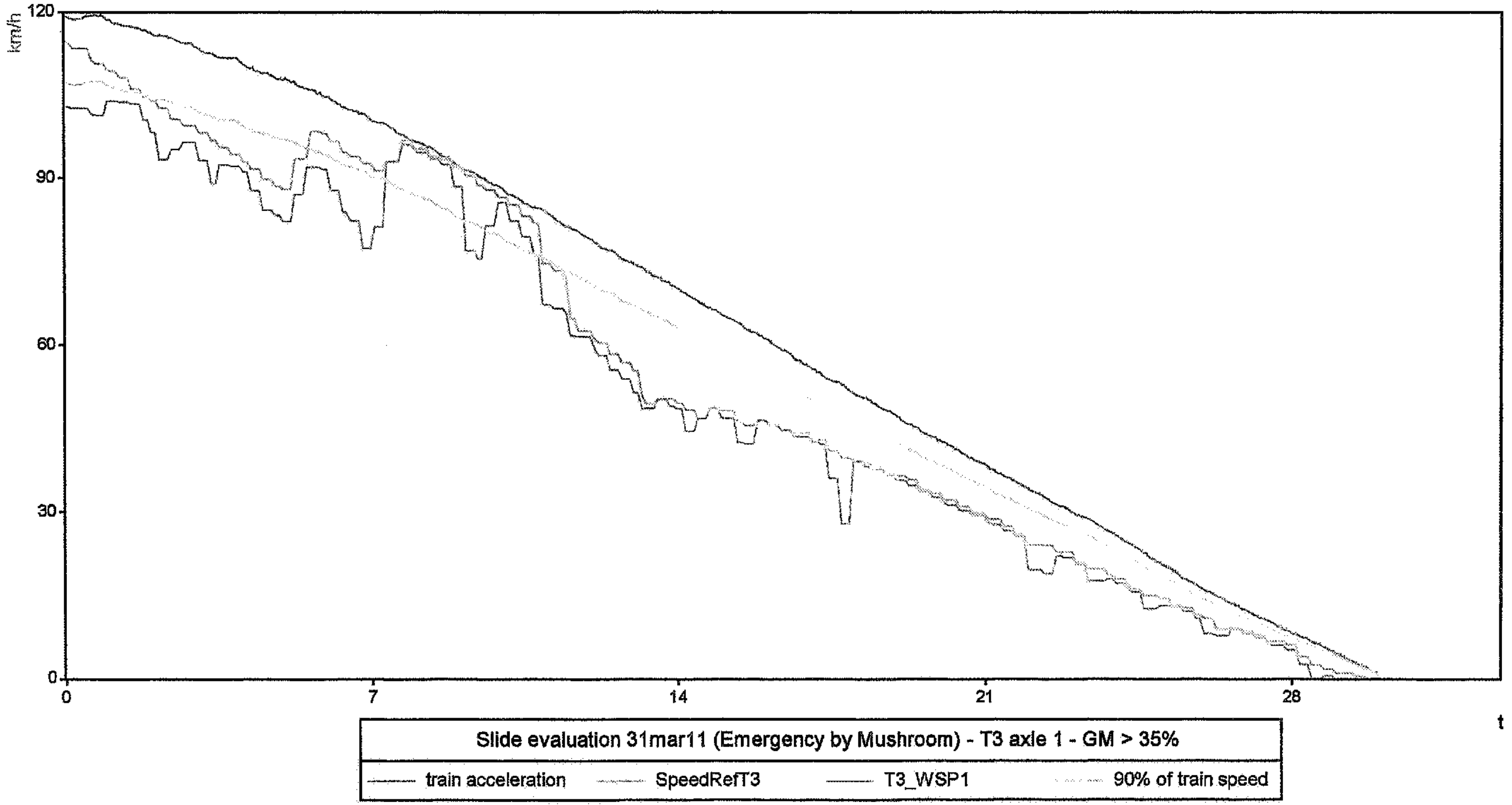
speed — brake line — Slide flag T3 — Slide flag M1

distance — acceleration — slide flag M4

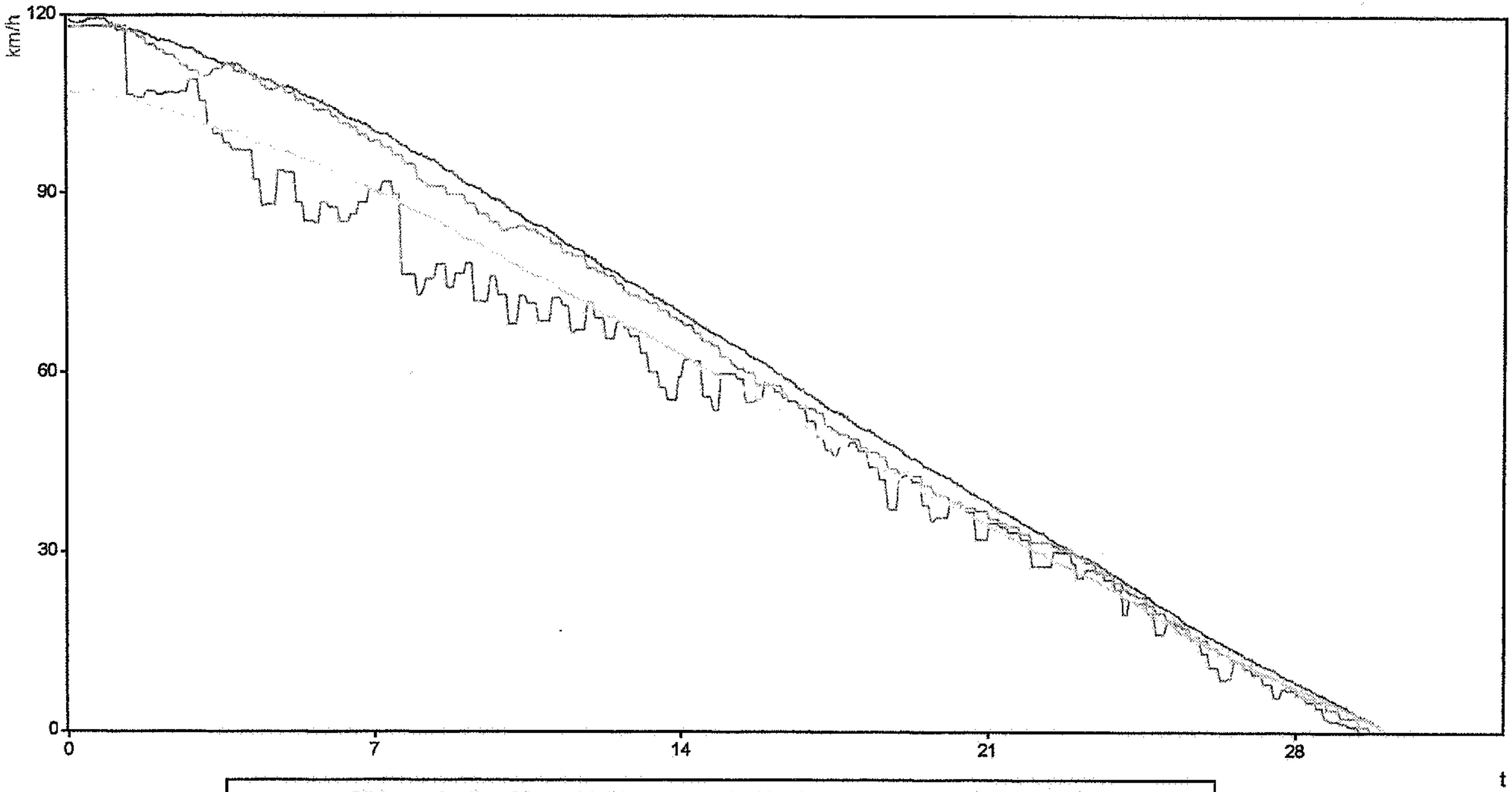

m/s²
-1,6
-1,2
-0,8
-0,4
0
0,4
0
7
14
21
28
t
Efficiency = 92,1%
Antislide efficiency calculation 31mar11 (Emergency by Mushroom) - Ta = 0,058 - Distance increase = 16,85%
train acceleration
train acceleration


M4_31_mar_11
16
14
12
10
8
6
4
2
0
-2
Speed [km/h]
0
10
20
30
40
50
Time [s]
SPEEDRIF [Kmh]
WSP_SPEED1 [Kmh]
WSP_SPEED2 [Kmh]
WSP_SPEED3 [Kmh]
WSP_SPEED4 [Kmh]
TRACTION [Digital]
BRAKE [Digital]
SOCCORSO [Digital]
SLIDE [Digital]


31 March Test 11
Pressure
12
11
10
9
8
7
6
5
4
3
2
1
0
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
Time
M.P. bar
BRAKE PIPE M1C bar
BRAKE PIPE T3 bar
BRAKE PIPE M4C bar
axle 1 T bar
axle 2 M bar
axle 3 M bar
axle 4 T bar
axle 5 T bar
axle 6 T bar
axle 7 T bar
axle 8 M bar
axle 9 M bar
axle 10 T bar
Brake signal V

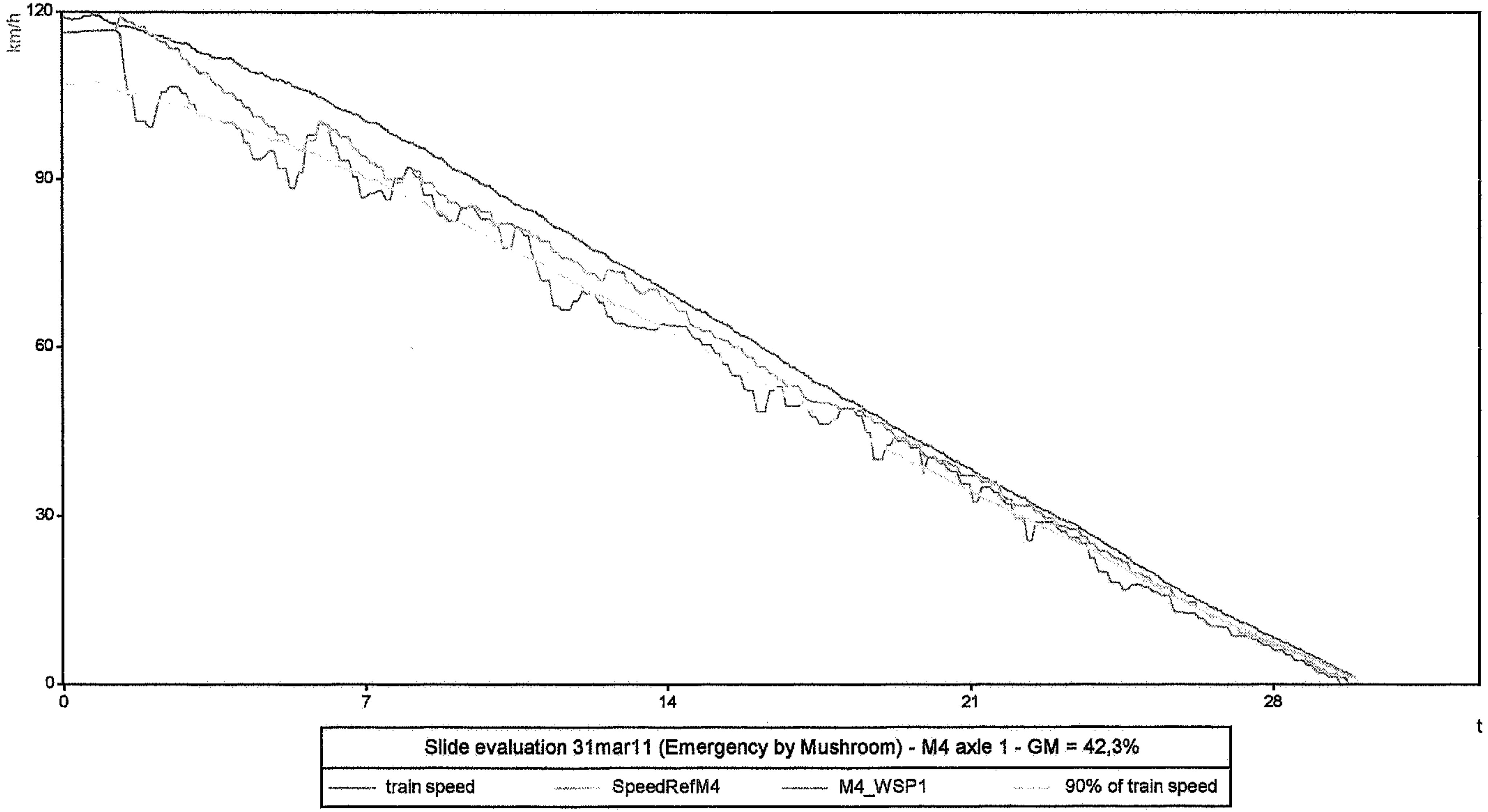


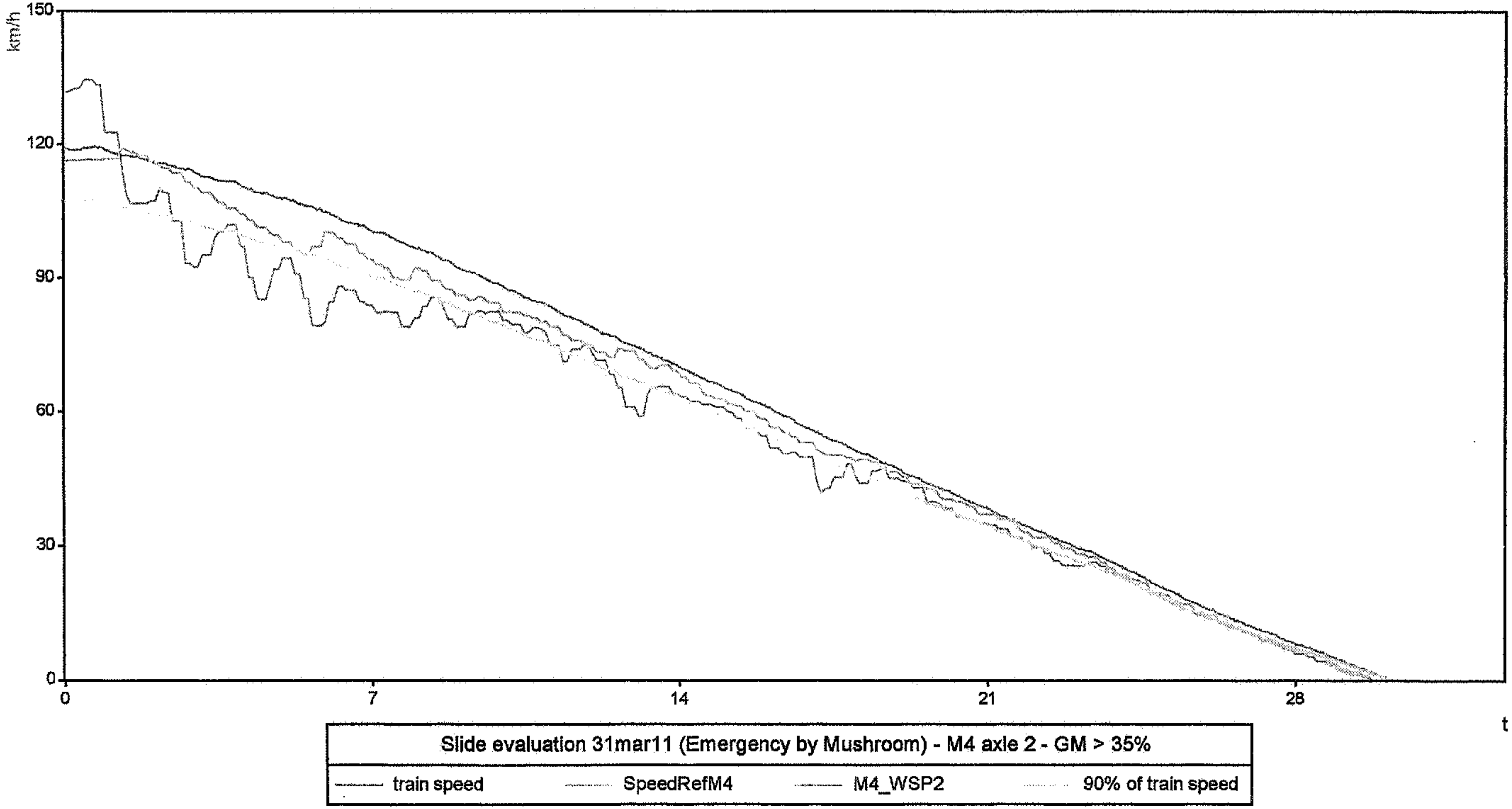
120
90
60
30
0
km/h
0
7
14
21
28
t
Slide evaluation 31mar11 (Emergency by Mushroom) - T3 axle 1 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP1
90% of train speed

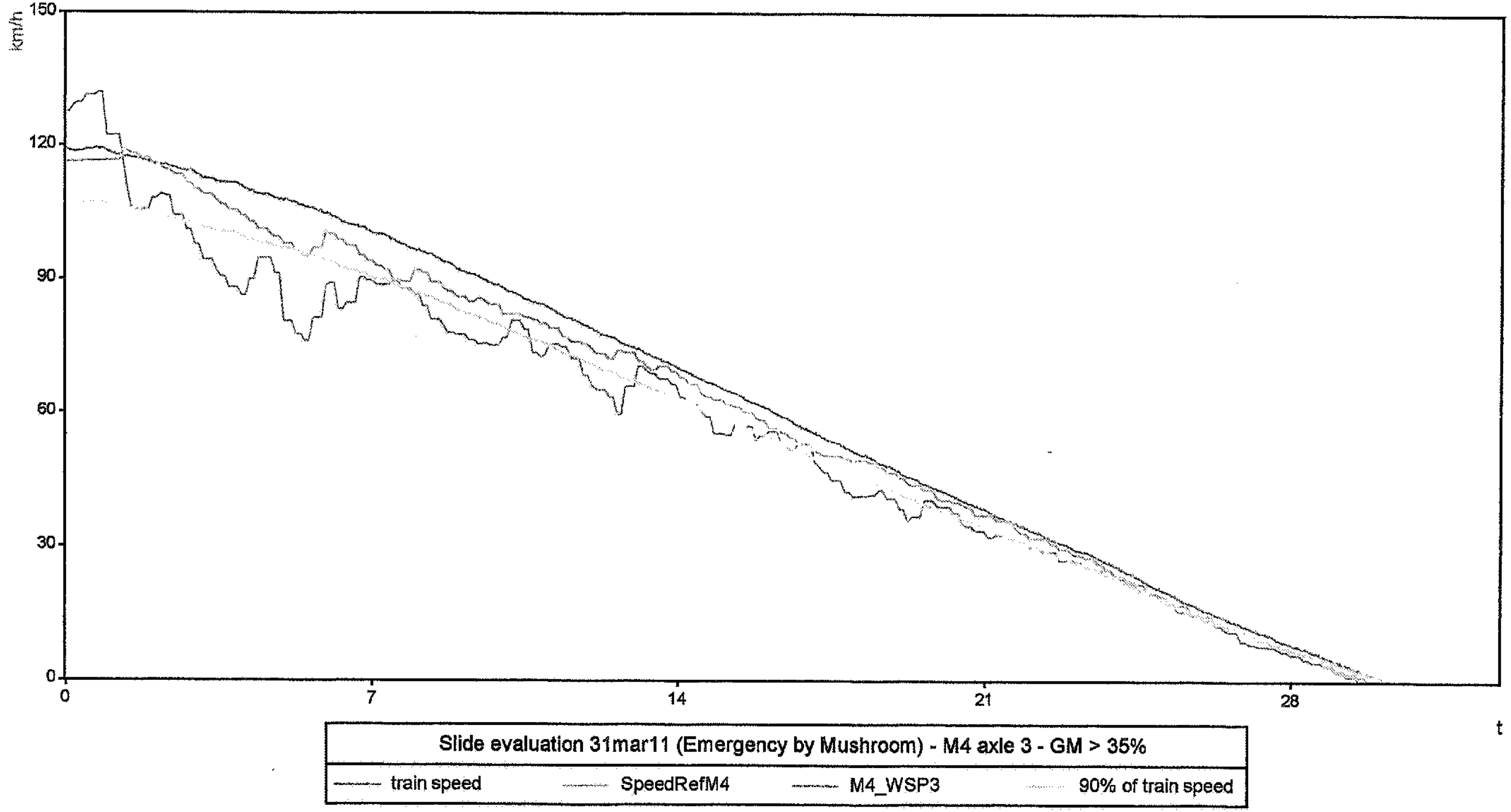


Slide evaluation 31mar11 (Emergency by Mushroom) - M1 axle 1 - GM > 35%

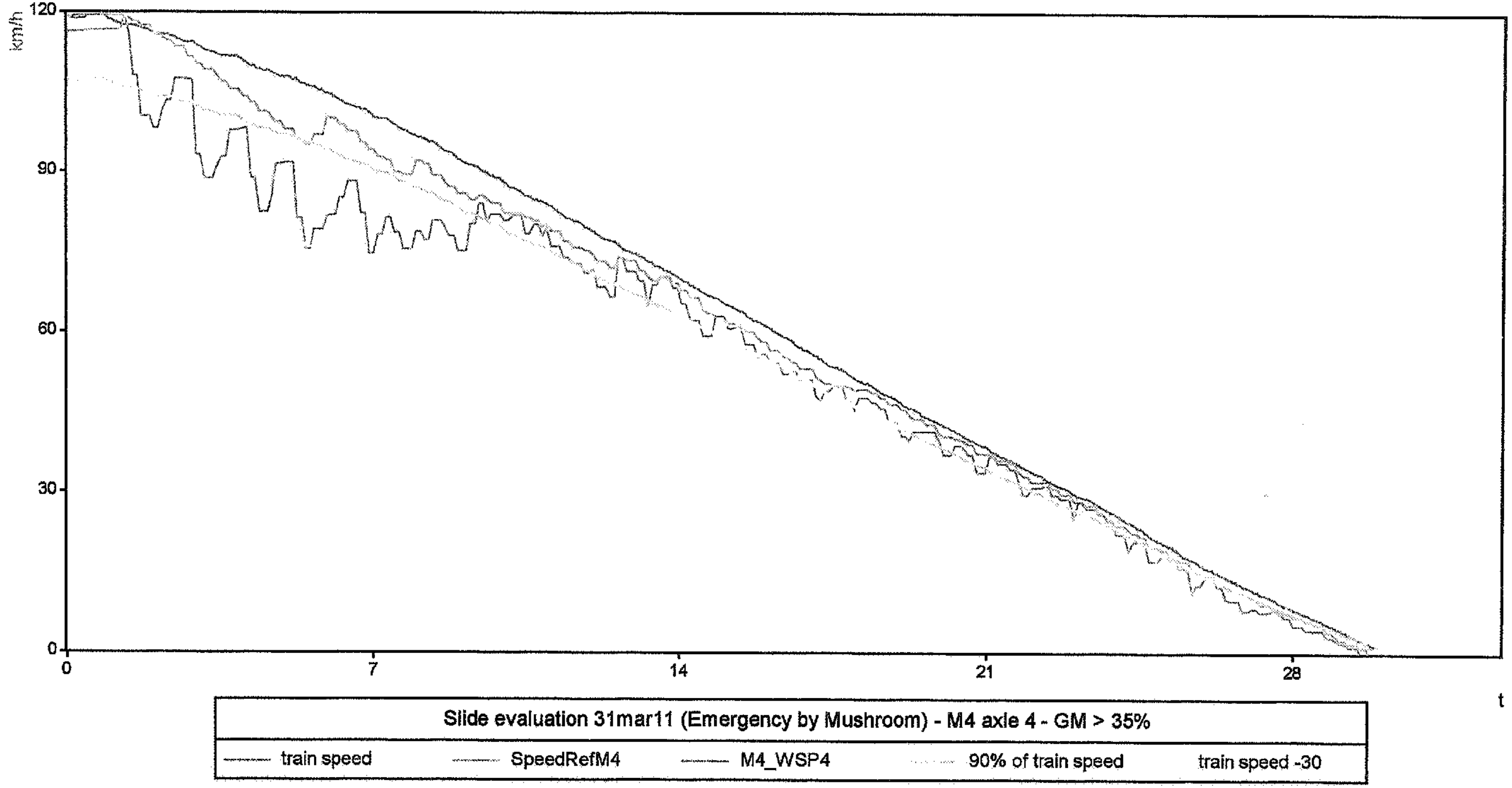
train speed　SpeedRefM1　M1_WSP1　90% of train speed

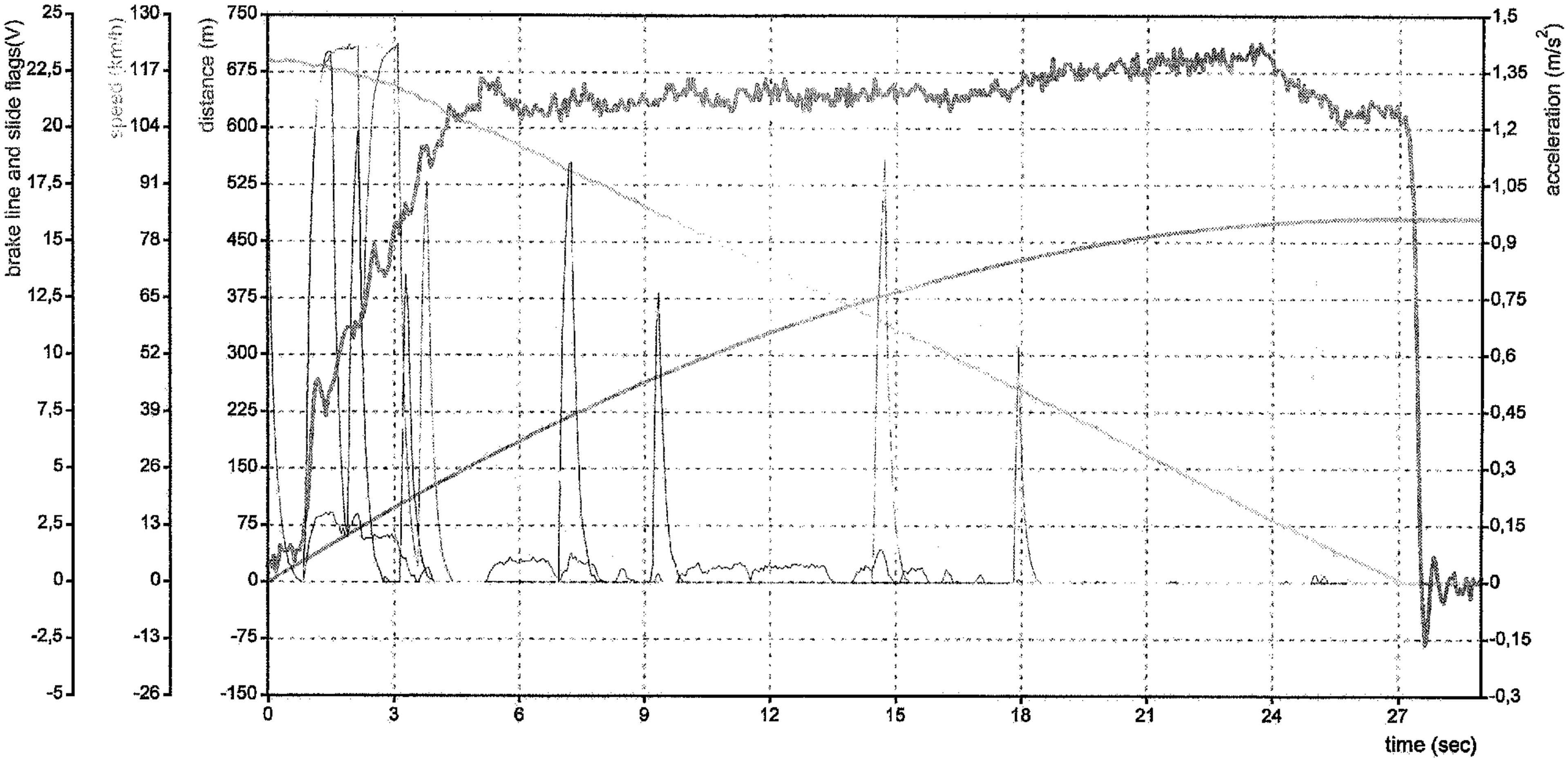

km/h
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 31mar11 (Emergency by Mushroom) - M4 axle 1 - GM = 42,3%
train speed
SpeedRefM4
M4_WSP1
90% of train speed


km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 31mar11 (Emergency by Mushroom) - M4 axle 2 - GM > 35%
train speed
SpeedRefM4
M4_WSP2
90% of train speed



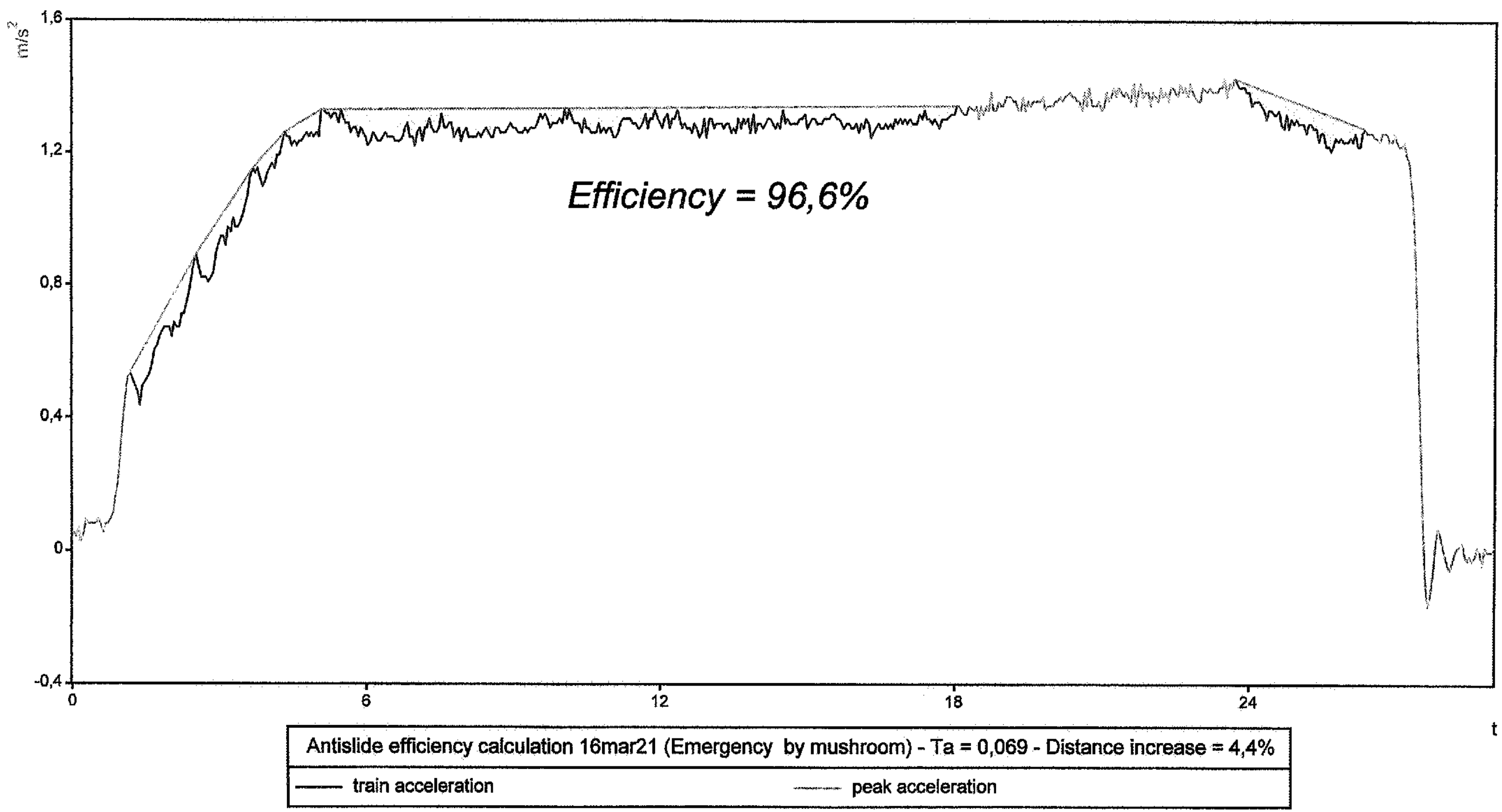
km/h
150
120
90
60
30
0
0
7
14
21
28
t
Slide evaluation 31mar11 (Emergency by Mushroom) - M4 axle 3 - GM > 35%
train speed
SpeedRefM4
M4_WSP3
90% of train speed


120
km/h
90
60
30
0
0
7
14
21
28
t
Slide evaluation 31mar11 (Emergency by Mushroom) - M4 axle 4 - GM > 35%
train speed
SpeedRefM4
M4_WSP4
90% of train speed
train speed -30

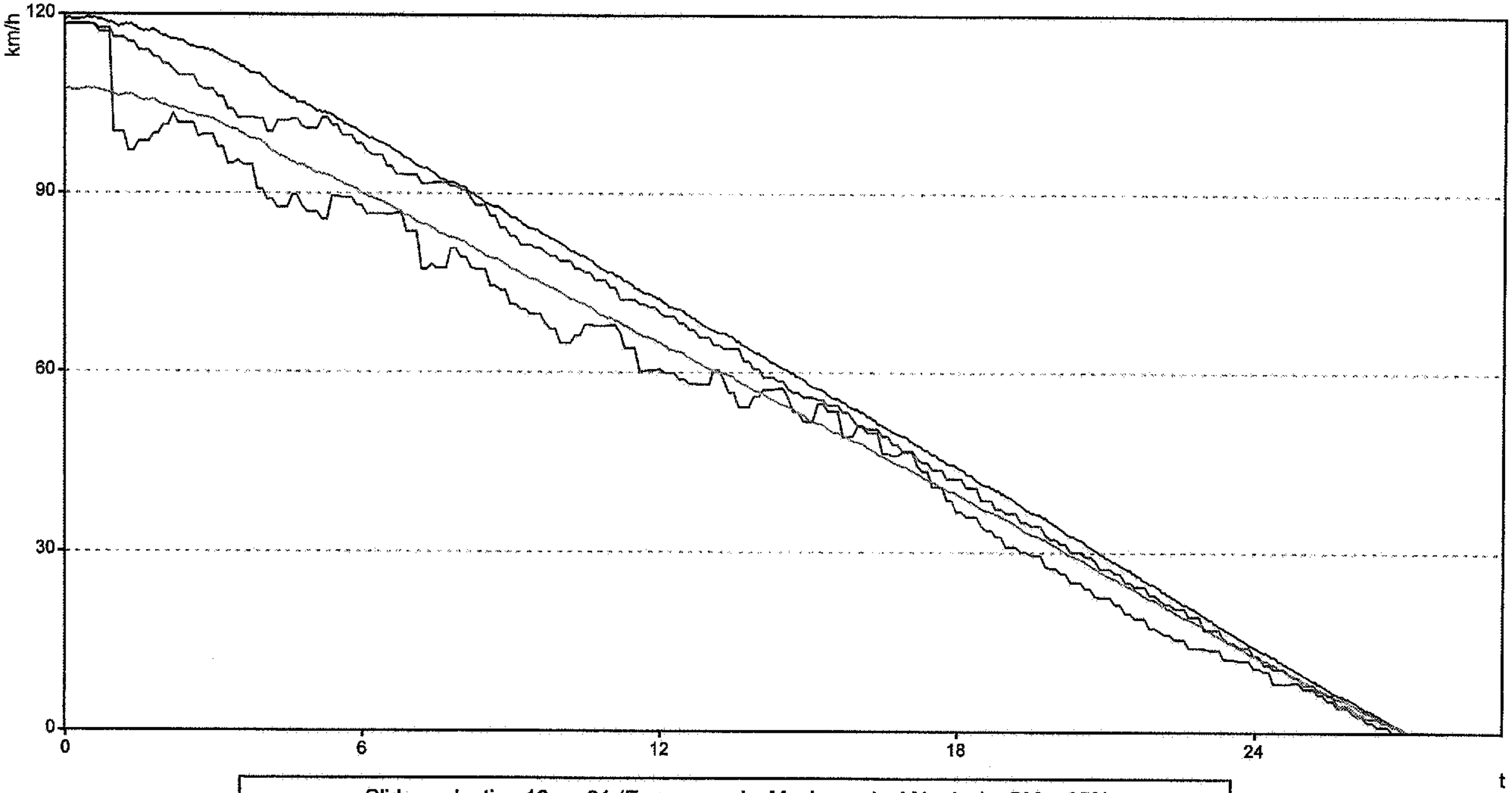


Emergency by Mushroom with soap from M1; initial speed = 119,39 km/h; stopp. distance = 481,59 m; mean dec = 1,14 m/s^2; File: 16mar21

speed	brake line	Slide flag T3	Slide flag M1
distance	acceleration	slide flag M4	

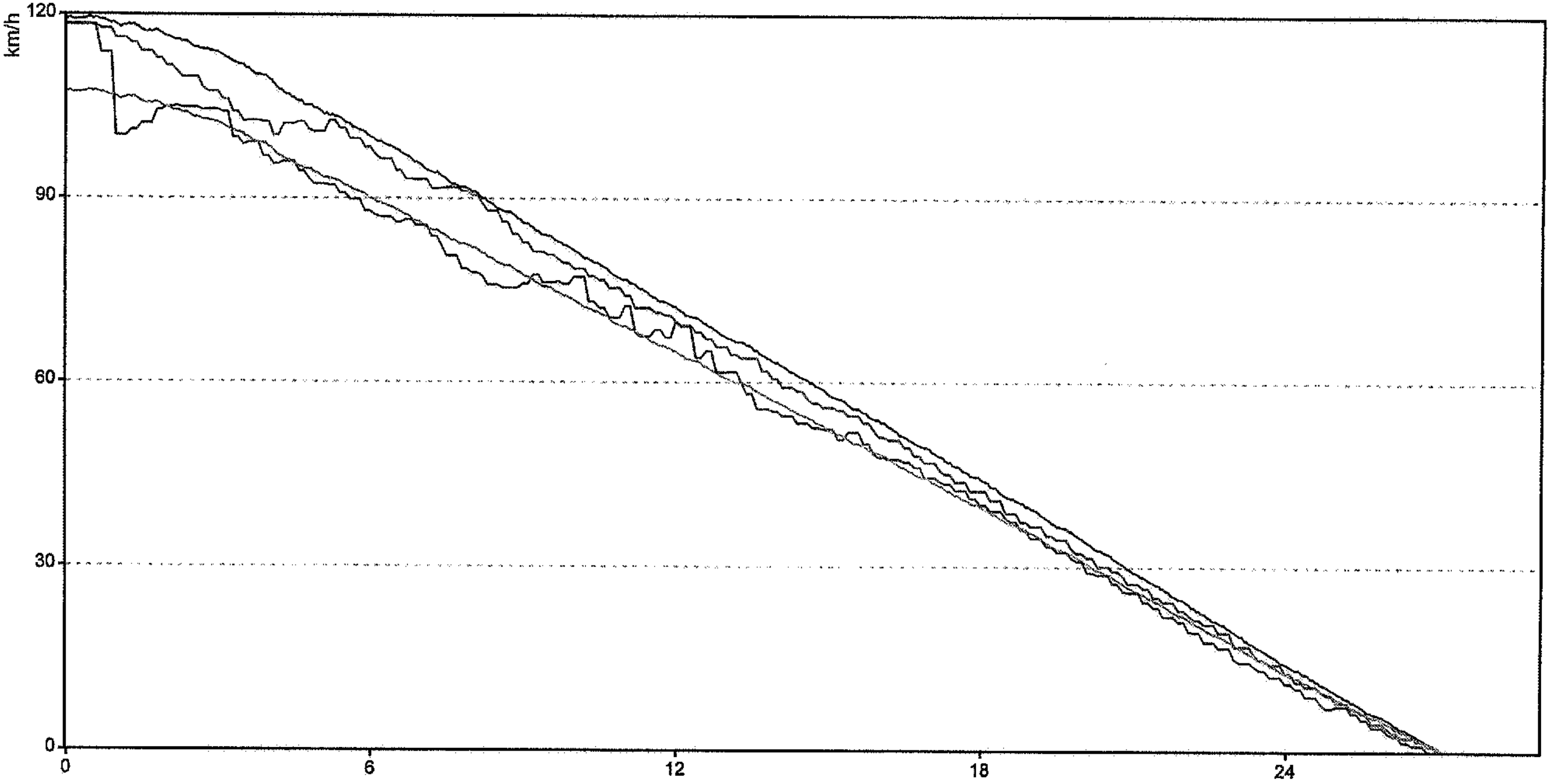


m/s²
1,6
1,2
0,8
0,4
0
-0,4
0
6
12
18
24
t
Efficiency = 96,6%
Antislide efficiency calculation 16mar21 (Emergency by mushroom) - Ta = 0,069 - Distance increase = 4,4%
train acceleration
peak acceleration



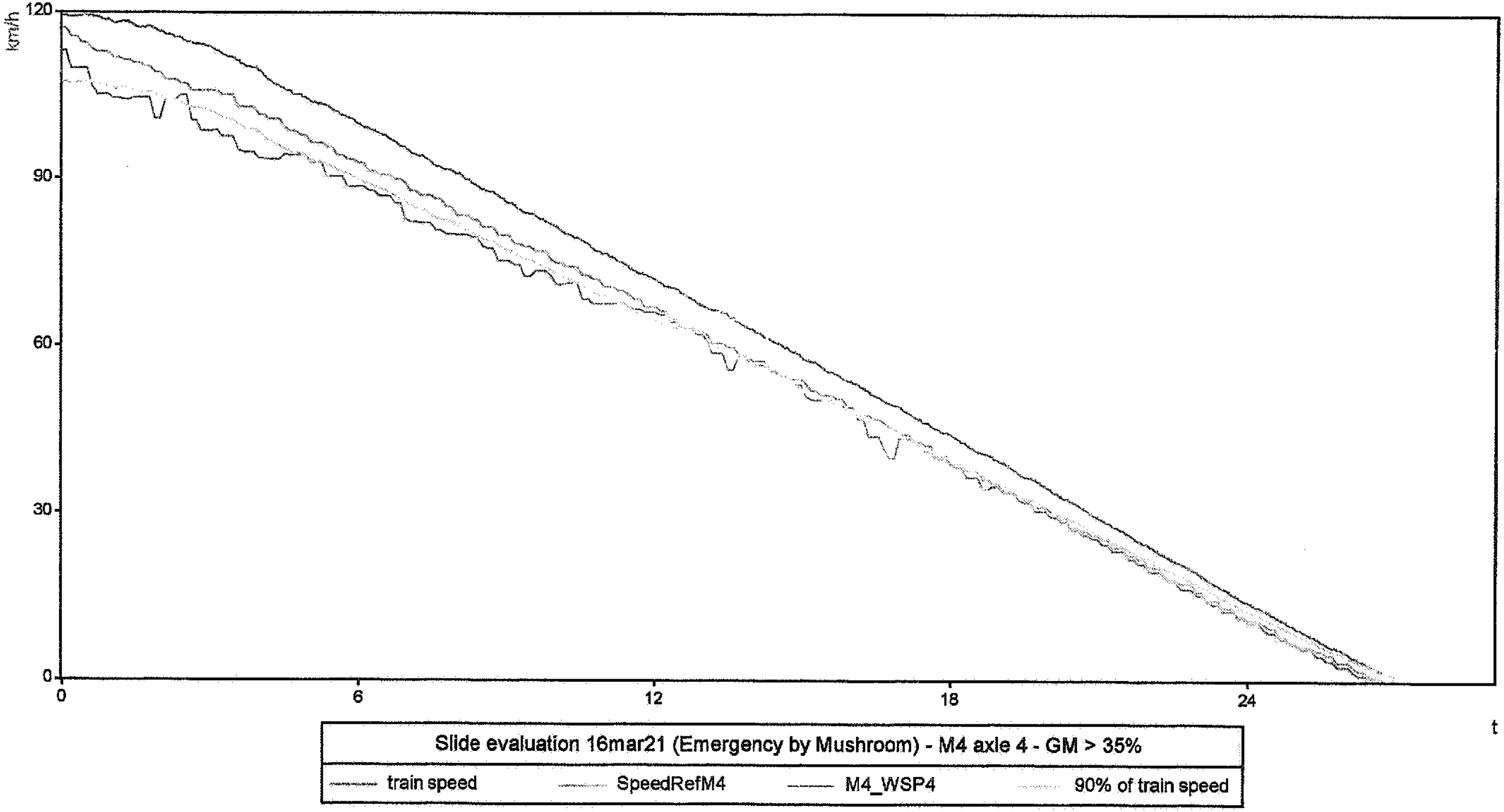
Slide evaluation 16mar21 (Emergency by Mushroom) - M1axle 1 - GM > 35%

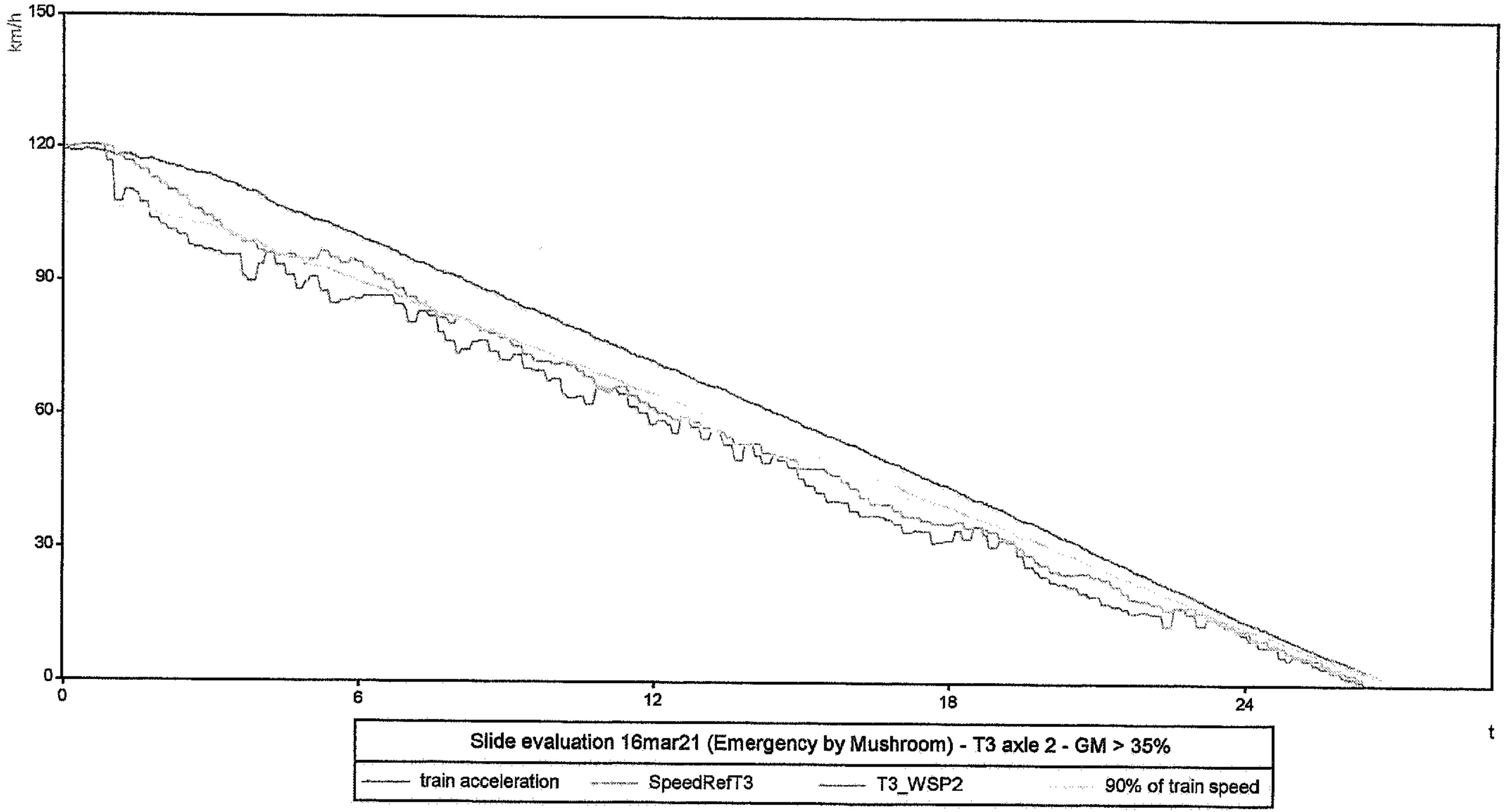
train speed	SpeedRefM1	M1_WSP1	90% of train speed

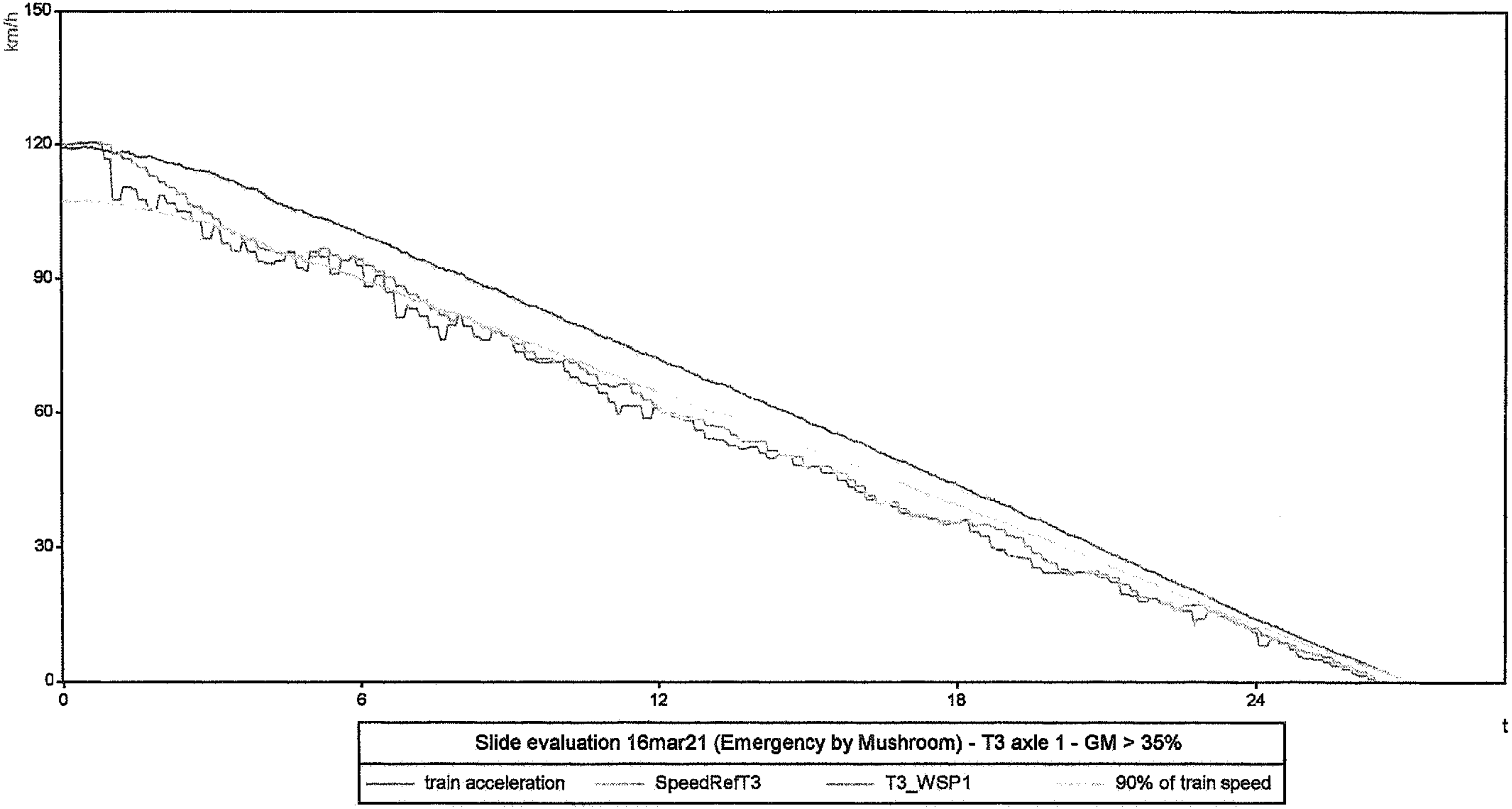


Slide evaluation 16mar21 (Emergency by Mushroom) - M1axle 2 - GM > 35%

train speed
SpeedRefM1
M1_WSP2
90% of train speed


km/h
120
90
60
30
0
0
6
12
18
24
t
Slide evaluation 16mar21 (Emergency by Mushroom) - M4 axle 4 - GM > 35%
train speed
SpeedRefM4
M4_WSP4
90% of train speed


km/h
150
120
90
60
30
0
0
6
12
18
24
t
Slide evaluation 16mar21 (Emergency by Mushroom) - T3 axle 2 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP2
90% of train speed



km/h
150
120
90
60
30
0
0
6
12
18
24
t
Slide evaluation 16mar21 (Emergency by Mushroom) - T3 axle 1 - GM > 35%
train acceleration
SpeedRefT3
T3_WSP1
90% of train speed

Vej/km	Tid	V [km/t]	ATC V	BL	K/B pos	Balise	TL Br(	TL N	MG-br(	Trækkraft udk.	ATC n(	ATC dr	Aks(	Aks(	Aks(	Aks	Aks	Aks	Aks(	Aks	Aks	Aks	Hjulbloke	Hjulslip
		Hastighe	ATC has	BrLeT	PosKB	br	k	l	m	n	s	t	D	E	F	G	H	I	K	L	M	N	a	b
577,002	07-11-11 15:15:58	179	179	4,9	13	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,009	07-11-11 15:15:58	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,039	07-11-11 15:15:59	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,039	07-11-11 15:15:59	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,071	07-11-11 15:15:59	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,081	07-11-11 15:15:59	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,093	07-11-11 15:16:00	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,101	07-11-11 15:16:00	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,101	07-11-11 15:16:00	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,126	07-11-11 15:16:00	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,131	07-11-11 15:16:00	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,131	07-11-11 15:16:00	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,143	07-11-11 15:16:01	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,160	07-11-11 15:16:01	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,160	07-11-11 15:16:01	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,180	07-11-11 15:16:01	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,188	07-11-11 15:16:02	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,222	07-11-11 15:16:02	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,247	07-11-11 15:16:03	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,277	07-11-11 15:16:03	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,307	07-11-11 15:16:04	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,339	07-11-11 15:16:05	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,361	07-11-11 15:16:05	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,369	07-11-11 15:16:05	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,379	07-11-11 15:16:05	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,391	07-11-11 15:16:06	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,391	07-11-11 15:16:06	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,398	07-11-11 15:16:06	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,406	07-11-11 15:16:06	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,408	07-11-11 15:16:06	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,428	07-11-11 15:16:06	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,441	07-11-11 15:16:07	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,458	07-11-11 15:16:07	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,478	07-11-11 15:16:07	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,488	07-11-11 15:16:08	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,488	07-11-11 15:16:08	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,500	07-11-11 15:16:08	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,508	07-11-11 15:16:08	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,520	07-11-11 15:16:08	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,530	07-11-11 15:16:09	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,537	07-11-11 15:16:09	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,550	07-11-11 15:16:09	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,580	07-11-11 15:16:09	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,585	07-11-11 15:16:10	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,612	07-11-11 15:16:10	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,642	07-11-11 15:16:11	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,672	07-11-11 15:16:11	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,672	07-11-11 15:16:11	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,702	07-11-11 15:16:12	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,727	07-11-11 15:16:12	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,764	07-11-11 15:16:13	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,769	07-11-11 15:16:13	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0

577,789	07-11-11 15:16:14	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,819	07-11-11 15:16:14	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,849	07-11-11 15:16:15	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,849	07-11-11 15:16:15	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,861	07-11-11 15:16:15	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,879	07-11-11 15:16:15	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,879	07-11-11 15:16:15	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,909	07-11-11 15:16:16	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,909	07-11-11 15:16:16	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,916	07-11-11 15:16:16	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,929	07-11-11 15:16:16	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,934	07-11-11 15:16:17	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,941	07-11-11 15:16:17	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,971	07-11-11 15:16:17	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,971	07-11-11 15:16:17	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,971	07-11-11 15:16:17	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,984	07-11-11 15:16:18	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,001	07-11-11 15:16:18	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,034	07-11-11 15:16:19	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,039	07-11-11 15:16:19	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,051	07-11-11 15:16:19	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,059	07-11-11 15:16:19	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,069	07-11-11 15:16:19	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,081	07-11-11 15:16:20	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,094	07-11-11 15:16:20	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,104	07-11-11 15:16:20	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,116	07-11-11 15:16:20	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,124	07-11-11 15:16:20	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,136	07-11-11 15:16:21	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,149	07-11-11 15:16:21	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,166	07-11-11 15:16:21	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,171	07-11-11 15:16:21	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,179	07-11-11 15:16:21	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,209	07-11-11 15:16:22	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,209	07-11-11 15:16:22	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,229	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,234	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,241	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,241	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,259	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,271	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,271	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,281	07-11-11 15:16:24	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,289	07-11-11 15:16:24	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,301	07-11-11 15:16:24	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,321	07-11-11 15:16:24	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,326	07-11-11 15:16:24	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,331	07-11-11 15:16:25	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,339	07-11-11 15:16:25	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,344	07-11-11 15:16:25	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,357	07-11-11 15:16:25	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,357	07-11-11 15:16:25	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,369	07-11-11 15:16:25	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,387	07-11-11 15:16:26	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0

578,419	07-11-11 15:16:26	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,419	07-11-11 15:16:26	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,450	07-11-11 15:16:27	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,482	07-11-11 15:16:27	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,487	07-11-11 15:16:28	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,500	07-11-11 15:16:28	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,505	07-11-11 15:16:28	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,512	07-11-11 15:16:28	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,530	07-11-11 15:16:28	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,543	07-11-11 15:16:29	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,555	07-11-11 15:16:29	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,555	07-11-11 15:16:29	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,573	07-11-11 15:16:29	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,578	07-11-11 15:16:29	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,590	07-11-11 15:16:30	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,598	07-11-11 15:16:30	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,620	07-11-11 15:16:30	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,628	07-11-11 15:16:30	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,628	07-11-11 15:16:30	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,633	07-11-11 15:16:31	181	181	4,9	12	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,638	07-11-11 15:16:31	181	181	4,9	12	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,646	07-11-11 15:16:31	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,653	07-11-11 15:16:31	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,653	07-11-11 15:16:31	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,658	07-11-11 15:16:31	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,658	07-11-11 15:16:31	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,666	07-11-11 15:16:31	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,683	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,691	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,696	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,708	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,708	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,716	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,721	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,726	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,731	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,738	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,746	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,746	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,751	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,756	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,761	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,761	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,776	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,776	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,781	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,781	07-11-11 15:16:34	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,789	07-11-11 15:16:34	181	181	4,9	0	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,794	07-11-11 15:16:34	181	181	4,9	0	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,794	07-11-11 15:16:34	181	181	4,9	-1	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,806	07-11-11 15:16:34	181	181	4,9	-1	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,806	07-11-11 15:16:34	181	181	4,9	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,814	07-11-11 15:16:34	180	181	4,9	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,814	07-11-11 15:16:34	180	181	4,8	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0

578,814	07-11-11 15:16:34	180	181	4,8	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,814	07-11-11 15:16:34	180	181	4,8	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,814	07-11-11 15:16:34	180	181	4,8	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,826	07-11-11 15:16:34	180	181	4,8	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,836	07-11-11 15:16:35	180	181	4,7	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,836	07-11-11 15:16:35	180	181	4,7	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,844	07-11-11 15:16:35	180	181	4,7	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,844	07-11-11 15:16:35	180	181	4,7	-2	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	1	0	0
578,844	07-11-11 15:16:35	180	181	4,7	-2	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	1	0	0
578,849	07-11-11 15:16:35	180	181	4,6	-2	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	1	0	0
578,856	07-11-11 15:16:35	180	181	4,6	-2	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	1	0	0
578,864	07-11-11 15:16:35	180	181	4,5	-2	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	1	0	0
578,869	07-11-11 15:16:35	180	181	4,5	-2	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	1	0	0
578,869	07-11-11 15:16:35	180	181	4,5	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
578,874	07-11-11 15:16:35	180	181	4,4	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
578,874	07-11-11 15:16:35	180	181	4,4	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
578,886	07-11-11 15:16:36	180	181	4,4	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
578,886	07-11-11 15:16:36	180	181	4,4	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
578,893	07-11-11 15:16:36	180	181	4,4	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
578,898	07-11-11 15:16:36	179	181	4,4	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
578,898	07-11-11 15:16:36	179	181	4,3	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
578,918	07-11-11 15:16:36	179	181	4,3	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
578,923	07-11-11 15:16:36	179	181	4,3	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
578,923	07-11-11 15:16:36	179	181	4,3	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,930	07-11-11 15:16:36	178	181	4,3	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,935	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,935	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,943	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,953	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,953	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,958	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,965	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,965	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,977	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,977	07-11-11 15:16:38	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,985	07-11-11 15:16:38	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,985	07-11-11 15:16:38	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,989	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,989	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,989	07-11-11 15:16:38	177	181	4,2	-2	1	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,994	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,994	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
578,994	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,002	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,002	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,007	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,012	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,012	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,012	07-11-11 15:16:38	177	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,019	07-11-11 15:16:38	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,019	07-11-11 15:16:38	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,024	07-11-11 15:16:38	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,031	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,041	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0

579,048	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,048	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,048	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,060	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,070	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,077	07-11-11 15:16:39	175	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,077	07-11-11 15:16:40	175	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,089	07-11-11 15:16:40	175	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,094	07-11-11 15:16:40	175	181	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,102	07-11-11 15:16:40	175	181	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,102	07-11-11 15:16:40	175	181	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,106	07-11-11 15:16:40	175	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,106	07-11-11 15:16:40	175	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,114	07-11-11 15:16:40	174	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,114	07-11-11 15:16:40	174	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,118	07-11-11 15:16:40	174	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,126	07-11-11 15:16:40	174	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,133	07-11-11 15:16:41	174	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,133	07-11-11 15:16:41	174	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,138	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,138	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,147	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,154	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,159	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,159	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,166	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,171	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,171	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,176	07-11-11 15:16:42	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,188	07-11-11 15:16:42	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,195	07-11-11 15:16:42	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,195	07-11-11 15:16:42	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,200	07-11-11 15:16:42	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,207	07-11-11 15:16:42	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,219	07-11-11 15:16:42	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,231	07-11-11 15:16:43	172	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,236	07-11-11 15:16:43	172	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,243	07-11-11 15:16:43	172	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,243	07-11-11 15:16:43	172	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,248	07-11-11 15:16:43	172	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,252	07-11-11 15:16:43	172	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,259	07-11-11 15:16:43	171	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,259	07-11-11 15:16:43	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,271	07-11-11 15:16:43	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,271	07-11-11 15:16:44	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,271	07-11-11 15:16:44	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,278	07-11-11 15:16:44	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,283	07-11-11 15:16:44	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,288	07-11-11 15:16:44	170	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,300	07-11-11 15:16:44	170	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,300	07-11-11 15:16:44	170	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,309	07-11-11 15:16:44	170	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	1	0
579,309	07-11-11 15:16:44	170	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	1	0
579,318	07-11-11 15:16:44	170	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	1	0

579,318	07-11-11 15:16:45	170	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,328	07-11-11 15:16:45	170	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,340	07-11-11 15:16:45	170	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,340	07-11-11 15:16:45	170	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,347	07-11-11 15:16:45	169	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,347	07-11-11 15:16:45	169	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,358	07-11-11 15:16:45	169	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,358	07-11-11 15:16:45	169	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,363	07-11-11 15:16:46	169	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,363	07-11-11 15:16:46	169	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,375	07-11-11 15:16:46	169	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
579,379	07-11-11 15:16:46	169	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
579,379	07-11-11 15:16:46	169	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
579,407	07-11-11 15:16:46	168	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
579,414	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,414	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,419	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,431	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,431	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,431	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,435	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,442	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,442	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	1	0
579,442	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	1	0
579,459	07-11-11 15:16:48	168	148	4	-3	0	0	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	1	0
579,459	07-11-11 15:16:48	168	148	4	-3	0	0	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	1	0
579,459	07-11-11 15:16:48	168	148	4	-4	0	0	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	1	0
579,466	07-11-11 15:16:48	168	148	4	-4	0	0	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	1	0
579,470	07-11-11 15:16:48	167	148	4	-4	0	0	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	1	0
579,470	07-11-11 15:16:48	167	148	4	-4	0	0	1	0	0	1	0	1	0	1	0	1	0	1	1	1	0	1	0
579,486	07-11-11 15:16:48	167	148	4	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,486	07-11-11 15:16:48	167	148	4	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,486	07-11-11 15:16:48	167	148	4	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,500	07-11-11 15:16:48	167	148	4	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,505	07-11-11 15:16:48	167	148	3,9	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,505	07-11-11 15:16:49	167	148	3,9	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,509	07-11-11 15:16:49	167	148	3,9	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,516	07-11-11 15:16:49	167	148	3,9	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,527	07-11-11 15:16:49	158	148	3,9	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,527	07-11-11 15:16:49	158	148	3,8	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,527	07-11-11 15:16:49	158	148	3,8	-4	0	0	1	0	0	1	0	1	0	1	0	1	0	1	1	1	0	1	0
579,527	07-11-11 15:16:49	158	148	3,8	-4	0	0	1	0	0	1	0	1	0	1	0	1	0	1	1	1	0	1	0
579,531	07-11-11 15:16:49	158	148	3,8	-4	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,535	07-11-11 15:16:49	158	148	3,8	-4	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,545	07-11-11 15:16:50	158	148	3,8	-4	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,556	07-11-11 15:16:50	158	148	3,8	-4	0	0	1	0	0	1	0	0	1	1	0	0	0	1	1	1	0	1	0
579,560	07-11-11 15:16:50	141	148	3,8	-4	0	0	1	0	0	1	0	0	1	1	0	0	0	1	1	1	0	1	0
579,581	07-11-11 15:16:50	141	148	3,8	-4	0	0	1	0	0	1	0	0	0	1	0	0	0	1	1	1	0	1	0
579,591	07-11-11 15:16:51	150	148	3,8	-4	0	0	1	0	0	1	0	0	0	1	0	0	0	1	1	1	0	1	0
579,598	07-11-11 15:16:51	150	148	3,8	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,598	07-11-11 15:16:51	150	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,602	07-11-11 15:16:51	150	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,606	07-11-11 15:16:51	150	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,616	07-11-11 15:16:51	150	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0

579,616	07-11-11 15:16:51	150	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,616	07-11-11 15:16:51	150	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0
579,624	07-11-11 15:16:51	142	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0
579,624	07-11-11 15:16:51	142	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0
579,636	07-11-11 15:16:52	142	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	1	1	0	1	1	1	0	1	0
579,643	07-11-11 15:16:52	142	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0
579,648	07-11-11 15:16:52	125	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0
579,657	07-11-11 15:16:52	125	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,657	07-11-11 15:16:52	125	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,664	07-11-11 15:16:53	125	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,664	07-11-11 15:16:53	125	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,670	07-11-11 15:16:53	125	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,679	07-11-11 15:16:53	135	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,679	07-11-11 15:16:53	135	148	3,7	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,693	07-11-11 15:16:53	135	148	3,7	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0
579,703	07-11-11 15:16:54	135	148	3,7	-5	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,703	07-11-11 15:16:54	135	148	3,7	-5	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,707	07-11-11 15:16:54	144	148	3,7	-5	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,707	07-11-11 15:16:54	144	148	3,7	-5	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,727	07-11-11 15:16:54	144	148	3,7	-5	0	0	1	0	0	1	0	0	1	1	0	0	1	1	1	1	0	1	0
579,732	07-11-11 15:16:54	144	148	3,7	-5	0	0	1	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	0
579,738	07-11-11 15:16:54	153	148	3,7	-5	0	0	1	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	0
579,738	07-11-11 15:16:54	153	148	3,7	-5	0	0	1	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	0
579,743	07-11-11 15:16:55	153	148	3,7	-5	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	0	1	0
579,743	07-11-11 15:16:55	153	148	3,7	-6	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	0	1	0
579,749	07-11-11 15:16:55	153	148	3,7	-6	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	0	1	0
579,767	07-11-11 15:16:55	139	148	3,7	-6	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	0	1	0
579,767	07-11-11 15:16:55	139	148	3,7	-6	0	0	1	0	0	1	0	0	0	1	0	1	1	1	1	1	0	1	0
579,775	07-11-11 15:16:55	139	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	0	1	0
579,780	07-11-11 15:16:55	139	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	0	1	0
579,780	07-11-11 15:16:56	139	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0
579,783	07-11-11 15:16:56	109	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0
579,788	07-11-11 15:16:56	109	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,788	07-11-11 15:16:56	109	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,788	07-11-11 15:16:56	109	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,791	07-11-11 15:16:56	109	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,791	07-11-11 15:16:56	109	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,798	07-11-11 15:16:56	110	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,798	07-11-11 15:16:56	110	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	1	0	0	0	1	0
579,806	07-11-11 15:16:56	110	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	0	1	0
579,809	07-11-11 15:16:57	110	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	1	1	0
579,812	07-11-11 15:16:57	113	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	1	1	0
579,817	07-11-11 15:16:57	113	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	1	1	0
579,828	07-11-11 15:16:57	118	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	1	1	0
579,828	07-11-11 15:16:57	118	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	1	1	0
579,846	07-11-11 15:16:58	118	148	3,7	-6	0	0	1	0	0	1	0	1	0	0	1	1	1	1	0	0	1	1	0
579,846	07-11-11 15:16:58	118	148	3,7	-6	0	0	1	0	0	1	0	1	0	0	1	1	1	1	0	0	1	1	0
579,851	07-11-11 15:16:58	118	148	3,7	-6	0	0	1	0	0	1	0	1	0	0	1	1	1	1	0	0	0	1	0
579,854	07-11-11 15:16:58	118	148	3,7	-6	0	0	1	0	0	1	1	1	0	0	1	1	1	1	0	0	0	1	0
579,860	07-11-11 15:16:58	127	148	3,7	-6	0	0	1	0	0	1	1	1	0	0	1	1	1	1	0	0	0	1	0
579,867	07-11-11 15:16:58	127	148	3,7	-6	0	0	1	0	0	1	1	1	0	0	1	1	1	0	0	0	1	1	0
579,871	07-11-11 15:16:58	127	148	3,7	-6	0	0	1	0	0	1	1	0	0	0	1	0	1	0	0	0	0	1	0
579,880	07-11-11 15:16:59	127	148	3,7	-6	0	0	1	0	0	1	1	0	0	0	1	0	1	0	0	0	0	1	0
579,890	07-11-11 15:16:59	138	148	3,7	-6	0	0	1	0	0	1	1	0	0	0	1	0	1	0	0	0	0	1	0

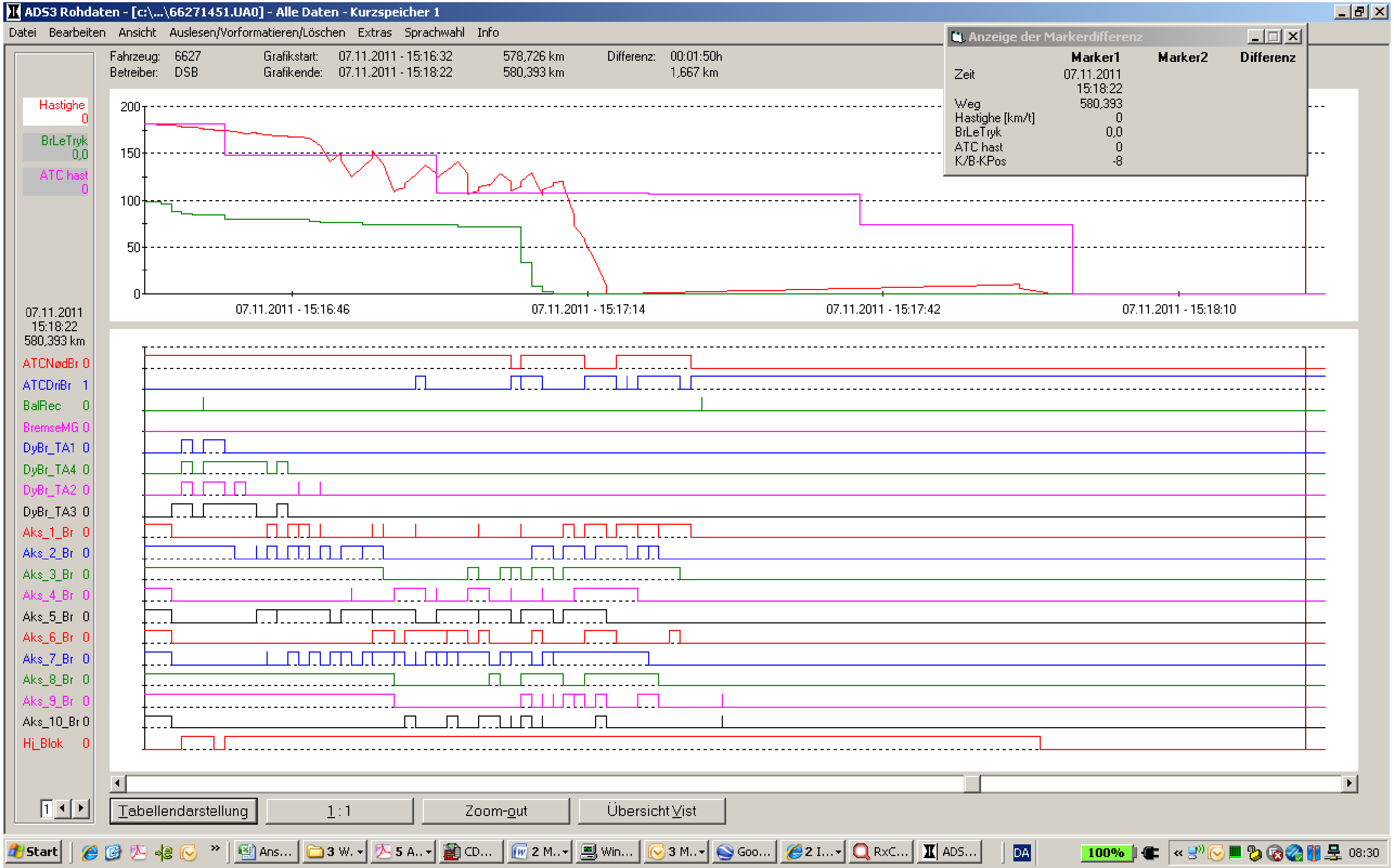
579,890	07-11-11 15:16:59	138	148	3,7	-6	0	0	1	0	0	1	1	0	0	0	1	0	1	1	0	0	0	1	0
579,904	07-11-11 15:16:59	138	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	0	1	1	0	0	0	1	0
579,904	07-11-11 15:16:59	138	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0	1	0
579,904	07-11-11 15:16:59	138	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0	1	0
579,909	07-11-11 15:16:59	138	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0	1	0
579,918	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0	1	0
579,918	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0	1	0
579,918	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0
579,918	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0
579,927	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,930	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0
579,938	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	1	0
579,938	07-11-11 15:17:00	128	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	1	0
579,944	07-11-11 15:17:00	128	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	1	0
579,947	07-11-11 15:17:00	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	1	0
579,947	07-11-11 15:17:00	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	1	0
579,952	07-11-11 15:17:01	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0
579,952	07-11-11 15:17:01	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0
579,961	07-11-11 15:17:01	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0
579,961	07-11-11 15:17:01	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0
579,965	07-11-11 15:17:01	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	0
579,974	07-11-11 15:17:01	124	107	3,7	-7	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	0
579,977	07-11-11 15:17:01	132	107	3,7	-7	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	0
579,977	07-11-11 15:17:01	132	107	3,7	-7	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	0
579,983	07-11-11 15:17:01	132	107	3,7	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	1	1	0
579,987	07-11-11 15:17:02	132	107	3,7	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	1	0
579,996	07-11-11 15:17:02	132	107	3,7	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0
580,002	07-11-11 15:17:02	132	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0
580,010	07-11-11 15:17:02	141	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0
580,020	07-11-11 15:17:02	141	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	1	0
580,039	07-11-11 15:17:03	128	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	1	0
580,043	07-11-11 15:17:03	128	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	0	1	0	1	0	0	0	1	0
580,054	07-11-11 15:17:03	106	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	0	1	0	1	0	0	0	1	0
580,054	07-11-11 15:17:03	106	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	1	1	0	1	0	0	0	1	0
580,061	07-11-11 15:17:04	106	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	1	0	0	1	0	0	1	1	0
580,061	07-11-11 15:17:04	106	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	1	0	0	1	0	0	1	1	0
580,066	07-11-11 15:17:04	106	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	1	0	1	1	0	0	1	1	0
580,069	07-11-11 15:17:04	110	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	1	0	1	1	0	0	1	1	0
580,072	07-11-11 15:17:04	110	107	3,6	-7	0	0	1	0	0	1	0	1	0	0	1	0	1	1	0	0	1	1	0
580,077	07-11-11 15:17:04	110	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	1	0	1	1	0	0	1	1	0
580,082	07-11-11 15:17:04	114	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	1	0	1	1	0	0	1	1	0
580,086	07-11-11 15:17:04	114	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	1	1	1	1	0	0	1	1	0
580,093	07-11-11 15:17:05	114	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	1	1	0
580,097	07-11-11 15:17:05	114	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	1	1	0
580,101	07-11-11 15:17:05	117	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	1	1	0
580,105	07-11-11 15:17:05	117	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1	0	1	1	0
580,113	07-11-11 15:17:05	116	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1	0	1	1	0
580,113	07-11-11 15:17:05	116	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	1	1	0	0	1	0	1	1	0
580,116	07-11-11 15:17:05	116	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0	1	1	0
580,124	07-11-11 15:17:06	116	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	1	1	0
580,130	07-11-11 15:17:06	116	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	0
580,138	07-11-11 15:17:06	116	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	0	1	0	1	0	0	0	1	0
580,142	07-11-11 15:17:06	128	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	0	1	0	1	0	0	0	1	0
580,161	07-11-11 15:17:07	128	107	3,6	-7	0	0	1	0	0	1	1	0	0	1	0	1	0	1	0	0	0	1	0

580,161	07-11-11 15:17:07	128	107	3,6	-7	0	0	1	0	0	1	1	0	0	1	0	1	0	1	0	0	0	1	0
580,161	07-11-11 15:17:07	128	107	3,6	-7	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	1	1	0
580,173	07-11-11 15:17:07	120	107	3,6	-7	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	1	1	0
580,173	07-11-11 15:17:07	120	107	3,6	-7	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0
580,177	07-11-11 15:17:07	120	107	3,6	-7	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0
580,180	07-11-11 15:17:07	120	107	3,6	-7	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0
580,185	07-11-11 15:17:07	120	107	3,6	-7	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0
580,185	07-11-11 15:17:07	120	107	3,6	-7	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0
580,185	07-11-11 15:17:07	120	107	3,6	-7	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0
580,189	07-11-11 15:17:07	110	107	3,6	-7	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0
580,189	07-11-11 15:17:07	110	107	3,6	-7	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0
580,192	07-11-11 15:17:07	110	107	3,6	-7	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0
580,192	07-11-11 15:17:08	110	107	3,6	-7	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	1	1	0
580,192	07-11-11 15:17:08	110	107	3,6	-7	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	1	1	0
580,199	07-11-11 15:17:08	110	107	3,6	-7	0	0	1	0	0	1	1	0	0	1	0	0	0	1	0	0	1	1	0
580,199	07-11-11 15:17:08	110	107	3,6	-7	0	0	1	0	0	1	1	0	0	1	0	0	0	1	0	1	1	1	0
580,199	07-11-11 15:17:08	110	107	3,6	-7	0	0	1	0	0	1	1	0	0	1	0	0	0	1	0	1	1	1	0
580,203	07-11-11 15:17:08	115	107	3,6	-7	0	0	1	0	0	1	1	0	0	1	0	0	0	1	0	1	1	1	0
580,203	07-11-11 15:17:08	115	107	3,6	-7	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	1	1	0
580,203	07-11-11 15:17:08	115	107	1,7	-7	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	1	1	0
580,203	07-11-11 15:17:08	115	107	1,7	-8	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	1	1	0
580,212	07-11-11 15:17:08	115	107	1,7	-8	0	0	0	0	0	1	1	0	0	1	0	0	0	1	0	1	1	1	0
580,212	07-11-11 15:17:08	115	107	1,7	-8	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	1	1	1	0
580,212	07-11-11 15:17:08	115	107	1,7	-8	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	1	1	1	0
580,220	07-11-11 15:17:08	120	107	1,7	-8	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	1	1	1	0
580,220	07-11-11 15:17:08	120	107	1,7	-8	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	1	1	1	0
580,220	07-11-11 15:17:08	120	107	1,7	-8	0	0	0	0	0	1	1	0	0	0	0	1	0	1	1	1	1	1	0
580,223	07-11-11 15:17:09	120	107	1,7	-8	0	0	0	0	0	1	1	0	1	0	0	1	0	1	1	1	1	1	0
580,229	07-11-11 15:17:09	120	107	1,7	-8	0	0	0	0	0	1	1	0	1	0	0	1	0	1	1	1	1	1	0
580,232	07-11-11 15:17:09	120	107	1,7	-8	0	0	0	0	0	1	1	0	1	0	0	1	0	1	1	1	0	1	0
580,243	07-11-11 15:17:09	120	107	0,4	-8	0	0	0	0	0	1	1	0	1	0	0	1	0	1	1	1	0	1	0
580,243	07-11-11 15:17:09	120	107	0,4	-8	0	0	0	0	0	1	1	0	1	1	0	1	0	0	1	0	0	1	0
580,247	07-11-11 15:17:09	130	107	0,4	-8	0	0	0	0	0	1	1	0	1	1	0	1	0	0	1	0	0	1	0
580,247	07-11-11 15:17:09	130	107	0,4	-8	0	0	0	0	0	1	1	0	1	1	0	1	1	0	1	0	0	1	0
580,260	07-11-11 15:17:10	130	107	0,2	-8	0	0	0	0	0	1	1	0	1	1	0	1	1	0	1	0	0	1	0
580,260	07-11-11 15:17:10	130	107	0,2	-8	0	0	0	0	0	1	1	0	1	1	0	1	1	0	1	1	1	1	0
580,265	07-11-11 15:17:10	105	107	0,2	-8	0	0	0	0	0	1	1	0	1	1	0	1	1	0	1	1	1	1	0
580,265	07-11-11 15:17:10	105	107	0,2	-8	0	0	0	0	0	1	0	0	1	1	0	1	1	0	1	1	1	1	0
580,265	07-11-11 15:17:10	105	107	0,2	-8	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	0
580,265	07-11-11 15:17:10	105	107	0,2	-8	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	0
580,272	07-11-11 15:17:10	105	107	0,1	-8	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	0
580,272	07-11-11 15:17:10	105	107	0,1	-8	0	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	1	1	0
580,275	07-11-11 15:17:10	105	107	0,1	-8	0	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	0
580,280	07-11-11 15:17:10	111	107	0,1	-8	0	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	0
580,283	07-11-11 15:17:10	111	107	0,1	-8	0	0	0	0	0	1	0	0	1	1	0	1	0	1	1	0	0	1	0
580,294	07-11-11 15:17:11	116	107	0,1	-8	0	0	0	0	0	1	0	0	1	1	0	1	0	1	1	0	0	1	0
580,303	07-11-11 15:17:11	116	107	0,1	-8	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
580,303	07-11-11 15:17:11	116	107	0,1	-8	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
580,308	07-11-11 15:17:11	119	107	0,1	-8	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
580,311	07-11-11 15:17:11	119	107	0,1	-8	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0
580,314	07-11-11 15:17:11	119	107	0	-8	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0
580,314	07-11-11 15:17:11	119	107	0	-8	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0
580,323	07-11-11 15:17:12	119	107	0	-8	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	1	0
580,331	07-11-11 15:17:12	119	107	0	-8	0	0	0	0	0	1	0	1	1	0	0	1	0	1	1	0	0	1	0

580,334	07-11-11 15:17:12	120	107	0	-8	0	0	0	0	0	1	0	1	1	0	0	1	0	1	1	0	0	1	0
580,334	07-11-11 15:17:12	120	107	0	-8	0	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
580,334	07-11-11 15:17:12	120	107	0	-8	0	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
580,339	07-11-11 15:17:12	117	107	0	-8	0	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
580,348	07-11-11 15:17:12	117	107	0	-8	0	0	0	0	0	1	0	1	1	1	0	1	0	1	0	1	0	1	0
580,351	07-11-11 15:17:13	117	107	0	-8	0	0	0	0	0	1	0	1	1	1	1	1	0	1	0	0	0	1	0
580,355	07-11-11 15:17:13	84	107	0	-8	0	0	0	0	0	1	0	1	1	1	1	1	0	1	0	0	0	1	0
580,357	07-11-11 15:17:13	84	107	0	-8	0	0	0	0	0	1	0	1	1	1	1	1	0	1	0	0	0	1	0
580,359	07-11-11 15:17:13	84	107	0	-8	0	0	0	0	0	1	0	1	1	1	1	1	0	1	0	1	0	1	0
580,364	07-11-11 15:17:13	84	107	0	-8	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	1	0	1	0
580,369	07-11-11 15:17:13	73	107	0	-8	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	1	0	1	0
580,376	07-11-11 15:17:14	73	107	0	-8	0	0	0	0	0	1	0	0	0	1	1	1	0	1	0	1	0	1	0
580,378	07-11-11 15:17:14	59	107	0	-8	0	0	0	0	0	1	0	0	0	1	1	1	0	1	0	1	0	1	0
580,380	07-11-11 15:17:14	59	107	0	-8	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	0	1	0
580,382	07-11-11 15:17:14	56	107	0	-8	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	0	1	0
580,382	07-11-11 15:17:14	56	107	0	-8	0	0	0	0	0	1	1	1	0	1	1	1	0	1	1	0	0	1	0
580,385	07-11-11 15:17:14	56	107	0	-8	0	0	0	0	0	1	1	1	0	1	1	1	1	1	1	0	0	1	0
580,386	07-11-11 15:17:14	56	107	0	-8	0	0	0	0	0	0	1	1	0	1	1	1	1	1	1	0	0	1	0
580,387	07-11-11 15:17:15	35	107	0	-8	0	0	0	0	0	0	1	1	0	1	1	1	1	1	1	0	0	1	0
580,387	07-11-11 15:17:15	35	107	0	-8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	1	0
580,388	07-11-11 15:17:15	35	107	0	-8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0
580,388	07-11-11 15:17:16	35	107	0	-8	0	0	0	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0
580,388	07-11-11 15:17:16	35	107	0	-8	0	0	0	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0
580,388	07-11-11 15:17:16	35	107	0	-8	0	0	0	0	0	0	1	1	1	1	1	0	1	1	1	0	0	1	0
580,388	07-11-11 15:17:16	35	107	0	-8	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	0	1	0
580,389	07-11-11 15:17:16	8	107	0	-8	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	0	1	0
580,389	07-11-11 15:17:16	8	107	0	-8	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	0	1	0
580,389	07-11-11 15:17:16	0	107	0	-8	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	1	0	1	1	1	0	1	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	1	0	1	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	0	0	1	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	1	1	1	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	1	1	1	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:18	0	107	0	-8	0	0	0	0	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:18	0	107	0	-8	0	0	0	0	0	1	1	1	0	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:18	0	107	0	-8	0	0	0	0	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:19	0	107	0	-8	0	0	0	0	0	1	0	0	1	1	1	0	0	1	1	1	0	1	0
580,389	07-11-11 15:17:19	0	107	0	-8	0	0	0	0	0	1	1	0	1	1	1	0	0	1	1	1	0	1	0
580,389	07-11-11 15:17:19	0	107	0	-8	0	0	0	0	0	1	1	0	1	1	0	0	0	1	1	1	0	1	0
580,389	07-11-11 15:17:19	0	107	0	-8	0	0	0	0	0	1	1	1	1	1	0	0	0	1	1	1	0	1	0
580,389	07-11-11 15:17:20	0	107	0	-8	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	0	1	0
580,389	07-11-11 15:17:20	0	107	0	-8	0	0	0	0	0	1	1	1	0	1	0	0	0	0	1	1	0	1	0
580,389	07-11-11 15:17:20	0	107	0	-8	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	0	1	0
580,389	07-11-11 15:17:20	0	106	0	-8	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	0	1	0
580,389	07-11-11 15:17:20	0	106	0	-8	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	0	1	0
580,389	07-11-11 15:17:21	0	106	0	-8	0	0	0	0	0	1	1	0	1	1	0	0	0	0	1	1	0	1	0
580,389	07-11-11 15:17:21	0	106	0	-8	0	0	0	0	0	1	1	0	0	1	0	0	0	0	1	1	0	1	0
580,389	07-11-11 15:17:21	0	106	0	-8	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	1	0
580,389	07-11-11 15:17:21	0	106	0	-8	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	1	0	1	0
580,389	07-11-11 15:17:21	0	106	0	-8	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:22	0	106	0	-8	0	0	0	0	0	1	1	1	0	1	0	0	1	0	0	0	0	1	0
580,389	07-11-11 15:17:23	0	106	0	-8	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	1	0

580,389	07-11-11 15:17:23	0	106	0	-8	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	1	0
580,389	07-11-11 15:17:23	0	106	0	-8	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	1	0
580,389	07-11-11 15:17:23	0	106	0	-8	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	1	0
580,389	07-11-11 15:17:23	0	106	0	-8	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:25	0	106	0	-8	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:25	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:25	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:25	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:25	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:26	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:26	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:26	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:27	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:27	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0
580,389	07-11-11 15:17:27	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0
580,389	07-11-11 15:17:27	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0
580,389	07-11-11 15:17:27	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0
580,389	07-11-11 15:17:27	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:28	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:31	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:35	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:39	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:40	0	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:40	0	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,389	07-11-11 15:17:48	0	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,390	07-11-11 15:17:54	0	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,391	07-11-11 15:17:55	10	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,393	07-11-11 15:17:55	6	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,393	07-11-11 15:17:57	6	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:17:58	0	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:17:59	0	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:00	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:11	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:16	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:18	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:18	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:20	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:22	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:33	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:46	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:03	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:17	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:21	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:37	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:45	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:45	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:46	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

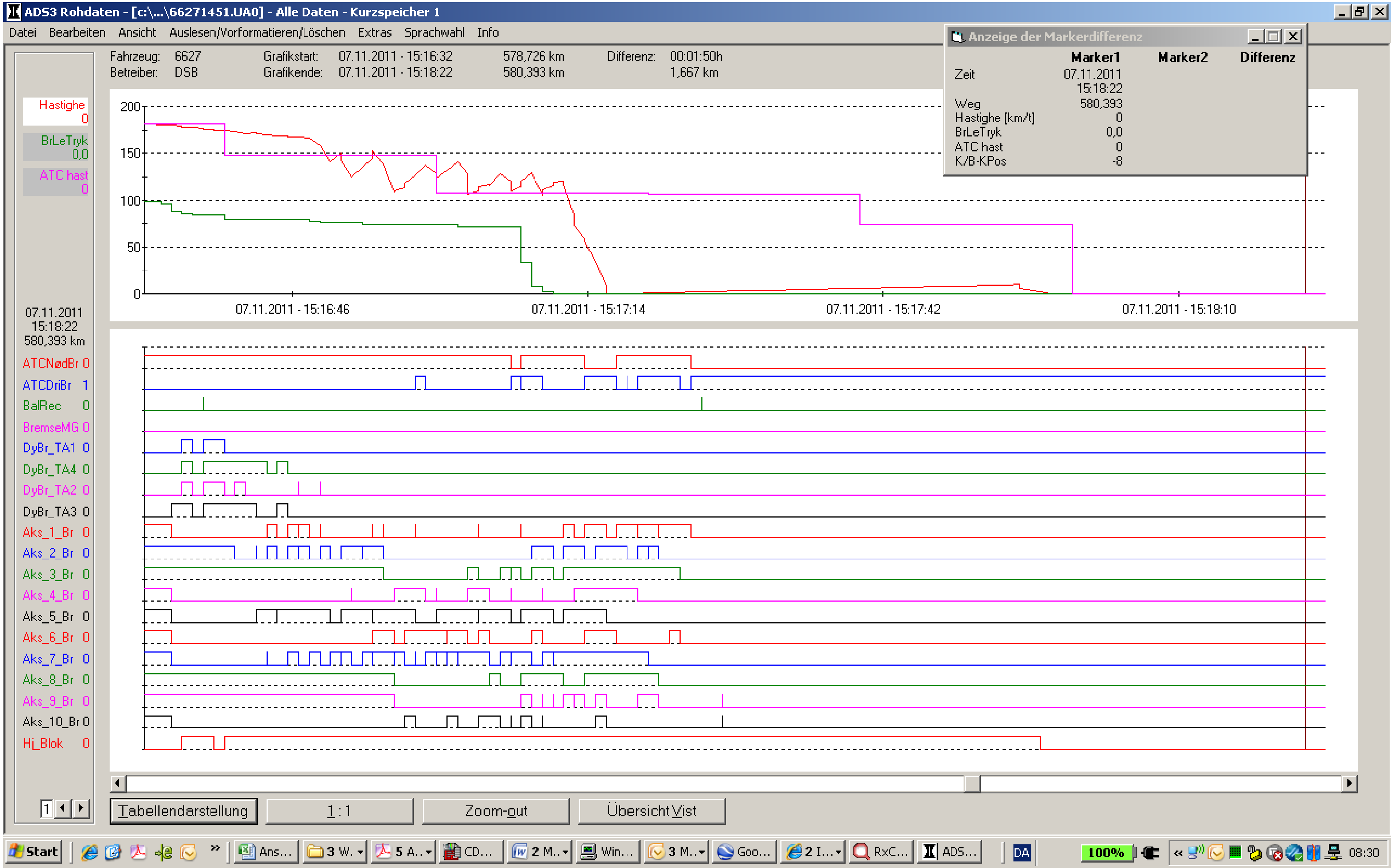
Havarilogudskrift MG 27 tog 27 Uv - Mv 07.11.2011



Kørselsforløb signalforbikørsel AM 2173

Kørselsforløb hjulblokering (delvis) i DSK-km 588,186

Havarilogudskrift MG 27 tog 27 Uv - Mv 07.11.2011



Kørselsforløb signalforbikørsel AM 2173

Bilag 3.2
Havarikommissionen
611-2011-23

Kørselsforløb hjulblokering (delvis) i DSK-km 588,186

Vej/km	Tid	V [km/t] Hastighe	ATC V ATC has	BL BrLeT	K/B pos PosKB	Balise br	TL Br k	TL N l	MG-br m	Trækkraft udk. n	ATC n s	ATC dr t	Aks D	Aks E	Aks F	Aks G	Aks H	Aks I	Aks K	Aks L	Aks M	Aks N	Hjulbloke a	Hjulslip b	
577,002	07-11-11 15:15:58	179	179	4,9	13	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	Balise AM 2133
577,009	07-11-11 15:15:58	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,039	07-11-11 15:15:59	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,039	07-11-11 15:15:59	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,071	07-11-11 15:15:59	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,081	07-11-11 15:15:59	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,093	07-11-11 15:16:00	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,101	07-11-11 15:16:00	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,101	07-11-11 15:16:00	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,126	07-11-11 15:16:00	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,131	07-11-11 15:16:00	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,131	07-11-11 15:16:00	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,143	07-11-11 15:16:01	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,160	07-11-11 15:16:01	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,160	07-11-11 15:16:01	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,180	07-11-11 15:16:01	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,188	07-11-11 15:16:02	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,222	07-11-11 15:16:02	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,247	07-11-11 15:16:03	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,277	07-11-11 15:16:03	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,307	07-11-11 15:16:04	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,339	07-11-11 15:16:05	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,361	07-11-11 15:16:05	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,369	07-11-11 15:16:05	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,379	07-11-11 15:16:05	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,391	07-11-11 15:16:06	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,391	07-11-11 15:16:06	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,398	07-11-11 15:16:06	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,406	07-11-11 15:16:06	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,408	07-11-11 15:16:06	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,428	07-11-11 15:16:06	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,441	07-11-11 15:16:07	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,458	07-11-11 15:16:07	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,478	07-11-11 15:16:07	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,488	07-11-11 15:16:08	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,488	07-11-11 15:16:08	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,500	07-11-11 15:16:08	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,508	07-11-11 15:16:08	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,520	07-11-11 15:16:08	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,530	07-11-11 15:16:09	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,537	07-11-11 15:16:09	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,550	07-11-11 15:16:09	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,580	07-11-11 15:16:09	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,585	07-11-11 15:16:10	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,612	07-11-11 15:16:10	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,642	07-11-11 15:16:11	179	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,672	07-11-11 15:16:11	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,672	07-11-11 15:16:11	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,702	07-11-11 15:16:12	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,727	07-11-11 15:16:12	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,764	07-11-11 15:16:13	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
577,769	07-11-11 15:16:13	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	

Bilag 3.3
Havarikommissionen
611-2011-23

Vej/km	Tid	V [km/t]	ATC V	BL	K/B pos	Balise	TL Br	TL N	MG-br	Trækkraft udk.	ATC n	ATC dr	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Hjulbloke	Hjulslip
		Hastighe	ATC has	BrLeT	PosKB	br	k	l	m	n	s	t	D	E	F	G	H	I	K	L	M	N	a	b
577,789	07-11-11 15:16:14	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,819	07-11-11 15:16:14	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,849	07-11-11 15:16:15	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,849	07-11-11 15:16:15	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,861	07-11-11 15:16:15	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,879	07-11-11 15:16:15	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,879	07-11-11 15:16:15	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,909	07-11-11 15:16:16	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,909	07-11-11 15:16:16	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,916	07-11-11 15:16:16	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,929	07-11-11 15:16:16	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,934	07-11-11 15:16:17	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,941	07-11-11 15:16:17	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,971	07-11-11 15:16:17	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,971	07-11-11 15:16:17	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,971	07-11-11 15:16:17	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
577,984	07-11-11 15:16:18	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,001	07-11-11 15:16:18	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,034	07-11-11 15:16:19	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,039	07-11-11 15:16:19	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,051	07-11-11 15:16:19	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,059	07-11-11 15:16:19	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,069	07-11-11 15:16:19	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,081	07-11-11 15:16:20	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,094	07-11-11 15:16:20	180	179	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,104	07-11-11 15:16:20	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,116	07-11-11 15:16:20	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,124	07-11-11 15:16:20	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,136	07-11-11 15:16:21	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,149	07-11-11 15:16:21	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,166	07-11-11 15:16:21	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,171	07-11-11 15:16:21	180	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,179	07-11-11 15:16:21	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,209	07-11-11 15:16:22	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,209	07-11-11 15:16:22	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,229	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,234	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,241	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,241	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,259	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,271	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,271	07-11-11 15:16:23	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,281	07-11-11 15:16:24	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,289	07-11-11 15:16:24	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,301	07-11-11 15:16:24	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,321	07-11-11 15:16:24	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,326	07-11-11 15:16:24	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,331	07-11-11 15:16:25	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,339	07-11-11 15:16:25	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,344	07-11-11 15:16:25	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,357	07-11-11 15:16:25	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,357	07-11-11 15:16:25	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0

Vej/km	Tid	V [km/t]	ATC V	BL	K/B pos	Balise	TL Br	TL N	MG-br	Trækkraft udk.	ATC n	ATC dr	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Hjulbloke	Hjulslip
		Hastighe	ATC has	BrLeT	PosKB	br	k	l	m	n	s	t	D	E	F	G	H	I	K	L	M	N	a	b
578,369	07-11-11 15:16:25	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,387	07-11-11 15:16:26	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,419	07-11-11 15:16:26	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,419	07-11-11 15:16:26	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,450	07-11-11 15:16:27	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,482	07-11-11 15:16:27	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,487	07-11-11 15:16:28	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,500	07-11-11 15:16:28	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,505	07-11-11 15:16:28	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,512	07-11-11 15:16:28	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,530	07-11-11 15:16:28	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,543	07-11-11 15:16:29	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,555	07-11-11 15:16:29	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,555	07-11-11 15:16:29	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,573	07-11-11 15:16:29	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,578	07-11-11 15:16:29	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,590	07-11-11 15:16:30	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,598	07-11-11 15:16:30	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,620	07-11-11 15:16:30	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,628	07-11-11 15:16:30	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,628	07-11-11 15:16:30	181	181	4,9	13	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,633	07-11-11 15:16:31	181	181	4,9	12	0	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,638	07-11-11 15:16:31	181	181	4,9	12	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,646	07-11-11 15:16:31	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,653	07-11-11 15:16:31	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,653	07-11-11 15:16:31	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,658	07-11-11 15:16:31	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1
578,658	07-11-11 15:16:31	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,666	07-11-11 15:16:31	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,683	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,691	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,696	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,708	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,708	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,716	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,721	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,726	07-11-11 15:16:32	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,731	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,738	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,746	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,746	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,751	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,756	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,761	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,761	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,776	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,776	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,781	07-11-11 15:16:33	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,781	07-11-11 15:16:34	181	181	4,9	0	0	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,789	07-11-11 15:16:34	181	181	4,9	0	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,794	07-11-11 15:16:34	181	181	4,9	0	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0
578,794	07-11-11 15:16:34	181	181	4,9	-1	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0

Vej/km	Tid	V [km/t] Hastighe	ATC V ATC has	BL BrLeT	K/B pos PosKB	Balise br	TL Br k	TL N l	MG-br m	Trækkraft udk. n	ATC n s	ATC dr t	Aks D	Aks E	Aks F	Aks G	Aks H	Aks I	Aks K	Aks L	Aks M	Aks N	Hjulbloke a	Hjulslip b	
578,806	07-11-11 15:16:34	181	181	4,9	-1	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
578,806	07-11-11 15:16:34	181	181	4,9	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
578,814	07-11-11 15:16:34	180	181	4,9	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
578,814	07-11-11 15:16:34	180	181	4,8	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
578,814	07-11-11 15:16:34	180	181	4,8	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
578,814	07-11-11 15:16:34	180	181	4,8	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
578,814	07-11-11 15:16:34	180	181	4,8	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
578,826	07-11-11 15:16:34	180	181	4,8	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
578,836	07-11-11 15:16:35	180	181	4,7	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
578,836	07-11-11 15:16:35	180	181	4,7	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
578,844	07-11-11 15:16:35	180	181	4,7	-2	0	0	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	
578,844	07-11-11 15:16:35	180	181	4,7	-2	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	1	0	0	
578,844	07-11-11 15:16:35	180	181	4,7	-2	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	1	0	0	
578,849	07-11-11 15:16:35	180	181	4,6	-2	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	1	0	0	
578,856	07-11-11 15:16:35	180	181	4,6	-2	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	1	0	0	
578,864	07-11-11 15:16:35	180	181	4,5	-2	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	1	0	0	
578,869	07-11-11 15:16:35	180	181	4,5	-2	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	1	0	0	
578,869	07-11-11 15:16:35	180	181	4,5	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0	
578,874	07-11-11 15:16:35	180	181	4,4	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0	
578,874	07-11-11 15:16:35	180	181	4,4	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0	
578,886	07-11-11 15:16:36	180	181	4,4	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0	
578,886	07-11-11 15:16:36	180	181	4,4	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0	
578,893	07-11-11 15:16:36	180	181	4,4	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0	
578,898	07-11-11 15:16:36	179	181	4,4	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0	
578,898	07-11-11 15:16:36	179	181	4,3	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0	
578,918	07-11-11 15:16:36	179	181	4,3	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0	
578,923	07-11-11 15:16:36	179	181	4,3	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0	
578,923	07-11-11 15:16:36	179	181	4,3	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,930	07-11-11 15:16:36	178	181	4,3	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,935	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,935	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,943	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,953	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,953	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,958	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,965	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,965	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,977	07-11-11 15:16:37	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,977	07-11-11 15:16:38	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,985	07-11-11 15:16:38	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,985	07-11-11 15:16:38	178	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,989	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,989	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,989	07-11-11 15:16:38	177	181	4,2	-2	1	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	Balise AM 2153
578,994	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,994	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
578,994	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
579,002	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
579,002	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
579,007	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
579,012	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	
579,012	07-11-11 15:16:38	177	181	4,2	-2	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0	

Vej/km	Tid	V [km/t] Hastighe	ATC V ATC has	BL BrLeT	K/B pos PosKB	Balise br	TL Br k	TL N l	MG-br m	Trækkraft udk. n	ATC n s	ATC dr t	Aks D	Aks E	Aks F	Aks G	Aks H	Aks I	Aks K	Aks L	Aks M	Aks N	Hjulbloke a	Hjulslip b
579,012	07-11-11 15:16:38	177	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,019	07-11-11 15:16:38	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,019	07-11-11 15:16:38	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,024	07-11-11 15:16:38	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,031	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,041	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,048	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,048	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,048	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,060	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,070	07-11-11 15:16:39	176	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,077	07-11-11 15:16:39	175	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,077	07-11-11 15:16:40	175	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,089	07-11-11 15:16:40	175	181	4,2	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,094	07-11-11 15:16:40	175	181	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,102	07-11-11 15:16:40	175	181	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	0	0
579,102	07-11-11 15:16:40	175	181	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,106	07-11-11 15:16:40	175	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,106	07-11-11 15:16:40	175	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,114	07-11-11 15:16:40	174	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,114	07-11-11 15:16:40	174	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,118	07-11-11 15:16:40	174	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,126	07-11-11 15:16:40	174	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,133	07-11-11 15:16:41	174	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,133	07-11-11 15:16:41	174	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,138	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,138	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,147	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,154	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,159	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,159	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,166	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,171	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,171	07-11-11 15:16:41	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,176	07-11-11 15:16:42	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,188	07-11-11 15:16:42	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,195	07-11-11 15:16:42	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,195	07-11-11 15:16:42	173	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,200	07-11-11 15:16:42	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,207	07-11-11 15:16:42	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,219	07-11-11 15:16:42	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,231	07-11-11 15:16:43	172	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,236	07-11-11 15:16:43	172	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,243	07-11-11 15:16:43	172	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,243	07-11-11 15:16:43	172	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,248	07-11-11 15:16:43	172	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,252	07-11-11 15:16:43	172	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,259	07-11-11 15:16:43	171	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,259	07-11-11 15:16:43	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,271	07-11-11 15:16:43	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,271	07-11-11 15:16:44	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,271	07-11-11 15:16:44	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0

Vej/km	Tid	V [km/t]	ATC V	BL	K/B pos	Balise	TL Br	TL N	MG-br	Trækkraft udk.	ATC n	ATC dr	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Hjulbloke	Hjulslip
		Hastighe	ATC has	BrLeT	PosKB	br	k	l	m	n	s	t	D	E	F	G	H	I	K	L	M	N	a	b
579,278	07-11-11 15:16:44	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,283	07-11-11 15:16:44	171	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,288	07-11-11 15:16:44	170	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,300	07-11-11 15:16:44	170	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,300	07-11-11 15:16:44	170	148	4	-3	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,309	07-11-11 15:16:44	170	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	1	0
579,309	07-11-11 15:16:44	170	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	1	0
579,318	07-11-11 15:16:44	170	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	1	0
579,318	07-11-11 15:16:45	170	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,328	07-11-11 15:16:45	170	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,340	07-11-11 15:16:45	170	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,340	07-11-11 15:16:45	170	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,347	07-11-11 15:16:45	169	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,347	07-11-11 15:16:45	169	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
579,358	07-11-11 15:16:45	169	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,358	07-11-11 15:16:45	169	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,363	07-11-11 15:16:46	169	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,363	07-11-11 15:16:46	169	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,375	07-11-11 15:16:46	169	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
579,379	07-11-11 15:16:46	169	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
579,379	07-11-11 15:16:46	169	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
579,407	07-11-11 15:16:46	168	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
579,414	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,414	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,419	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,431	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,431	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,431	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,435	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,442	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,442	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	1	0
579,442	07-11-11 15:16:47	168	148	4	-3	0	0	1	0	0	1	0	1	1	1	0	1	0	0	1	1	0	1	0
579,459	07-11-11 15:16:48	168	148	4	-3	0	0	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	1	0
579,459	07-11-11 15:16:48	168	148	4	-3	0	0	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	1	0
579,459	07-11-11 15:16:48	168	148	4	-4	0	0	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	1	0
579,466	07-11-11 15:16:48	168	148	4	-4	0	0	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	1	0
579,470	07-11-11 15:16:48	167	148	4	-4	0	0	1	0	0	1	0	1	0	1	0	1	0	0	1	1	0	1	0
579,470	07-11-11 15:16:48	167	148	4	-4	0	0	1	0	0	1	0	1	0	1	0	1	0	1	1	1	0	1	0
579,486	07-11-11 15:16:48	167	148	4	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,486	07-11-11 15:16:48	167	148	4	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,486	07-11-11 15:16:48	167	148	4	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,500	07-11-11 15:16:48	167	148	4	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,505	07-11-11 15:16:48	167	148	3,9	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,505	07-11-11 15:16:49	167	148	3,9	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,509	07-11-11 15:16:49	167	148	3,9	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,516	07-11-11 15:16:49	167	148	3,9	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,527	07-11-11 15:16:49	158	148	3,9	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,527	07-11-11 15:16:49	158	148	3,8	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,527	07-11-11 15:16:49	158	148	3,8	-4	0	0	1	0	0	1	0	1	0	1	0	1	0	1	1	1	0	1	0
579,527	07-11-11 15:16:49	158	148	3,8	-4	0	0	1	0	0	1	0	1	0	1	0	1	0	1	1	1	0	1	0
579,531	07-11-11 15:16:49	158	148	3,8	-4	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,535	07-11-11 15:16:49	158	148	3,8	-4	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0

Vej/km	Tid	V [km/t]	ATC V	BL	K/B pos	Balise	TL Br	TL N	MG-br	Trækkraft udk.	ATC n	ATC dr	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Hjulbloke	Hjulslip
		Hastighe	ATC has	BrLeT	PosKB	br	k	l	m	n	s	t	D	E	F	G	H	I	K	L	M	N	a	b
579,545	07-11-11 15:16:50	158	148	3,8	-4	0	0	1	0	0	1	0	0	1	1	0	0	0	0	1	1	0	1	0
579,556	07-11-11 15:16:50	158	148	3,8	-4	0	0	1	0	0	1	0	0	1	1	0	0	0	1	1	1	0	1	0
579,560	07-11-11 15:16:50	141	148	3,8	-4	0	0	1	0	0	1	0	0	1	1	0	0	0	1	1	1	0	1	0
579,581	07-11-11 15:16:50	141	148	3,8	-4	0	0	1	0	0	1	0	0	0	1	0	0	0	1	1	1	0	1	0
579,591	07-11-11 15:16:51	150	148	3,8	-4	0	0	1	0	0	1	0	0	0	1	0	0	0	1	1	1	0	1	0
579,598	07-11-11 15:16:51	150	148	3,8	-4	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,598	07-11-11 15:16:51	150	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,602	07-11-11 15:16:51	150	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,606	07-11-11 15:16:51	150	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,616	07-11-11 15:16:51	150	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,616	07-11-11 15:16:51	150	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,616	07-11-11 15:16:51	150	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0
579,624	07-11-11 15:16:51	142	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0
579,624	07-11-11 15:16:51	142	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0
579,636	07-11-11 15:16:52	142	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	1	1	0	1	1	1	0	1	0
579,643	07-11-11 15:16:52	142	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0
579,648	07-11-11 15:16:52	125	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0
579,657	07-11-11 15:16:52	125	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,657	07-11-11 15:16:52	125	148	3,8	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	1	0	1	0
579,664	07-11-11 15:16:53	125	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,664	07-11-11 15:16:53	125	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	0
579,670	07-11-11 15:16:53	125	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,679	07-11-11 15:16:53	135	148	3,8	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,679	07-11-11 15:16:53	135	148	3,7	-5	0	0	1	0	0	1	0	0	0	1	0	1	0	1	1	1	0	1	0
579,693	07-11-11 15:16:53	135	148	3,7	-5	0	0	1	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1	0
579,703	07-11-11 15:16:54	135	148	3,7	-5	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,703	07-11-11 15:16:54	135	148	3,7	-5	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,707	07-11-11 15:16:54	144	148	3,7	-5	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,707	07-11-11 15:16:54	144	148	3,7	-5	0	0	1	0	0	1	0	1	1	1	0	0	0	0	1	1	0	1	0
579,727	07-11-11 15:16:54	144	148	3,7	-5	0	0	1	0	0	1	0	0	1	1	0	0	1	1	1	1	0	1	0
579,732	07-11-11 15:16:54	144	148	3,7	-5	0	0	1	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	0
579,738	07-11-11 15:16:54	153	148	3,7	-5	0	0	1	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	0
579,738	07-11-11 15:16:54	153	148	3,7	-5	0	0	1	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	0
579,743	07-11-11 15:16:55	153	148	3,7	-5	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	0	1	0
579,743	07-11-11 15:16:55	153	148	3,7	-6	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	0	1	0
579,749	07-11-11 15:16:55	153	148	3,7	-6	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	0	1	0
579,767	07-11-11 15:16:55	139	148	3,7	-6	0	0	1	0	0	1	0	1	1	1	0	1	1	1	1	1	0	1	0
579,767	07-11-11 15:16:55	139	148	3,7	-6	0	0	1	0	0	1	0	0	0	1	0	1	1	1	1	1	0	1	0
579,775	07-11-11 15:16:55	139	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	0	1	0
579,780	07-11-11 15:16:55	139	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	1	1	0	1	0
579,780	07-11-11 15:16:56	139	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0
579,783	07-11-11 15:16:56	109	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0	1	0
579,788	07-11-11 15:16:56	109	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,788	07-11-11 15:16:56	109	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,788	07-11-11 15:16:56	109	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,791	07-11-11 15:16:56	109	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,791	07-11-11 15:16:56	109	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,798	07-11-11 15:16:56	110	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0	1	0
579,798	07-11-11 15:16:56	110	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	1	0	0	0	1	0
579,806	07-11-11 15:16:56	110	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	0	1	0
579,809	07-11-11 15:16:57	110	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	1	1	0
579,812	07-11-11 15:16:57	113	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	1	1	0

Vej/km	Tid	V [km/t] Hastighe	ATC V ATC has	BL BrLeT	K/B pos PosKB	Balise br	TL Br k	TL N l	MG-br m	Trækkraft udk. n	ATC n s	ATC dr t	Aks D	Aks E	Aks F	Aks G	Aks H	Aks I	Aks K	Aks L	Aks M	Aks N	a	Hjulbloke	Hjulslip b
579,817	07-11-11 15:16:57	113	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	1		1	0
579,828	07-11-11 15:16:57	118	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	0	1	0	0	1		1	0
579,828	07-11-11 15:16:57	118	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	1		1	0
579,846	07-11-11 15:16:58	118	148	3,7	-6	0	0	1	0	0	1	0	1	0	0	1	1	1	1	0	0	1		1	0
579,846	07-11-11 15:16:58	118	148	3,7	-6	0	0	1	0	0	1	0	1	0	0	1	1	1	1	0	0	1		1	0
579,851	07-11-11 15:16:58	118	148	3,7	-6	0	0	1	0	0	1	0	1	0	0	1	1	1	1	0	0	0		1	0
579,854	07-11-11 15:16:58	118	148	3,7	-6	0	0	1	0	0	1	1	1	0	0	1	1	1	1	0	0	0		1	0
579,860	07-11-11 15:16:58	127	148	3,7	-6	0	0	1	0	0	1	1	1	0	0	1	1	1	1	0	0	0		1	0
579,867	07-11-11 15:16:58	127	148	3,7	-6	0	0	1	0	0	1	1	1	0	0	1	1	1	0	0	0	1		1	0
579,871	07-11-11 15:16:58	127	148	3,7	-6	0	0	1	0	0	1	1	0	0	0	1	0	1	0	0	0	0		1	0
579,880	07-11-11 15:16:59	127	148	3,7	-6	0	0	1	0	0	1	1	0	0	0	1	0	1	0	0	0	0		1	0
579,890	07-11-11 15:16:59	138	148	3,7	-6	0	0	1	0	0	1	1	0	0	0	1	0	1	0	0	0	0		1	0
579,890	07-11-11 15:16:59	138	148	3,7	-6	0	0	1	0	0	1	1	0	0	0	1	0	1	1	0	0	0		1	0
579,904	07-11-11 15:16:59	138	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	0	1	1	0	0	0		1	0
579,904	07-11-11 15:16:59	138	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0		1	0
579,904	07-11-11 15:16:59	138	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0		1	0
579,909	07-11-11 15:16:59	138	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0		1	0
579,918	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0		1	0
579,918	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	0	1	1	0	0	0		1	0
579,918	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0		1	0
579,918	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0		1	0
579,927	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0	0		1	0
579,930	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0		1	0
579,938	07-11-11 15:17:00	128	148	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0		1	0
579,938	07-11-11 15:17:00	128	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0		1	0
579,944	07-11-11 15:17:00	128	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0		1	0
579,947	07-11-11 15:17:00	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0		1	0
579,947	07-11-11 15:17:00	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0		1	0
579,952	07-11-11 15:17:01	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0		1	0
579,952	07-11-11 15:17:01	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0		1	0
579,961	07-11-11 15:17:01	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0		1	0
579,961	07-11-11 15:17:01	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0		1	0
579,965	07-11-11 15:17:01	124	107	3,7	-6	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0		1	0
579,974	07-11-11 15:17:01	124	107	3,7	-7	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0		1	0
579,977	07-11-11 15:17:01	132	107	3,7	-7	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0		1	0
579,977	07-11-11 15:17:01	132	107	3,7	-7	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0		1	0
579,983	07-11-11 15:17:01	132	107	3,7	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	1		1	0
579,987	07-11-11 15:17:02	132	107	3,7	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0		1	0
579,996	07-11-11 15:17:02	132	107	3,7	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0		1	0
580,002	07-11-11 15:17:02	132	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0		1	0
580,010	07-11-11 15:17:02	141	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	0		1	0
580,020	07-11-11 15:17:02	141	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0		1	0
580,039	07-11-11 15:17:03	128	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0		1	0
580,043	07-11-11 15:17:03	128	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	0	1	0	1	0	0	0		1	0
580,054	07-11-11 15:17:03	106	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	0	1	0	1	0	0	0		1	0
580,054	07-11-11 15:17:03	106	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	1	1	0	1	0	0	0		1	0
580,061	07-11-11 15:17:04	106	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	1	0	0	1	0	0	1		1	0
580,061	07-11-11 15:17:04	106	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	1	0	0	1	0	0	1		1	0
580,066	07-11-11 15:17:04	106	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	1	0	1	1	0	0	1		1	0
580,069	07-11-11 15:17:04	110	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	1	0	1	1	0	0	1		1	0
580,072	07-11-11 15:17:04	110	107	3,6	-7	0	0	1	0	0	1	0	1	0	0	1	0	1	1	0	0	1		1	0
580,077	07-11-11 15:17:04	110	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	1	0	1	1	0	0	1		1	0

Vej/km	Tid	V [km/t] Hastighe	ATC V ATC has	BL BrLeT	K/B pos PosKB	Balise br	TL Br k	TL N l	MG-br m	Trækkraft udk. n	ATC n s	ATC dr t	Aks D	Aks E	Aks F	Aks G	Aks H	Aks I	Aks K	Aks L	Aks M	Aks N	Hjulbloke a	Hjulslip b
580,082	07-11-11 15:17:04	114	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	1	0	1	1	0	0	1	1	0
580,086	07-11-11 15:17:04	114	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	1	1	1	1	0	0	1	1	0
580,093	07-11-11 15:17:05	114	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	1	1	0
580,097	07-11-11 15:17:05	114	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	1	1	0
580,101	07-11-11 15:17:05	117	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	0	0	1	1	0
580,105	07-11-11 15:17:05	117	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1	0	1	1	0
580,113	07-11-11 15:17:05	116	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	1	0	1	0	1	1	0
580,113	07-11-11 15:17:05	116	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	1	1	0	0	1	0	1	1	0
580,116	07-11-11 15:17:05	116	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	0	0	1	0	1	1	0
580,124	07-11-11 15:17:06	116	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	1	1	0
580,130	07-11-11 15:17:06	116	107	3,6	-7	0	0	1	0	0	1	0	0	0	0	0	1	0	1	0	0	0	1	0
580,138	07-11-11 15:17:06	116	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	0	1	0	1	0	0	0	1	0
580,142	07-11-11 15:17:06	128	107	3,6	-7	0	0	1	0	0	1	0	0	0	1	0	1	0	1	0	0	0	1	0
580,161	07-11-11 15:17:07	128	107	3,6	-7	0	0	1	0	0	1	1	0	0	1	0	1	0	1	0	0	0	1	0
580,161	07-11-11 15:17:07	128	107	3,6	-7	0	0	1	0	0	1	1	0	0	1	0	1	0	1	0	0	0	1	0
580,161	07-11-11 15:17:07	128	107	3,6	-7	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	1	1	0
580,173	07-11-11 15:17:07	120	107	3,6	-7	0	0	1	0	0	1	1	0	0	0	0	1	0	0	0	0	1	1	0
580,173	07-11-11 15:17:07	120	107	3,6	-7	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0
580,177	07-11-11 15:17:07	120	107	3,6	-7	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0
580,180	07-11-11 15:17:07	120	107	3,6	-7	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0
580,185	07-11-11 15:17:07	120	107	3,6	-7	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0
580,185	07-11-11 15:17:07	120	107	3,6	-7	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0
580,185	07-11-11 15:17:07	120	107	3,6	-7	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0
580,189	07-11-11 15:17:07	110	107	3,6	-7	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0
580,189	07-11-11 15:17:07	110	107	3,6	-7	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0
580,192	07-11-11 15:17:07	110	107	3,6	-7	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	1	0
580,192	07-11-11 15:17:08	110	107	3,6	-7	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	1	1	0
580,192	07-11-11 15:17:08	110	107	3,6	-7	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	1	1	0
580,199	07-11-11 15:17:08	110	107	3,6	-7	0	0	1	0	0	1	1	0	0	1	0	0	0	1	0	0	1	1	0
580,199	07-11-11 15:17:08	110	107	3,6	-7	0	0	1	0	0	1	1	0	0	1	0	0	0	1	0	1	1	1	0
580,199	07-11-11 15:17:08	110	107	3,6	-7	0	0	1	0	0	1	1	0	0	1	0	0	0	1	0	1	1	1	0
580,203	07-11-11 15:17:08	115	107	3,6	-7	0	0	1	0	0	1	1	0	0	1	0	0	0	1	0	1	1	1	0
580,203	07-11-11 15:17:08	115	107	3,6	-7	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	1	1	0
580,203	07-11-11 15:17:08	115	107	1,7	-7	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	1	1	0
580,203	07-11-11 15:17:08	115	107	1,7	-8	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	1	1	0
580,212	07-11-11 15:17:08	115	107	1,7	-8	0	0	0	0	0	1	1	0	0	1	0	0	0	1	0	1	1	1	0
580,212	07-11-11 15:17:08	115	107	1,7	-8	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	1	1	1	0
580,212	07-11-11 15:17:08	115	107	1,7	-8	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	1	1	1	0
580,220	07-11-11 15:17:08	120	107	1,7	-8	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	1	1	1	0
580,220	07-11-11 15:17:08	120	107	1,7	-8	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0	1	1	1	0
580,220	07-11-11 15:17:08	120	107	1,7	-8	0	0	0	0	0	1	1	0	0	0	0	1	0	1	1	1	1	1	0
580,223	07-11-11 15:17:09	120	107	1,7	-8	0	0	0	0	0	1	1	0	1	0	0	1	0	1	1	1	1	1	0
580,229	07-11-11 15:17:09	120	107	1,7	-8	0	0	0	0	0	1	1	0	1	0	0	1	0	1	1	1	1	1	0
580,232	07-11-11 15:17:09	120	107	1,7	-8	0	0	0	0	0	1	1	0	1	0	0	1	0	1	1	1	0	1	0
580,243	07-11-11 15:17:09	120	107	0,4	-8	0	0	0	0	0	1	1	0	1	0	0	1	0	1	1	1	0	1	0
580,243	07-11-11 15:17:09	120	107	0,4	-8	0	0	0	0	0	1	1	0	1	1	0	1	0	0	1	0	0	1	0
580,247	07-11-11 15:17:09	130	107	0,4	-8	0	0	0	0	0	1	1	0	1	1	0	1	0	0	1	0	0	1	0
580,247	07-11-11 15:17:09	130	107	0,4	-8	0	0	0	0	0	1	1	0	1	1	0	1	1	0	1	0	0	1	0
580,260	07-11-11 15:17:10	130	107	0,2	-8	0	0	0	0	0	1	1	0	1	1	0	1	1	0	1	0	0	1	0
580,260	07-11-11 15:17:10	130	107	0,2	-8	0	0	0	0	0	1	1	0	1	1	0	1	1	0	1	1	1	1	0
580,265	07-11-11 15:17:10	105	107	0,2	-8	0	0	0	0	0	1	1	0	1	1	0	1	1	0	1	1	1	1	0
580,265	07-11-11 15:17:10	105	107	0,2	-8	0	0	0	0	0	1	0	0	1	1	0	1	1	0	1	1	1	1	0

Vej/km	Tid	V [km/t] Hastighe	ATC V ATC has	BL BrLeT	K/B pos PosKB	Balise br	TL Br k	TL N l	MG-br m	Trækkraft udk. n	ATC n s	ATC dr t	Aks D	Aks E	Aks F	Aks G	Aks H	Aks I	Aks K	Aks L	Aks M	Aks N	Hjulbloke a	Hjulslip b
580,265	07-11-11 15:17:10	105	107	0,2	-8	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	0
580,265	07-11-11 15:17:10	105	107	0,2	-8	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	0
580,272	07-11-11 15:17:10	105	107	0,1	-8	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	0
580,272	07-11-11 15:17:10	105	107	0,1	-8	0	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	1	1	0
580,275	07-11-11 15:17:10	105	107	0,1	-8	0	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	0
580,280	07-11-11 15:17:10	111	107	0,1	-8	0	0	0	0	0	1	0	0	1	1	0	1	1	1	1	1	0	1	0
580,283	07-11-11 15:17:10	111	107	0,1	-8	0	0	0	0	0	1	0	0	1	1	0	1	0	1	1	0	0	1	0
580,294	07-11-11 15:17:11	116	107	0,1	-8	0	0	0	0	0	1	0	0	1	1	0	1	0	1	1	0	0	1	0
580,303	07-11-11 15:17:11	116	107	0,1	-8	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
580,303	07-11-11 15:17:11	116	107	0,1	-8	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
580,308	07-11-11 15:17:11	119	107	0,1	-8	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	0	1	0
580,311	07-11-11 15:17:11	119	107	0,1	-8	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0
580,314	07-11-11 15:17:11	119	107	0	-8	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0
580,314	07-11-11 15:17:11	119	107	0	-8	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	1	0
580,323	07-11-11 15:17:12	119	107	0	-8	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	1	0
580,331	07-11-11 15:17:12	119	107	0	-8	0	0	0	0	0	1	0	1	1	0	0	1	0	1	1	0	0	1	0
580,334	07-11-11 15:17:12	120	107	0	-8	0	0	0	0	0	1	0	1	1	0	0	1	0	1	1	0	0	1	0
580,334	07-11-11 15:17:12	120	107	0	-8	0	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
580,334	07-11-11 15:17:12	120	107	0	-8	0	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
580,339	07-11-11 15:17:12	117	107	0	-8	0	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	0	1	0
580,348	07-11-11 15:17:12	117	107	0	-8	0	0	0	0	0	1	0	1	1	1	0	1	0	1	0	1	0	1	0
580,351	07-11-11 15:17:13	117	107	0	-8	0	0	0	0	0	1	0	1	1	1	1	1	0	1	0	0	0	1	0
580,355	07-11-11 15:17:13	84	107	0	-8	0	0	0	0	0	1	0	1	1	1	1	1	0	1	0	0	0	1	0
580,357	07-11-11 15:17:13	84	107	0	-8	0	0	0	0	0	1	0	1	1	1	1	1	0	1	0	0	0	1	0
580,359	07-11-11 15:17:13	84	107	0	-8	0	0	0	0	0	1	0	1	1	1	1	1	0	1	0	1	0	1	0
580,364	07-11-11 15:17:13	84	107	0	-8	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	1	0	1	0
580,369	07-11-11 15:17:13	73	107	0	-8	0	0	0	0	0	1	0	0	1	1	1	1	0	1	0	1	0	1	0
580,376	07-11-11 15:17:14	73	107	0	-8	0	0	0	0	0	1	0	0	0	1	1	1	0	1	0	1	0	1	0
580,378	07-11-11 15:17:14	59	107	0	-8	0	0	0	0	0	1	0	0	0	1	1	1	0	1	0	1	0	1	0
580,380	07-11-11 15:17:14	59	107	0	-8	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	0	1	0
580,382	07-11-11 15:17:14	56	107	0	-8	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	0	0	1	0
580,382	07-11-11 15:17:14	56	107	0	-8	0	0	0	0	0	1	1	1	0	1	1	1	0	1	1	0	0	1	0
580,385	07-11-11 15:17:14	56	107	0	-8	0	0	0	0	0	1	1	1	0	1	1	1	1	1	1	0	0	1	0
580,386	07-11-11 15:17:14	56	107	0	-8	0	0	0	0	0	0	1	1	0	1	1	1	1	1	1	0	0	1	0
580,387	07-11-11 15:17:15	35	107	0	-8	0	0	0	0	0	0	1	1	0	1	1	1	1	1	1	0	0	1	0
580,387	07-11-11 15:17:15	35	107	0	-8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	1	0
580,388	07-11-11 15:17:15	35	107	0	-8	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0
580,388	07-11-11 15:17:16	35	107	0	-8	0	0	0	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0
580,388	07-11-11 15:17:16	35	107	0	-8	0	0	0	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0
580,388	07-11-11 15:17:16	35	107	0	-8	0	0	0	0	0	0	1	1	1	1	1	0	1	1	1	0	0	1	0
580,388	07-11-11 15:17:16	35	107	0	-8	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	0	1	0
580,389	07-11-11 15:17:16	8	107	0	-8	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	0	1	0
580,389	07-11-11 15:17:16	8	107	0	-8	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	0	1	0
580,389	07-11-11 15:17:16	0	107	0	-8	0	0	0	0	0	0	1	0	1	1	1	0	1	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	1	0	1	1	1	0	1	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	1	0	1	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	0	0	1	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	1	1	1	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	1	1	1	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:17	0	107	0	-8	0	0	0	0	0	1	0	1	1	1	1	0	0	1	1	0	0	1	0
580,389	07-11-11 15:17:18	0	107	0	-8	0	0	0	0	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0

Vej/km	Tid	V [km/t]	ATC V	BL	K/B pos	Balise	TL Br	TL N	MG-br	Trækkraft udk.	ATC n	ATC dr	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Hjulbloke	Hjulslip	
		Hastighe	ATC has	BrLeT	PosKB	br	k	l	m	n	s	t	D	E	F	G	H	I	K	L	M	N	a	b	
580,389	07-11-11 15:17:18	0	107	0	-8	0	0	0	0	0	1	1	1	0	1	1	0	0	1	1	0	0	1	0	
580,389	07-11-11 15:17:18	0	107	0	-8	0	0	0	0	0	1	0	1	0	1	1	0	0	1	1	0	0	1	0	
580,389	07-11-11 15:17:19	0	107	0	-8	0	0	0	0	0	1	0	0	1	1	1	0	0	1	1	1	0	1	0	
580,389	07-11-11 15:17:19	0	107	0	-8	0	0	0	0	0	1	1	0	1	1	1	0	0	1	1	1	0	1	0	
580,389	07-11-11 15:17:19	0	107	0	-8	0	0	0	0	0	1	1	0	1	1	0	0	0	1	1	1	0	1	0	
580,389	07-11-11 15:17:19	0	107	0	-8	0	0	0	0	0	1	1	1	1	1	0	0	0	1	1	1	0	1	0	
580,389	07-11-11 15:17:20	0	107	0	-8	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	0	1	0	
580,389	07-11-11 15:17:20	0	107	0	-8	0	0	0	0	0	1	1	1	0	1	0	0	0	0	1	1	0	1	0	
580,389	07-11-11 15:17:20	0	107	0	-8	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	0	1	0	
580,389	07-11-11 15:17:20	0	106	0	-8	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	0	1	0	
580,389	07-11-11 15:17:20	0	106	0	-8	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	1	0	1	0	
580,389	07-11-11 15:17:21	0	106	0	-8	0	0	0	0	0	1	1	0	1	1	0	0	0	0	1	1	0	1	0	
580,389	07-11-11 15:17:21	0	106	0	-8	0	0	0	0	0	1	1	0	0	1	0	0	0	0	1	1	0	1	0	
580,389	07-11-11 15:17:21	0	106	0	-8	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	1	0	
580,389	07-11-11 15:17:21	0	106	0	-8	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	1	0	1	0	
580,389	07-11-11 15:17:21	0	106	0	-8	0	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:22	0	106	0	-8	0	0	0	0	0	1	1	1	0	1	0	0	1	0	0	0	0	1	0	
580,389	07-11-11 15:17:23	0	106	0	-8	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	1	0	
580,389	07-11-11 15:17:23	0	106	0	-8	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	1	0	
580,389	07-11-11 15:17:23	0	106	0	-8	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	1	0	
580,389	07-11-11 15:17:23	0	106	0	-8	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	1	0	
580,389	07-11-11 15:17:23	0	106	0	-8	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:24	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:25	0	106	0	-8	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	Balise AM 2173
580,389	07-11-11 15:17:25	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:25	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:25	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:25	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:26	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:26	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:26	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:27	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:27	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	
580,389	07-11-11 15:17:27	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	
580,389	07-11-11 15:17:27	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	
580,389	07-11-11 15:17:27	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	1	0	
580,389	07-11-11 15:17:27	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:28	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:31	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:35	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:39	0	106	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:40	0	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:40	0	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,389	07-11-11 15:17:48	0	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,390	07-11-11 15:17:54	0	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
580,391	07-11-11 15:17:55	10	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	

Vej/km	Tid	V [km/t]	ATC V	BL	K/B pos	Balise	TL Br	TL N	MG-br	Trækkraft udk.	ATC n	ATC dr	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Aks	Hjulbloke	Hjulslip
		Hastighe	ATC has	BrLeT	PosKB	br	k	l	m	n	s	t	D	E	F	G	H	I	K	L	M	N	a	b
580,393	07-11-11 15:17:55	6	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0
580,393	07-11-11 15:17:57	6	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:17:58	0	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:17:59	0	74	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:00	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:11	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:16	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:18	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:18	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:20	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:22	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:33	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:18:46	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:03	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:17	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:21	0	0	0	-8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:37	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:45	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:45	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
580,393	07-11-11 15:19:46	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

Kort notat omkring undersøgelse af skinnerne (højre side mod Odense) mellem Langeskov og Marslev - AM signal 2153 - AM signal 2173 og hen til I-signal i Marslev.

Torsdag aften den 10.11.2011 var undertegnede på observation i førerrummet på Lyn 55. Lokoføreren foretog to fuldbremsninger uden brug af skinnebremsen ved henholdsvis 2. afstandsmærke til AM 2153 og 3. afstandsmærke til AM 2173. Begge nedbremsninger foregik uden udluftning af bremsecylinderne, og uden at toget kørte i "slæde".

I forbindelse med observationer i førerrummet blev der observeret en "streg" mellem skinnerne, der kunne indikerer et oliespild eller lignende.

Fredag den 11.11.2011 var undertegnede og Jørgen Hansen fra Banedanmark på besigtigelse af selve skinnelegemet mellem Langeskov og Marslev, for at efterse om der var tale om oliespild eller lignende på skinnerne i højre side mod Odense.

Først blev stykket mellem AM signal 2173 og I signalet til Marslev efterset - der var ingen indikationer på oliespild på skinnerne - ej heller på andre elementer kunne skabe "glatte/fedtede" skinner.

Oliespildet, (den sorte streg) som blev observeret dagen før fra førerrummet i Lyn 55, var reelt kun små dryp af olie af ældre dato (meget indtørret). Dette har ikke haft nogen indvirkning eller betydning for bremseevnen på nogen måde.

Sporstykket mellem AM 2153 og 2173 blev gennemgået med start ca. 200 meter før 2. afstandsmærke fra AM signal 2173, hvor det vil være mest sandsynligt, at en fuldbremsning er indtruffet (AM signal 2153 passeres med visningen "kør" og forvent stop på næste signal AM 2173).

Når signalet AM 2153 passeres vil lokomotivføreren sandsynligvis sætte kørekontrolleren i stilling 0 - herefter vil lokomotivføreren påbegynde en nedbremsning umiddelbart ved passage af 1. afstandsmærke, således at en fuldbremsning er indtruffet umiddelbart før passage af 2. afstandsmærke. Derfor er sporstukket ca. 1000 meter før AM signal 2173 undersøgt for oliespild og særlige slidmærker p.g.a. "slædekørsel".

Der blev ikke fundet nogen tegn på oliespild eller lignende på selve skinnerne, herunder heller ikke særlige slidmærker efter "slædekørsel".

På strækningen umiddelbart efter 1. afstandsmærke og frem til AM signal 2173 er der vegetation på begge sider, herunder lidt beboelse med træer og hække. Vegetationen vil kunne medvirke til "glatte/fedtede" skinner - Umiddelbart efter AM signal 2173 er der åbent på begge sider af banelegemet, og således ikke grundlag for "glatte/fedtede" skinner. Der er heller ikke vegetation fra AM signal 2153 til umiddelbart efter 1. afstandsmærke hen i mod AM signal 2173.

AM signal 2173 kan først ses få meter umiddelbart 2. afstandsmærke. Såfremt fuldbremsningen først er påbegyndt her, er det ikke usandsynligt at toget er kørt i "slæde" med aktive blokeringsbeskyttere helt hen forbi AM signal 2173 p.g.a. "glatte/fedtede" skinner, der er opstået p.g.a. meget stor fugtighed (tæt tåge) i luften og "bladsaft" fra vegetationen på netop dette sted. Umiddelbart efter AM signal 2173 er der ingen vegetation, hvilket medfører at "glatte/fedtede" skinner ophører kort efter passage af signalet.

Undersøgelsen er foretaget i samarbejde med Banedanmark V/Jørgen Hansen Odense via områdeleder Tom Larsen Fredericia, samt Hardy Olsen fra DSB Risk Management.

Med venlig hilsen
Hardy Olsen

TEKNOLOGISK INSTITUT

PRØVNINGSRAPPORT

Undersøgelse af materiale opsamlet fra jernbaneskinner.

Udarbejdet for:

Havarikommissionen for Civil Luftfart og Jernbane
Langebjergvænget 21
4000 Roskilde

Att.: Søren Groth
2011.12.20

TEKNOLOGISK INSTITUT

Prøvningsrapport

Rapport nr.: 2011561

Rekvirent: Havarikommissionen for Civil Luftfart og Jernbane
Langebjergvænget 21
4000 Roskilde

Att.: Søren Groth

Opgave: Undersøgelse af materiale opsamlet fra jernbaneskinner.

Prøver modtaget: 8. december 2011

Prøvetagning ved: rekvirent

Prøvning foretaget: uge 50 og 51, 2011

Prøvningsresultat: Resultaterne af prøvningen samt redegørelse for anvendt(e) metode(r) er anført på rapportens side 3, og vedrører kun de(t) prøvede emne(r).

Prøvningen er udført på almindelige vilkår for rekvirerede opgaver på Teknologisk Institut.

Prøvningsrapporten må kun gengives i uddrag, hvis rapporten er offentlig tilgængelig, eller hvis Center for Mikroteknologi og Overfladeanalyse har godkendt uddraget.

Center for Mikroteknologi og Overfladeanalyse, Taastrup
den 2011.12.20

Pia Wahlberg
Sektionsleder

Kenneth Haugshøj
Cand. scient.

INDLEDNING

Center for Mikroteknologi og Overfladeanalyse, Teknologisk Institut, har for Havarikommissionen for Civil Luftfart og Jernbane foretaget en undersøgelse af materiale opsamlet fra jernbaneskinner. Materialet er opsamlet på små træpinde. Materialet er undersøgt med henblik på identifikation. Prøverne var mærket: Prøve 1 til prøve 5.

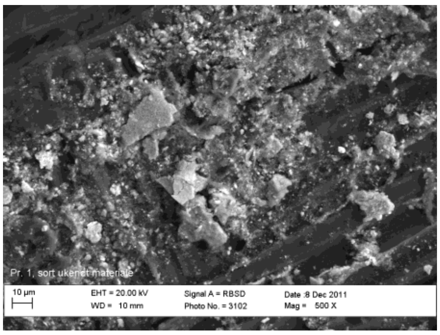
Materialet opsamlet i de fem prøver er mørkt. Materialet er efter klargøring undersøgt ved:

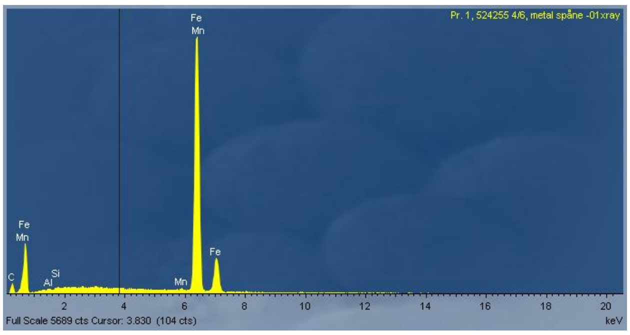
- Scanning elektronmikroskopi (SEM) forsynet med faciliteter til røntgenmikroanalyse (EDX). Ved SEM/EDX-undersøgelsen identificeres strukturen og grundstofsammensætningen af prøverne. Struktur og grundstofsammensætning dokumenteres i henholdsvis SEM-billeder og røntgenspektre.
- Infrarød spektrometri (FT-IR) for indhold af organisk materiale.

RESULTATER

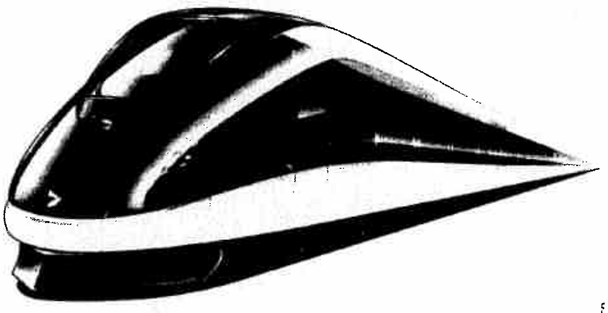
Resultatet af undersøgelsen viser, at de fem prøver af mørkt materiale opsamlet fra jernbaneskinner alle er dannet af en blanding af rust (jernoxid), sandkorn og små sten (silikater). Der er i prøverne ikke påvist olie eller fedt.

Nedenfor er vist et SEM-billede og et røntgenspektrum opsamlet fra en typisk prøve (prøve 1). SEM-billedet er taget ved en forstørrelse på 500 gange. Røntgen-spektrummet viser, at materialet opsamlet fra skinnerne består af ilt (O), jern (Fe) og silicium (Si). Materialet vurderes ud fra struktur og grundstofsammensætning at være dannet af jernoxid og silikater:





DMU - IC4



DRDT 15

PROVA DI SERIE SUL VEICOLO
VEHICLE ROUTINE TEST

BRAKE STATIC TEST

TEST REPORT

TEST RESULT

TRAIN N. 27

Performed 17/11 2011

DATA / DATE 17/11/11			
M1C N° TELAIO / UNDERFRAME No. **AA01KVZ/071/B**	**T2HK** N° TELAIO / UNDERFRAME No. **AA01KW0/023/O**	**T3** N° TELAIO / UNDERFRAME No. **AA01KW1/024/O**	**M4C** N° TELAIO / UNDERFRAME No. **AA01KVZ/066/B**

According to the procedure AA02JG2 DRDT15 rev14

18/11

	Expected value	Actual value
Ground fault value	-0,5 v< g.f<0,5	

Software Configuration in accordance to relevant design configuration document

Rev. DSB PARKE 1

Table of the Results

9.1 Prove preliminari Preliminary test

Ref. Procedure		Expected Value	OK
9.1.1 Controllo magnetotermici Switch control		**OK**	/
9.1.2 Controllo essiccatori Air dryer control		**OK**	/
9.1.3 Controllo rubinetti Cocks control		**OK**	/
9.1.4 Controllo pressostati Pressure switch control		**OK**	/
9.1.5 Corrispondenza pneumatica e elettrica degli assi Pneumatic and electric correspondence of the axles	**M1C**	**OK**	OK
	T3	**OK**	OK
	M4C	**OK**	OK
9.1.6 Corrispondenze EVS, EVF, Dump valveEVS, EVF, Dump valve correspondence	**a)**	**OK**	OK
	b)	**OK**	OK
	c)	**OK**	OK
	d)	**OK**	OK
	e)	**OK**	OK
	f)	**OK**	OK
9.1.7 Verifica funzionale dispositivo 5A50 Functional check of 5A50 devices	**a)**	**OK**	/
	b)	**OK**	/
9.1.8 Verifica trasduttori 5B51→5B60 Check of 5B51→5B60 transducers	**a)**	**OK**	/

18/11

9.2 PROVE SULLA PRIMA MOTRICE Test on the First Motor Coach

9.2.1 Prove Funzionali Freno Pneumatico Pneumatic Brake Functional Test

Ref. Procedure		Expected Value	OK
9.2.1.1 Pattini Magnetic Tracke Brake	a)	OK	
	b)	OK	
	c)	OK	
	d)	OK	
	e)	OK	
	f)	OK	
	g)	OK	
	h)	OK	
	i)	OK	
	j)	OK	
	k)	OK	
	l)	OK	
	m)	OK	
	n)	OK	
	o)	OK	
	p)	OK	
	q)	OK	
	r)	OK	
	s)	OK	
	t)	OK	
	u)	OK	
	v)	OK	
	w)	OK	
	x)	OK	
	y)	OK	
	z)	OK	
Verifica CFG 1419 CFG 1419 verification		OK	
9.2.1.2 Test freno di parcheggio Test of parking brake	a)	OK	
Controlli in M1C Check in M1C	a)	OK	
	b)	OK	
	c)	OK	
	d)	OK	
	e)	OK	
	f)	OK	
Controlli in T3 Check in T3	a)	OK	
	b)	OK	
	c)	OK	
	d)	OK	

According to the procedure AA02JG2 DRDT15 rev14

18/11 [signature]

Ref. Procedure		Expected Value	OK
	e)	OK	
	f)	OK	
	g)	OK	
	h)	OK	
	i)	OK	
Controlli in M4C Check in M4C	a)	OK	
	b)	OK	
	c)	OK	
	d)	OK	
	e)	OK	
	f)	OK	
Section Added for DMU1773	a)	OK	
	b)	OK	
	c)	OK	
	d)	OK	
	e)	OK	
	f)	OK	
Test Funzionale Functional test	a)	OK	
	b)	OK	
	c)	OK	
	d)	OK	
	e)	OK	
	f)	OK	
Secondo Carrello Second Boogie	a)	OK	
	b)	OK	
	c)	OK	
	d)	OK	
	e)	OK	
	f)	OK	
Terzo Carrello Third Boogie	g)	OK	
	h)	OK	
	i)	OK	
	j)	OK	
Quarto Carrello Fourth Boogie	k)	OK	
	l)	OK	
	m)	OK	
	n)	OK	
	o)	OK	
	p)	OK	

According to the procedure AA02JG2 DRDT15 rev14

9.2.1.3 Verifica delle pressioni delle sospensioni dei cilindri freno a tara
Check of the pressure of suspension and of brake cylinders at tara load

Condition	Acronymus	BOGIE 1		BOGIE 2		BOGIE 3		BOGIE 4		BOGIE 5	
		TP_{LP} [bar]	TP_{PFA} [bar]	TP_{LP} [bar]	TP_{PFA} [bar]	TP_{LP} [bar]	TP_{PFA} [bar]	TP_{LP} [bar]	TP_{PFA} [bar]	TP_{LP} [bar]	TP_{PFA} [bar]
TARE	AWO	**5.6** ±0,5	**2.7** ±0,2	**4.7** ±0,7	**2.7** ±0,2	**4.2** ±0,7	**3** ±0,2	**4.7** ±0,7	**2.7** ±0,2	**5.6** ±0,5	**2.7** ±0,2
			Axle 1		Axle 3		Axle 5		Axle 7		Axle 9
			Axle 2		Axle 4		Axle 6		Axle 8		Axle 10

Ref. Procedure		Expected Value	OK
9.2.1.4 Frenatura di sicurezza attraverso il master controller, il fungo e l'uomo morto a tara **Safety brake by means of master controller, mushroom push button, and dead man at tare load**	a)	OK	
	b)	OK	
	c)	OK	
	d)	OK	
	e)	OK	
	f)	OK	
	g)	OK	

9.2.2 Prove funzionali freno elettro-pneumatico — **Electro-pneumatic brake functional test**

Ref. Procedure		Expected Value	OK
9.2.2.1 Verifica posizioni del manettino **Master controller position check**		OK	
9.2.2.1 Freno elettro-pneumatico a tara **Electro-pneumatic at tare load**		OK	
9.2.2.2 Freno elettro-pneumatico a tara **Electro-pneumatic at tare load**	a)	OK	
	b)	OK	
	c)	OK	
	d)	OK	
	e)	OK	
	f)	OK	
	g)	OK	
	h)	OK	
	i)	OK	
	j)	OK	
	k)	OK	
	l)	OK	
	m)	OK	
	n)	OK	

According to the procedure AA02JG2 DRDT15 rev14

16/4 [signature]

Ref. Procedure		Expected Value	OK
9.2.3 Test automatico del freno (commutazione freno EP/IP) Automatic brake test (brake EP/IP)	**a)**	**OK**	
	b)	**OK**	
9.2.3.1 Isolamento assi Carrello Bogie axle isolation	**a)**	**OK**	
	b)	**OK**	
	c)	**OK**	
	d)	**OK**	
	e)	**OK**	
	f)	**OK**	
	g)	**OK**	
	h)	**OK**	
	i)	**OK**	
	j)	**OK**	
	k)	**OK**	
	l)	**OK**	
	m)	**OK**	
	n)	**OK**	
	o)	**OK**	
	p)	**OK**	
	q)	**OK**	
	r)	**OK**	
	s)	**OK**	
	t)	**OK**	

Ref. Procedure		Expected Value	OK
9.2.4 Test WSP	**a)**	**OK**	Ok
	b)	**OK**	OK
	c)	**OK**	OK
	d)	**OK**	OK
9.2.5 Test rilascio forzato holding brake 4S17 Test of forced release of holding brake by 4S17	**a)**	**OK**	
	b)	**OK**	
9.2.6 Test Ungibordo Wheel flange lubrication system test		**OK**	

According to the procedure AA02JG2 DRDT15 rev14

18/1/[illegible]

9.3 PROVE SULLA SECONDO MOTRICE TEST ON THE SECOND MOTOR COACH

9.3.1 Prove Funzionali Freno Pneumatico Pneumatic Brake Functional Test

Ref. Procedure		Expected Value	OK
9.3.1.1 Pattini Magnetic Tracke Brake Verifica CFG 1419 CFG 1419 verification		OK	/
9.3.1.2 Test freno di parcheggio Test of parking brake	a)	OK	/
	b)	OK	/
	c)	OK	/
9.3.1.3 Frenatura di sicurezza attraverso il master controller, il fungo e l'uomo morto a tara Safety brake by means of master controller, mushroom push button, and dead man at tare load	a)	OK	/
	b)	OK	/
	c)	OK	/
	d)	OK	/
	e)	OK	/
	f)	OK	/
	g)	OK	/

Ref. Procedure		Expected Value	OK
9.3.2 Test automatico del freno Automatic brake test	a)	OK	OK
	b)	OK	OK

Ref. Procedure	Expected Value	OK
9.2.6 Test Ungibordo Wheel flange lubrication system test	OK	/

18/11 [signature]

NOTE (ELENCO OPEN-ITEM):
NOTES (OPEN ITEMS LIST):

LISTA MANCANTI:
MISSING PARTS LIST:

DEVIAZIONI RISPETTO ALLA PROCEDURA:
DEVIATIONS FROM THE PROCEDURE:

ELENCO ALLEGATI:
ATTACHMENTS LIST:

SEE ATTACHMENT TO THE TEST REPORT OF DRDT 15 CARRIED OUT ON TRAIN 27

STRUMENTI / *INSTRUMENTS*		
TIPO *TYPE*	**N° MATR.** *SERIAL NUMBER*	**DATA CALIBRAZIONE** *DATE OF CALIBRATION*

ESITO DEL TEST / TEST RESULT			
INCOMPLETO INCOMPLETE	☐	CONFORME COMPLIANT	☒

Firma del collaudatore: *Tester's signature:*	**Firma dell'ispettore:** *Inspector signature:*

Ole Mortensen, DSB
[signature], AB
[signature], AB

DATA: *DATE:* 17/11/2011

According to the procedure AA02JG2 DRDT15 rev14

18/11 [initials]

Attachment to the test report of DRDT 15 carried out on Train 27

Participants:

AB	Gabriele Casella Davide Marandola Marco Storri
DSB	Ole Mårtesson Enrik Just Steen L. Andersen
AIB	Bo Haaning Søren Groth

NOTE:

- Wheel Diameter in the BCU-T3 on axle 5 it was set to 860mm instead of the real diameter of **849mm**
- The reason why was isolated both Magnetic Track Brakes could be the message CCU_PA 111 and CCU_PA 112 relevant to the error code on 5K07 M1 and 5K07 M4 have been wrong translated on the Danish MMI Database. 5K07 has been exchanged with 5E07 relevant to the PAP - pressure switch for Magnetic Track Brake.

AB:

DSB:

AIB:

18/6

Bilag 4.4
Havarikommissionen
611-2011-23

Test program and principal test report for MG5627 Vojens 01 - 05 Dec 2011.
Revised on the 8th of December
The A and B where the planed program.

Priority 1

TEST record number	Test Identification	Description	Brake mode	V0	File name	Criteria	Braking distance	Start Braking line Km	Remark and time	Driving from M1C or M4C
				km/h		m/s²	m	Km		
1 2/12	A1	Speed Step up (Dry)	7' + HD	120		â ³ 1,0	550	65.0	11.15	M4C
22 3/12	A1/1			120			550	70,2	17.04	M1C
2	A2	Speed Step up (	7' + HD	140		â ³ 1,1	700	70	11.25	M4C
3	A1/2	Speed Step up (Dry)		120	Failed				11:52	M1C
4 2/12	A3	Speed Step up (	8' + MTB ej HD	160		â ³ 1,2	650	69,6	13:00	M4C
23 3/12	A3/5			160			900	68		M4C
5	A4	Speed Step up (	8' + MTB	180		â ³ 1,2	850	69,6	13.24	M1C
6	SSV	Speed signal verification dry track		180	GPS failed due to missin g power but all BCU was record ed.	All 12 speed signals are correct and without noise or jumps. Train is braked by MTB brake only.	Check in the DLU and BCU plus ATC logger unit.		3 timeouts of 60 sec. before standstill by MTB. One PP switched off before and during retardation.	M4C
7	BCU SCAl	BCU takes the highest of the axle speeds?		180		Brake in step 7 can maybe be made A4	11:50	69.6	Aprox 15.12	M1C
15	A5/1	Dry track	7' + HD	160		â ³ 1,0	950	65	18.57 light rain much slide but only at top speed.	M4C
20	A6	Dry track	7' - HD	160	Ok Files	â ³ 1,0	900	66	20:51	M4C
24	A6/1	Dry track	7' - HD	160			900	70,2	17:31	M1C
21	A7	Dry track	7' - HD	160		â ³ 1,0	950	73	20:57 warm brakes	M4C
16	A5/2						950	85	19:07 Not trigged correct GPS fails in M1C.	M1C
17	A5/3								Fail because of PP3 drop out	
18	A5/4				Ok Files		925	74	20.18	M1C
	A8	Dry track	8' + MTB	160		â ³ 1,2				
	A9	Dry track	8' + MTB	180		â ³ 1,2				
12	A10	Dry track	8' - MTB	160	Not all file	â ³ 1,0	850	84	ca 17:12	M4C
13	B11	Dry track	8' - MTB	160		â ³ 1,0	800	87	18:12:00 light rain some slide	M1C
11	A12	Dry track	8' - MTB	180		â ³ 1,0	950	70	17:02	M4C
14	A13	Dry track	8' - MTB	180		â ³ 1,0	1100	65	18.28 light rain much slide	M1C
	A56	Smooth Track	7' + HD	120						
	A57	Smooth Track	7' + HD	140						
	A14	Smooth Track	7' + HD	160		UIC 541-05				
	A15	Smooth Track	7' + HD	160		UIC 541-05				

	A16	Smooth Track	7' - HD	160		UIC 541-05				
	A17	Smooth Track	7' - HD	160		UIC 541-05				
	A18	Smooth Track	8' - MTB	160		UIC 541-05				
	A19	Smooth Track	8' - MTB	160		UIC 541-05				
	A20	Smooth Track	8' - MTB	180		UIC 541-05				
	A21	Smooth Track	8' - MTB	180		UIC 541-05				
	A22	Smooth Track	8' + MTB	160		UIC 541-05				
	A23	Smooth Track	8' + MTB	160		UIC 541-05				
	A24	Smooth Track	8' - MTB	180		UIC 541-05				
	A25	Smooth Track	8' - MTB	180		UIC 541-05				
	A26	Very Smooth Tra	8' - MTB	180		WSP activity similar to incident				
	A27	Very Smooth Tra	8' - MTB	180		WSP activity similar to incident				
	A28	Very Smooth Tra	8' + MTB	180		WSP activity similar to incident				

Priority 2

TEST RECORD Number and Date.	Test Identification	Rail condition	Brake mode	V_0	OK/NOK	Criteria	Start Braking	Braking distance	Remark a	Driving from M1C or M4C
				km/h		m/s^2	km	M		
	B29	Dry track	7' + HD	160		â ³ 1,0				
	B30	Dry track	7' + HD	160		â ³ 1,0				
	B31	Dry track	7' + HD	160		â ³ 1,0				
	B32	Dry track	7' - HD	160		â ³ 1,0				
	B33	Dry track	7' - HD	160		â ³ 1,0				
	B34	Dry track	8' + MTB	160		â ³ 1,2				
	B35	Dry track	8' + MTB	160		â ³ 1,2				
	B36	Dry track	8' - MTB	160		â ³ 1,0				
	B37	Dry track	8' - MTB	160		â ³ 1,0				
33	B38/3	Very slippery 50% soap	7 + HD	160			Slide Br % lowering	1200	01.10	M1C
32	B38/2	Very slippery 50% soap	7 + HD	160			Wheel Block in soap	975 m rain	00.43	M1C
31	B38/1	Very slippery	7' + HD	160		Very smooth	Sliding Friction at aprox 4% Br % lowering	at Km 67,2 1100m	00:21	M1C
30	B38	Smooth Track	7' + HD	160		Very smooth	sliding	1150m from Km 69,8	00:00	M4C
	B39	Smooth Track	7' + HD	160		UIC 541-05				
26	B40	Smooth Track	7' - HD	160		UIC 541-05	no slide.	900	21:25	M4C
27	B41	Smooth Track	7' - HD	160		UIC 541-05 7,5%	Friction at aprox 4% Br % lowering.	1200	22:52	M1C
28	B41/1	Smooth Track	7' - HD	160		UIC 541-05 7,5%	Slide Br % lowering	not noted	23:00	M1C

29	B41/2	Smooth Track	7' - HD	160		UIC 541-05 7,5%	Slide Br % lowering	1100	23.44	M4C
	B42	Smooth Track	8' - MTB	160		UIC 541-05				
	B43	Smooth Track	8' - MTB	160		UIC 541-05				
	B44	Smooth Track	8' + MTB	160		UIC 541-05				
	B45	Smooth Track	8' + MTB	160		UIC 541-05				
	B46	Very Smooth Track	8' - MTB	180		WSP activity similar to incident				
	B47	Very Smooth Track	8' - MTB	180		WSP activity similar to incident				
	B48	Very Smooth Track	8' - MTB	180		WSP activity similar to incident				
	B49	Very Smooth Track	8' - MTB	180		WSP activity similar to incident				
	B50	Very Smooth Track	8' + MTB	180		WSP activity similar to incident				
	B51	Very Smooth Track	slowly brake step increase from 1 to 7	180		WSP activity similar to incident				
	B52	Very Smooth Track	Slowly brake step increase from 1 to 8 w/O MTB	180		WASP activity similar to incident				
	B53	Very Smooth Track	Slowly brake step increase from 1 to 8 with MTB	180		WASP activity similar to incident				

Other test made

	Cxx		Brake mode		File name		**Start Braking**	**Braking distance**	**Remark time**	**Driving from M1C or M4C**
25	**C60/1**	Soap	Step 7 - HD	120		Brake % write down fault on axel 5 or 6.		800	20:40	M4C
8	A54/1	Dry rails.	Time domain increase brake steps like Marslev -(-MTB) step 2 at 0 sec , step 3 after 4 sec from begin, step 4 after 14sec, after 17 sec step 5, after 21 sec step 6 , after 27 sec step 7, after 34 step 8.		Several missing files		72,2	73,820= 1620	15.52	M4C

9	A54/2	Dry rails.	Time domain increase brake steps like Marslev		Files OK			Not noted	16:28	M1C
10	A54/3	Dry rails.	Time domain increase brake steps like Marslev		Failed					M1C
19	A55		Like A54/x plus MTB		Part time Slide		65	1700	20.23	M1C
34	C70/1	soap + pre spay of soap mix 7 or 5%	Brake step 7 + HD	180	Much slide due soap and rain		68,2	1400	01:41	M1C
35	C70/2	soap + pre spay of soap mix 7 or 5%	Brake step 7 + HD	180	Much slide due soap and rain		68,2	1300	02:12	M1C
36	C70/3	100%soap + pre spay of soap mix 50%	Brake step 7 + HD	180	One PP Fault and therefo re loss of GPS data		68,2	1300	02.44	M1C
37	C70/4	100% soap + pre spay of soap 100%	Brake step 7 + HD switch off HD during braking	180	light rain		68,8	1200	03:03	M4C
38	C80/1	50%soap + pre spay of soap mix 7 or 5%	Brake step 7 + HD and from 140 step 8 w/o MTB	180	No rain some slide		68,2	1300	03:21	M1C
39	C80/2	50% soap + pre spay of soap 50%	Brake step 7 + HD and from 140 step 8 w/o MTB	180	hardly no slide		68	1100	03:38	M4C
40	C90/1	50%soap + pre spay of soap mix 50%	Brake step 7 + HD and from 140 step 8 w/o MTB	180	hardly no slide		68,2	1200	03:55	M1C
41 4/12	D1/1	50%soap + pre spay of soap mix 50%	Brake step 8 - MTB	160	some slide		68,2	1000	17:03	M4C
42	D2/1	50% Soap	Brake step 8 - MTB	180	Rain + Slide		69,8	1100	17:30	M1C
43	D1/2	50% Soap	Brake step 8 - MTB	160	little Slide		68,2	900	17:43	M4C

44	E1/1	Shampoo on 300 m from km 69,5 to 69,8	Brake step 8 - MTB	160			69,8			M1C
45	E1/2	Shampoo on 300 m from km 69,5 to 69,8 plus 50% soap during running on front bogie	Brake step 8 - MTB	160			69,6	900	18.05	M4C
46	F1/1	Step 7 + HD after rain	Step 7 + HD after rain	180	Much slide	plus 50% soap purrede during running.	69,8	1375	19:16	M1C
47	G1/1	Food oil on rail from 69,6 - 68,9 manual and foam applied.	Step 7 + HD after light rain/hail	180	Al PFA switch ed= brake loose		69	1400	21:02	M4C
48	G1/2	10 minutes rain from G1/1	Step 7 + HD	180	Not very low cylinde r pressu res.		70	1400	21.20	M1C
49	H1/1	Food oil purred onto the rail top by pump at the end of the train. Total 2,1 km (67,9- 70,0)	Step 7 + HD	180	only 173 km/h at test.		68	3100m DLU only 1823m long periods with 9 km/h on DLU.	23:35	M4C
50	I1/1	Like Marslev incident simulation in time domain. Brake step by step.Time domain increase brake steps like Marslev -(-MTB) step 2 at 0 sec , step 3 after 4 sec from begin, step 4 after 14sec, after 17 sec step 5, after 21 sec step 6 , after 27 sec step 7, after 34 step 8.	very slippery1 to 8 - MTB	180	Very low cylinde r pressu res. But no WSP time out.		70	2900m GPS gave 2800m Wheel flats on Axel 4 big to be investigat ed was class B2 (but close to B3).	23:50	M1C

51	J1/1	Step 8 + MTB	very very slippery still and no rain	180			68	1475m train checked for big Wheel flats. No Big but many new wheel flats.	00:53	M4C
52	E1/3	Step 8 - MTB	very very slippery still and no rain	180		Drivers Speed odometer (axel 4) showed nil, the train was moving with 140 km/h. Several wheel flats after the test. Train unable to used for further test runs.	70	1650 m DLU only 289 m. Many very big wheel flats the train can not be use for test runs any more	just after 1:00	M1C

2nd of December 2011
Weather 3,9 C light wind from SW light showers and sun at the day.
Very good conditions and dry and clean rails during the day and only light showers at other time.
Test runs made 1 to and with 21. Rain during test run 12 to 14.

3rd and 4th of December.
Weather 1 to 4 degrees C fresh to moderate wind from SW max 9 m/s short showers with hail and water/snow mix time to time.
Time to time dry and clean rail condition even at night between short : rather intensive.
Test run made from 22 to and with 40.
The people on the rail cleaning vehicle after the test runs informed

4th and 5th of December.
Weather around 2 degrees C but frost on ground from around midnight
Moderate wind 5-9 m/s except from short showers with rain and hail , low wind between the showers.
The rail where first pre spayed med 50% UIC soap (grovrens) before tested run 41 to 43.
Afterwards pre spayed with shampoo but the substance look like mayonnaise and was not nicely even applied on top of the rails contact surface from km 69,5 to 69,8 = 300 m. Test run 44 to 46. at the last (46)test run 50% UIC soap was sprayed/pured in front of the front wheel during running. This did not produce very low fiction properly due the "mayonnaise" contains too little shampoo and a short rain shower can have reduced the friction.
Food oil applied from the rear end of the train uneven on top of rail from km 69,6 to - 68,9 = 700 m also by hand.
This produced very very low friction in test run 47 and 48 even in the other direction without extra oil on the rails.
The second oil spay was placed directly on top of rail at the contact surface from 2 hoses (9 mm) in a unbroken beam
This applications method works good therefore food oil was purred from km 70,0 - 67,9 = 2,1 km
Following 4 test runs 49-52 where made without adding more oil on the rail surface.
After the test runs the rail was washed.

DSB	IC4 IC2	IC4 Programmet København Århus

Test Report

Test on IC4 MG5660 and IC3 MF5011 in Vojens in relation to the incident in Marslev 07 Nov. 2011

Editor	Reviewer	
Ole Mårtensson	**Lars Slott J.**	

1 Introduction

- The 07 Nov. 2011, MG5627 passed a signal in red close to Marslev on island Fyn in Denmark.

- Train set MG5627 was tested in Vojens in the period 02. - 05. Dec. 2011 on the east track between the stations Vojens st. (OJ) and Rødekro st. (Rg). The aim of these tests was to verify the right functionality of the Brake system on train set MG5627 and to simulate the incident in Marslev. The test report is found in ref. /1/

Train set MG5660 and IC3 MF5011 was tested in Vojens in the period of 10. - 11 Jan. 2012. The aim of this test was to compare the brake performance of IC4 MG5660 with IC3 MF5011 and IC4 MG5627 on dry track and contaminated track with very low adhesion.

2 Description of the IC4 and IC3 train set

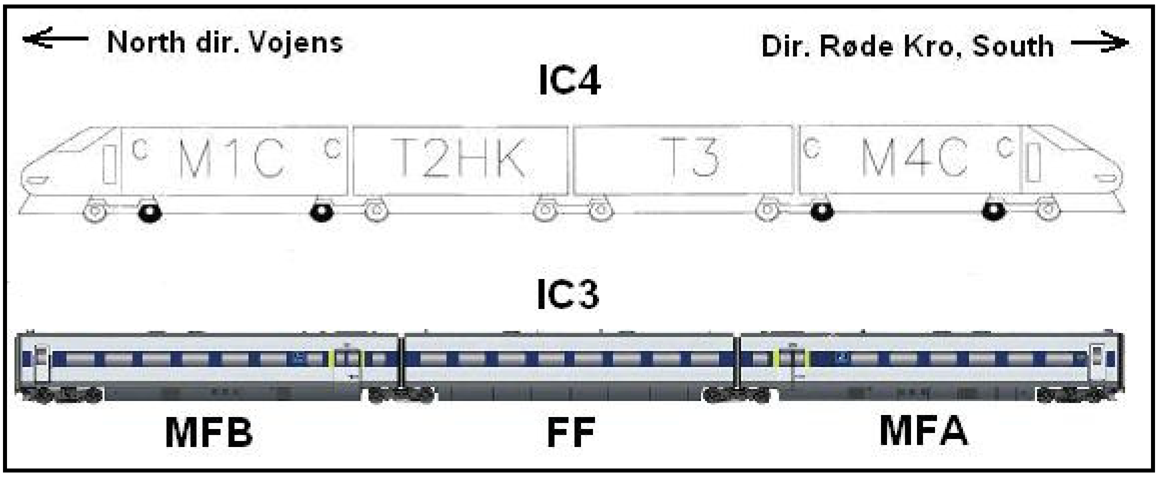


Figure 1: External Schematics of IC4 and IC3 with orientation during test in Vojens

IC4 and IC3 is a Diesel multiple train Unit (DMU) with four and three cars respectively.

Characteristics	IC4	IC3	mass
Length	86	59	m
Weight, Tara	163	97	ton
No. of axles	10	8	
Max. speed	180	180	Km/h

Figure 2: Characteristic data for IC4 and IC3

/1/ DSB, P000231742: "Test Report for test on IC4 Train set no. 27 in Vojens in relation to the incident in Marslev 07 Nov. 2011", 04-01-2012

3 Description of the Brake Systems on IC4 and IC3

Both IC4 and IC3 is equipped with an direct acting computer controlled EP-brake system, in parallel to a conventional Indirect acting pneumatic Brake System (IP), based on a distributor valve controlled 5 bar Brake Pipe system.
IC3 has separate IP and EP Brake valve on the driver's desk. In IC4 these are integrated in the Master Controller. Thus, the brake pipe pressure will always follow the brake request on IC4, on IC3 the pressure in the brake Pipe is reduced by the IP brake handle only in emergency.

Characteristics	IC4	IC3	mass
Wheel axles	10	8	
Brake Calipers	26	16	
Magnetic track Brakes	2	2	
Parking Brake Calipers	8	8	
Distributor Valves	3	2	
Brake Computers	3	2	
Brake Percentage	170	184	%
Adhesion Utilization	15	12	%

Figure 3: Brake characteristic data for IC4 and IC3

4 Test description

The test was carried out in the period of 10. - 11. Jan. 2012 on the east track between the stations Vojens station (Oj) and Rødekro station (Rg) in km 59,2 and 79,6 respectively. The IC4 and IC3 train sets was orientated according to Figure 1.

Date and time	Remarks	Weather condition
10. Jan. 2012 12:00 - 15:00	Test carried out on dry rails only.	Ambient temperature 5 °C - 6 °C. High humidity. Light wind 2 - 3 m/s from SW. Partly cloudy
11. Jan. 2012 11:00 - 16:00	Rail prepared with oil over a distance of 2,1 km started from km 67,9 to km 70,0 to reduce the adhesion to a level about or less than 2 %. Rail became prepared to times, one before test of IC4 and IC3 respectively	Ambient temperature 4 °C - 7 °C. Moderate humidity. Light wind 8 - 10 m/s from W. Cloudy. During after noon lighter wind and sun shine

Most of the test is carried out at line from km 68 to km 70. The gradient of this part of the line is given in the following table, given in direction south.

Position km	DH: Down hill UH: Up hill	Gradient
67,92 - 68,32	DH South	2,48 ‰
68,32 - 68,76	UH South	0,99 ‰
68,76 - 68,92	DH South	1,04 ‰
68,92 - 69,47		0,00 ‰
69,47 - 69,79	UH South	3,11 ‰
69,79 - 70,05	UH South	5,55 ‰
Average	UH South	0,81 ‰

Figure 4: Gradient on test line

The test participants are given in Annex G:

5 Test Scheme

The precondition for the test runs and the test data Id. is schematically set up in the table in Annex A.

The columns in Annex A are described in the following table:

Test No.	Test run number in the sequence	**Train Set**	Id. of the train set to be tested. IC4 or IC3
Test Id.	Identification name of the test. Indicating similar test condition, and comparable with test according to report /1/	**Time for initiation of Brake**	The time when the brake is initiated according to the Data Logging Unite (DLU) records
Description	Short description of the test performance and rail condition, dry or wet	**Brake Mode**	Brake type: 7': Max. Service Brake 8': Emergency Brake HD: Hydraulic Brake (Intarder) MTB: Magnetic Track Brake
Initial speed	Nominal Train velocity when the brake is Initiated	**Remarks**	Remarks to the test results.
Criteria	The success criteria for the test. Mainly according to the contract or relevant standards	**Braking distance**	The braking distance measured from the driver has applied the brake to stand still. Measured manually by marks along the track
Position	Train position on the track where the brake is initiated.	**Running direction**	Running direction during the test, and the Id. of the front car according to Figure 1
Data file name from recording of div. Systems	Test Id. for each system recorded during the tests. No Test Id. is due lack of test recording for the individual systems		

6 Test data

The test data is found in the file /2/ in 'MS Excel 2003'- and Adobe format
Each system has test data files according to the last eight columns table of Annex A: columns: "Data file name from recording of div. Systems". In case of absence of test Id. in these columns, no test data are available.

Where the abbreviation for the system are according to following scheme:

Abbreviation	**System**
IDU	Integrated Diagnostic Unite
BCU	Brake Control Unit
DLU	Data Logging Unit
TC	Train Computer
GPS	Global Positioning System

/2/ DSB, P000235317: "Test data form test IC3 and IC4 10.-11.01.2012 (P000235317).rar"

The recorded test data are described in following annexes:

Abbreviation	Train set	Annex
IDU	IC4	Annex B:
BCU	IC4	Annex C:
DLU	IC4	Annex D:
DLU	IC3	Annex E:
TC	IC4	Annex F:

Remarks to the recorded data:

- The IDU messages is not recorded on the IC3
- On IC3 the most relevant data (train speed, wheel speed, Brake cylinder Pressure, Master controller Position) from the BCU is recorded by the Train computer (TC)
- The digital DLU data on IC3 is primary restricted to data relevant for ATC only
- The available TC data of IC3 is very comprehensive and not described in annex. The headline of the data describes the data to some extend. The most relevant analog data is presented on graph in Adobe format.
- The headline of the GPS data gives good description of the data for both IC4 and IC3. The acceleration data is positive in north direction and given in the unite of gravity (g) [9,82 m/s²]

7 Correction of the measured Brake Distances

The measured Brake Distances is corrected by the up- and down hill gradient on the line and the deviation of the initial speed compared to the nominal speed.
This correction is done according to appendix F.2 of UIC 544-1, See Annex H:

8 Test results

8.1 Test results on dry track

The test on dry track was carried out on Tuesday the 10 January 2012 in Vojens.
The tests were carried out according to Test Scheme Annex A:
The test data is found in document /2/
The Brake Distances is recorded by extern GPS equipment and the train Data Logging Unite (DLU) and corrected according to sec. 7

8.1.1 IC4 Brake Distance on dry track

Test	**Gradient [‰]**	**Test Mode**	**Speed [km/h]**			**Brake distance [m]**			
	+ Up Hill		**Nominal**	**Initial**		**Measured**		**Corrected**	
	- Down			**GPS**	**DLU**	**GPS**	**DLU**	**GPS**	**DLU**
2	-4,20	7' + HD	160	161,0	161	971,0	964	**926**	**920**
3	1,22	7' + HD	160	161,5	161	943,0	941	**935**	**939**
4	-0,72	8' + MTB	180	180,5	180	918,4	922	**909**	**918**
5	-2,16	8' + MTB	180	181,0	181	959,0	950	**935**	**926**
6	-0,72	8' - MTB	180	180,5	180	1051,2	1043	**1040**	**1037**
7	-2,16	8' - MTB	180	181,1	181	1082,7	1082	**1052**	**1053**
8	-0,72	7' - HD	180	180,5	180	1151,2	1143	**1138**	**1136**
9	-2,16	7' - HD	180	181,1	181	1161,3	1157	**1127**	**1124**

Figure 5: IC4 Brake distance on dry track

8.1.2 IC3 Brake Distance on dry track

Test	Gradient [‰]	Test Mode	Speed [km/h]			Brake distance [m]			
	+ Up Hill		Nominal	Initial		Measured		Corrected	
	- Down			GPS	DLU	GPS	DLU	GPS	DLU
11	-2,16	8' + MTB	180	179,8	183	1088,6	1125	**1073**	**1070**
12	-0,72	8' + MTB	180	184,9	188	1104,8	1135	**1041**	**1035**
13	-2,16	8' - MTB	180	183,6	186	1425,0	1460	**1341**	**1339**
14	-0,72	8' - MTB	180	184,0	187	1410,2	1440	**1340**	**1325**

Figure 6: IC3 Brake Distance on dry track

8.2 Test results on oil contaminated rails

Before testing of IC3 and IC4 the rails was contaminated by oil over a distance of 2,1 km. The amount of oil was 65 litters and 45 litters for IC3 and IC4 respectively. The oil was only applied once before testing each train sets. There were four test runs on the same oil for IC3 and three for IC4.

Just after the contamination, the rail - wheel adhesion was fare below the range for normal UIC test program (5 % - 8 %) according UIC 544-05.

After the contamination the adhesion is expected to be 2 % or below.

8.2.1 IC3 Brake Distance on low adhesion

Prior to the test 65 litter of oil was applied to the rail head over a distance of 2,1 km. All four tests (Test 21 - 24) were carried out on the same oil.

Test	Gradient [‰]	Times	Locked	Test Mode	Speed [km/h]			Brake distance [m]			
	+ Up Hill	on Oil	Wheels		Nominal	Initial		Measured		Corrected	
	- Down					GPS	DLU	GPS	DLU	GPS	DLU
21	-0,81	1.	none	8' + MTB	180	184,2	187	2535,5	2520	**2388**	**2304**
22	0,81	2.	none	8' - MTB	180	187,7	191	2778,3	2805	**2593**	**2528**
23	-0,81	3.	none	8' + MTB	180	184,5	187	2396,4	2380	**2251**	**2177**
24	0,81	4.	none	8' - MTB	180	187,9	191	2685,5	2455	**2500**	**2208**

8.2.2 IC4 Brake Distance on low adhesion

Prior to the test 45 litter of oil was applied to the rail head over a distance of 2,1 km. All three tests (Test 27 - 29) were carried out on the same oil.

Test	Gradient [‰]	Times	Locked	Test Mode	Speed [km/h]		Brake distance [m]					
	+ Up Hill	on Oil	Wheels		Nominal	Initial		Measured		Corrected	
	- Down					GPS	DLU	GPS	DLU	GPS	DLU
27	0,81	1.	3, 4, 7, 8 partly	8' + MTB	180	180,0	180	2173,6	248	**2201**	**248**
28	-0,81	2.	none	8' - MTB	180	179,9	180	1658,5	1428	**1645**	**1416**
29	0,81	3.	3 partly, 4, 7, 8 partly	8' + MTB	180	180,1	180	1523,8	371	**1536**	**372**

8.2.3 Wheel locking on very low adhesion

The IC3 did not show any locked wheels during the test on low adhesion.

According to the test carried out on IC4 train set 5607 See. Document /1/, IC4 did not show any wheel lock at neither dry track nor test with adhesion within the conventional UIC test program according to UIC 544-05.

At test 27 and test 29 on very low adhesion IC4 had locked wheels.

8.2.3.1 Locked Wheels during test 27

During test 27 IC4 had locked wheels on axle 3, 4, 7 and partly on axle 8 according to BCU records. Axle 3, 4 and 7 was locked 60 % - 80 % of the Brake duration; Axle 8 was locked about 3 % of the Brake duration.

The IDU gave following five relevant messages:

No	Time	Status	Car	Description	Brake Pipe	Speed
1	15:17:11	START	M4C	Parkeringsbremse ikke helt aktiveret på MG58	0	114
2	15:17:12	END	M4C	Parkeringsbremse ikke helt aktiveret på MG58	0	124
3	15:17:19	START	M1C	Fejl på WSP hastighedsgiver på Aksel 3 på MG56	0	104
4	15:17:19	START	M1C	Fejl på WSP hastighedsgiver på Aksel 4 på MG56	0	103
5	15:17:19	START	M4C	Fejl på WSP hastighedsgiver på Aksel 7 på MG58	0	103
6	15:17:20	START	M4C	Fejl på WSP hastighedsgiver på Aksel 9 på MG58	0	104
7	15:17:28	END	M4C	Fejl på WSP hastighedsgiver på Aksel 9 på MG58	0	95
8	15:18:21	END	M4C	Fejl på WSP hastighedsgiver på Aksel 7 på MG58	1949	0
9	15:18:39	END	M1C	Fejl på WSP hastighedsgiver på Aksel 3 på MG56	4981	0
10	15:18:39	END	M1C	Fejl på WSP hastighedsgiver på Aksel 4 på MG56	4981	0

The Brake was applied at 15:16:55 and the train stand still before expire of the fault on axle 3, 4 and 7.
At 15:17:11 the Parking Brake was partly applied on the M4C car in duration of about one sec.
The speed sensors on axle 3, 4, 7 and 9 were simultaneously excluded by the WSP-system.
When the WSP exclude a speed sensor, the WSP system became inactive on the axle in question, and consequently the WSP Dump Valve pressurizes the Brake Cylinder.
According to the BCU-log the WSP-system on axle 9 was active during the entire test 27, thus the message regarding axle 9 is not obviously

8.2.3.2 Locked Wheels during test 29

The trend of wheel axle locking during test 29 is very similar to that of test 27.
During test 29 IC4 had locked wheels on axle 4, 7 and partly on axle 3 and axle 8 according to BCU records. Axle 4 and 7 was locked 60 % - 80 % of the Brake duration. Axle 3 and axle 8 was locked 3 % - 5 % of the Brake duration.

The IDU gave following three relevant messages:

No	Time	Status	Car	Description	Brake Pipe	Speed
1	15:55:10	START	M1C	Parkeringsbremse ikke helt aktiveret på MG56	0	136
2	15:55:11	END	M1C	Parkeringsbremse ikke helt aktiveret på MG56	0	130
3	15:55:14	START	M1C	Fejl på WSP hastighedsgiver på Aksel 4 på MG56	0	124
4	15:55:14	START	M4C	Fejl på WSP hastighedsgiver på Aksel 7 på MG58	0	124
5	15:55:49	END	M1C	Fejl på WSP hastighedsgiver på Aksel 4 på MG56	0	0
6	15:56:07	END	M4C	Fejl på WSP hastighedsgiver på Aksel 7 på MG58	0	0

The Brake was applied at 15:54:51 and the train stand still before expire of the fault on axle 4 and 7.
At 15:55:10 the Parking Brake was partly applied on the M1C car in duration of about one sec.
The speed sensors on axle 4 and 7 were simultaneously excluded by the WSP-system. When the WSP exclude a speed sensor, the WSP system became inactive on the axle in question, and consequently, the WSP Dump Valve will pressurize the brake Cylinder.

9 Conclusion

On dry track the test results shows:

- In average the Brake Distance of the IC3 Emergency brake is about 21 % longer compared to the similar Brake application of IC4
- On IC4 the Magnetic Track brake (MTB) reduce the Brake distance with about 12 % at Emergency Brake from 180 km/h
- On IC3 the Magnetic Track brake (MTB) reduce the Brake distance with about 21 % at Emergency Brake from 180 km/h
- The consistence of the speed recorded by DLU and GPS is better on IC4 than on IC3

Before comparing the results of the brake performance of IC4 and IC3 on contaminated rails, a major reservation should be put on the contamination condition. The rails was contaminated by about 44 % (65 litter) more oil before the test of IC3, compared to the oil contamination before testing of IC4 (45 litter)

Under these reservations the test results shows:

- The IC4 has shorter brake distance than IC3.
  Reservation: The track was heavier contaminated before test of IC3
- The Brake distance of all four test of IC3 extend beyond the contaminated area of about 2,1 km

- Only the Brake distance of the first test (27) of IC4 extend beyond the contaminated area of about 2,1 km. At the last two tests of IC4, the train stopped before leaving the contaminated area.
- As a average; On IC3 the Magnetic Track Brake (MTB) reduced the Brake Distance with 227 m, or about 9 % on a distance of 2547 m.
  Reservation: Due to the fact, that the test without the MTB was done after the test with MTB, the cleaning affect of the contaminated rails will reduce the Braking Distance of the test without MTB compared to those with. The consequence is that the effect of the MTB is reduced.
- Outside expectation the Brake distance with MTB active on IC4 was about 34 % (556 m) longer than the Brake Distance without MTB active.
  Reservation: Due to the fact, that the test without the MTB was done after the test with MTB, the cleaning affect of the contaminated rails will reduce the Brake Distance of the test without MTB. The consequence is that the effect of the MTB can obviously not be deducted for IC4 by these results.
- IC3 had no locked wheels during braking at contaminated rails.
  IC4 had four locked wheel axles during braking at very low adhesion.
- The Brake Distances of IC4 is reduced significantly from test 27 to test 29. The best assumption is that this is due to the elevated cleaning effect by the blocked wheels. This assumption is based on the face, that the mean deceleration of IC4 during test 29 was about 0,81 m/s^2. This require a mean adhesion of more than 8,2 %, much above the expected adhesion after contamination of about 2 %.

In general and with the reservation on de deviation in the adhesion during the test program, IC4 shows the best performance on the Brake Distance, compared to IC3. On the ability to avoiding locking of the wheels IC3 had the best performance.

Annex A: Test Scheme

Test No.	Train set	Test Id.	Time for Initiation of Brake	Description	Brake mode	Initial Speed	Remarks	Criteria	Braking distance	Start Position	Running direction	Data file name from recording of div. Systems						
						km/h			**m**	**Km**	**North: South:**	**IDU**	**BCU 1**	**BCU 2**	**BCU 3**	**DLU**	**TC**	**GPS**
1	IC4	**WDC/1**	10.01.12 12:24	Speed signal verification on dry track	Brake step 1	180	No GPS data	All axles has same speed		69	S: M4C	X	M1C	T3	M4C	X	X	
2	IC4	**A5/1**	10.01.12 12:54:14	Speed Step up. Dry track	7' + HD	160	No BCU M1C date. Test repeated as test no. 3	â ³ 1,0 No WSP intervention	900	69,9	N: M1C	X		T3	M4C	X	X	X
3	IC4	**A5/2**	10.01.12 12:58:27	Speed Step up. Dry track	7' + HD	160	OK	â ³ 1,0 No WSP intervention	924 875 (GPS)	64,8	S: M4C	X	M1C	T3	M4C	X	X	X
4	IC4	**A9/1**	10.01.12 13:16:17	Dry track	8' + MTB	180		â ³ 1,2 No WSP intervention	825	68	S: M4C	X	M1C	T3	M4C	X	X	X
5	IC4	**A9/2**	10.01.12 13:31:14	Dry track	8' + MTB	180		â ³ 1,2 No WSP intervention	875	69,9	N: M1C	X	M1C	T3	M4C	X	X	X
6	IC4	**A12/1**	10.01.12 13:55:50	Dry track	8' - MTB	180		â ³ 1,0 No WSP intervention	1050	68	S: M4C	X	M1C	T3	M4C	X	X	X
7	IC4	**A12/2**	10.01.12 14:10:52	Dry track	8' - MTB	180		â ³ 1,0 No WSP intervention	1050	69,9	N: M1C	X	M1C	T3	M4C	X	X	X
8	IC4	**AA/1**	10.01.12 14:35:07	Dry rails.	7' - HD.	180		â ³ 1,0 No WSP intervention	1100	68	S: M4C	X	M1C	T3	M4C	X	X	X
9	IC4	**AA/2**	10.01.12 14:49:27	Dry rails.	7' - HD.	180		â ³ 1,0 No WSP	1060	69,9	N: M1C	X	M1C	T3	M4C	X	X	X

Test No.	Train set	Test Id.	Time for Initiation of Brake	Description	Brake mode	Initial Speed	Remarks	Criteria	Braking distance	Start Position	Running direction	Data file name from recording of div. Systems						
						km/h			m	Km	North: South:	IDU	BCU 1	BCU 2	BCU 3	DLU	TC	GPS
								intervention										
10	IC3	WDC/ 1	10.01.12 16:29:37	Speed signal verification on dry track	Starting at Brake Step 1, at the end Brake Step 4	180		All axles has same speed		73,8	S: MFA					X		
11	IC3	A9/1	10.01.12 16:39:05	Dry track	8' + MTB	180			1100	69,8	N: MFB					X	X	X
12	IC3	A9/2	10.01.12 16:52:24	Dry track	8' + MTB	180			1150 1146 (GPS)	68	S: MFA					X	X	X
13	IC3	A12/1	10.01.12 17:06:23	Dry track	8' - MTB	180			1450	69,9	N: MFB					X	X	X
14	IC3	A12/2	10.01.12 17:22:33	Dry track	8' - MTB	180			1450	68	S: MFA					X	X	X
20	IC3	OIL	11.01.12 11:01:05 - 12:00:03	65 litters oil applied to the rail head at a speed of 2,5 km/h from the rear end of the IC3 at car MFA. From km 67,9 to km 70,0 over a distance of 2,1 km. (20 litters oil more than for the forth coming IC4 test)												X		
21	IC3	J1/1	11.01.12 12:29:22	1. run on same oil	8' + MTB Br.% = 184 %	180	Brake fault reduced the Brake power to 108 %. The reason was not shown on the screen. No wheel flats. The WSP system worked al the time and the wheels turned at speed close to the speed of the train. Mean cylinder pressure lower than 1,5 bar		2500 2421 (GPS)	69,9	N: MFB					X	X	X
22	IC3	E1/1	11.01.12 13:00:40	2. run on same oil	8' - MTB Br.% = 151 %	180	No wheel flats. The WSP system worked al the time and the wheels turned at speed close to the speed of the train. Mean cylinder pressure lower than 1,5 bar. At the end of the test, when the train has left the oiled track a fault		2800	68	S: MFA					X	X	X

Test No.	Train set	Test Id.	Time for Initiation of Brake	Description	Brake mode	Initial Speed	Remarks	Criteria	Braking distance	Start Position	Running direction	Data file name from recording of div. Systems						
						km/h			m	Km	North: South:	IDU	BCU 1	BCU 2	BCU 3	DLU	TC	GPS
							reduced the Brake Power to 113 %											
23	IC3	J1/2	11.01.12 13:20:02	3. run on same oil	8' + MTB Br.% = 184 %	180	The train speed was 96 km/h when the train left the pre oiled rails		2400 2421 (GPS)	69,9	N: MFB					X	X	X
24	IC3	E1/2	11.01.12 13:37:23	4. run on same oil	8' - MTB Br.% = 151 %	180	The train speed was 122 km/h when the train left the pre oiled rails.		2250	68	S: MFA					X	X	X
25	IC3	Acc	11.01.12 13:38:45	5. run on same oil	Acceleration on oiled rails. The test started at step 4. At about 30 km/h the MC was put in to step 7.	0	After last test with IC3 on oiled rails there were no flats on any of the wheels.				N: MFB					X		
26	IC4	OIL	11.01.12 14:29:42 - 15:01:45	45 litters oil applied to the rail head at a speed of 3 - 4 km/h from the rear end of the IC4 at car M1C. From km 67,9 to km 70,0 over a distance of 2,1 km. (20 litters oil less than for the previous IC3 test)												X		
27	IC4	J1/1	11.01.12 15:16:55	1. run on same oil	8' + MTB Br.% = 170 %	180	Wheel flats on axle 3, 4 and 5. The DLU speed sensor at axle 4 shows zero speed in a long period. The speed in the IDU jumped up and down, but was not zero		2250	69,9	S: M4C	X	M1C	T3	M4C	X	X	GPS
28	IC4	E1/1	11.01.12 15:34:51	2. run on same oil	8' - MTB Br.% = 170 %	180	The DLU speed sensor at axle 4 shows zero speed in a long period. The speed in the IDU jumped up and down, but was not zero Rail checked for remaining oil on the rail head, and assessed as still intact but thin.		1650	68	N: M1C	X	M1C	T3	M4C	X	X	GPS
29	IC4	J1/2	11.01.12 15:54:51	3. run on same oil	8' + MTB Br.% = 170 %	180	IDU fault 195 and IDU??? WSP fault on axle 4 and 7.		1500	69,9	S: M4C	X	M1C	T3	M4C	X	X	GPS

Test No.	Train set	Test Id.	Time for Initiation of Brake	Description	Brake mode	Initial Speed	Remarks	Criteria	Braking distance	Start Position	Running direction	Data file name from recording of div. Systems						
						km/h			m	Km	North: South:	IDU	BCU 1	BCU 2	BCU 3	DLU	TC	GPS
							Brake percentage unchanged (170 %). Parking Brake was indicated on during part of the test. More and bigger flats on axle 3, 4 and others flats on bogie 3 and 4. Due to lack of time and sever wheel flats, the test was stopped and the speed was restricted to max. 60 km/h The DLU speed sensor at axle 4 shows zero speed in a long period. The speed in the IDU jumped up and down, but was not zero											

Annex B: Description of recorded IC4 IDU data.

This annex describe the recorded data from the IC4 Integrated Diagnostic Unite (IDU)

The IDU is an event log, only recording at the initiation and expire of at fault detected on the IDU. For diagnostics a row of operation data is recorded together with the fault data.

Without any further explanation following data are recorded by the IDU

Date	Time	Device	Status	Coach	Type
Description	Desk Key M1	Desk Key M4	Desk enabled/UIC	Engine Cmd(4S1M1	Engine Cmd(4S1M4
Master Control Position	Num Trains	Speed	BCU1 speed	BCU2 speed	BCU3 speed
5A50 Sensor M1C	5A50 Sensor M4C	BCU1 slide axle1	BCU1 slide axle2	BCU1 slide axle3	BCU1 slide axle4
BCU2 slide axle5	BCU2 slide axle6	BCU3 slide axle7	BCU3 slide axle8	BCU3 slide axle9	BCU3 slide axle10
Safety loop	5k25 M1C	5k25 M4C	Brake pipe M1	Brake pipe M4	Brake pipe T3
DLU Brake pipe pressure	5k20 M1	5k23 M1	5S20 M1	5S20 M4	Trainline brake BCU1
Trainline brake BCU2	Trainline brake BCU3	Trainline Traction BCU1	Trainline Traction BCU2	Trainline Traction BCU3	Trainline em.brake BCU1
Trainline em.brake BCU2	Trainline em.brake BCU3	% BCU M1	% BCU M4	% BCU T3	4k51 M1
4k51 M4	Brake Mass(%)	DLU Main pipe pressure	Active CCU M1 equip.	Active CCU M4 equip.	Active RIO M1 equip.
Active RIO M4 equip.	Active RIO T2 equip.	Active RIO T3 equip.	Legal Time	4S13 M1C	4S05 M1C
4S05 M4C	4S06 M1C	4S06 M4C	PP1 M1C	PP2 M1C	PP2 M4C
PP1 M4C	4S20 M1C	4S20 M4C	5k22 status	5S90 (on M1 only)	Traction line
Emergency line	Ready line	ATC command	5k21 status	Bypass TractiM1C	Bypass TractiM4C
4S16 bypass M1	4S16 bypass M4	4S17 holding brake	Tunnel mode M1C	Tunnel mode M4C	Main pipe pressure not enough
Hardware door loop	Brakepipe pressure not enough	5K07 OR 5K08 unduly on	BCU in emergency state	Hatch open or external supply	Mvb failure
Brakes not released	Coupling relay fault	Available traction effort<25%	Parking brake applied	5K25 Safety brake loop fail	Cab window open in washing
TRAC/BRAKE wires fault	Only one psl active	Holding brake not released	Current gears not engaged	Arg directions not ok	EVAPP valve isolated m1c/m4c
Software door loop not closed	Magnetic brake activated	EVAPP stuck closed	Axle 1 Pressure	Axle 2 Pressure	Axle 3 Pressure
Axle 4 Pressure	Axle 5 Pressure	Axle 6 Pressure	Axle 7 Pressure	Axle 8 Pressure	Axle 9 Pressure
Axle 10 Pressure	Battery Voltage M1C	Battery Current M1C	Load Current M1C	Magnetic Truck Current M1C	Medium Voltage M1C
Battery Voltage T2	Battery Current T2	Load Current T2	Battery Voltage T3	Battery Current T3	Load Current T3
Battery Voltage M4C	Battery Current M4C	Load Current M4C	Magnetic Truck Current M4C	Medium Voltage M4C	

Due to a bug in the IDU SW the recording of the cylinder pressure on M4C is mirrored as follow:

Axle 7 Pressure	Cylinder pressure on train axle 10
Axle 8 Pressure	Cylinder pressure on train axle 9
Axle 9 Pressure	Cylinder pressure on train axle 8
Axle 10 Pressure	Cylinder pressure on train axle 7

Annex C: Description of recorded IC4 BCU data.

This annex describe the recorded data from the IC4 Brake Control Unite (BCDU)

The relation between the axle number in each of the three BCU's and the official axle number of the entire train set is according to the table down below.

Abbreviation	BCU M1C	BCU T3	BCU M4C
Time	Time in sec	Time in sec	Time in sec
SPEEDRIF	Reference Speed	Reference Speed	Reference Speed
WSP_SPEED1	Speed of train axle 1	Speed of train axle 5	Speed of train axle 7
WSP_SPEED2	Speed of train axle 2	Speed of train axle 6	Speed of train axle 8
WSP_SPEED3	Speed of train axle 3		Speed of train axle 9
WSP_SPEED4	Speed of train axle 4		Speed of train axle 10
CONTROL1	Cylinder pressure at train axle 1 requested by BCU at Tpil	Cylinder pressure at train axle 5 and 6 requested by BCU at Tpil	Cylinder pressure at train axle 10 requested by BCU at Tpil
CONTROL2	Cylinder pressure at train axle 2 requested by BCU at Tpil		Cylinder pressure at train axle 9 requested by BCU at Tpil
CONTROL3	Cylinder pressure at train axle 3 requested by BCU at Tpil		Cylinder pressure at train axle 8 requested by BCU at Tpil
CONTROL4	Cylinder pressure at train axle 4 requested by BCU at Tpil		Cylinder pressure at train axle 9 requested by BCU at Tpil
CYLIN1	Cylinder pressure after the WSP Dump valve at train axle 1 at TCF	Cylinder pressure after the WSP Dump valve at train axle 5 at TCF	Cylinder pressure after the WSP Dump valve at train axle 10 at TCF
CYLIN2	Cylinder pressure after the WSP Dump valve at train axle 2 at TCF	Cylinder pressure after the WSP Dump valve at train axle 6 at TCF	Cylinder pressure after the WSP Dump valve at train axle 9 at TCF
CYLIN3	Cylinder pressure after the WSP Dump valve at train axle 3 at TCF		Cylinder pressure after the WSP Dump valve at train axle 8 at TCF
CYLIN4	Cylinder pressure after the WSP Dump valve at train axle 4 at TCF		Cylinder pressure after the WSP Dump valve at train axle 7 at TCF
AUXRES3	Auxiliary reservoir pressure at TPAR in the IRV for train axle 3	Auxiliary reservoir pressure at TPAR in the IRV for train axle 5	Auxiliary reservoir pressure at TPAR in the IRV for train axle 8
BPPRESS	Brake Pipe Pressure	Brake Pipe Pressure	Brake Pipe Pressure
SL_AX1	Slide indication on train axle 1, '1' => Slide	Slide indication on train axle 5, '1' => Slide	Slide indication on train axle 7, '1' => Slide
SL_AX2	Slide indication on train axle 2, '1' => Slide	Slide indication on train axle 6, '1' => Slide	Slide indication on train axle 8, '1' => Slide
SL_AX3	Slide indication on train axle 3, '1' => Slide		Slide indication on train axle 9, '1' => Slide
SL_AX4	Slide indication on train axle 4, '1' => Slide		Slide indication on train axle 10, '1' => Slide
BRAKE	Train Line Brake, '0' => Brake applied	Train Line Brake, '0' => Brake applied	Train Line Brake, '0' => Brake applied
SOCCORSO	Train Line Emergency, '0' => Emergency Brake applied	Train Line Emergency, '0' => Emergency Brake applied	Train Line Emergency, '0' => Emergency Brake applied
TRACTION	Train Line Traction, '0' => Traction OFF	Train Line Traction, '0' => Traction OFF	Train Line Traction, '0' => Traction OFF
EVSOC	Safety valve EVSOCC in M1C ON/OFF, '0' => IP Brake ON	Safety valve EVSOCC in T3 ON/OFF, '0' => IP Brake ON	Safety valve EVSOCC in M4C ON/OFF, '0' => IP Brake ON
PFA_AX1	Pressure Switch PFA train axle 1 indication Brake	Pressure Switch PFA train axle 5 indication Brake	Pressure Switch PFA train axle 10 indication Brake

Abbreviation	BCU M1C	BCU T3	BCU M4C
	ON/OFF, '0' => Cv < 0,5 bar => Brake ON	ON/OFF, '0' => Cv < 0,5 bar => Brake ON	ON/OFF, '0' => Cv < 0,5 bar => Brake ON
PFA_AX2	Pressure Switch PFA train axle 2 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON	Pressure Switch PFA train axle 6 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON	Pressure Switch PFA train axle 9 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
PFA_AX3	Pressure Switch PFA train axle 3 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON		Pressure Switch PFA train axle 8 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
PFA_AX4	Pressure Switch PFA train axle 4 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON		Pressure Switch PFA train axle 7 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
MJF	BCU Major Fault, '0' => No Major Fault, '1' => EVSOC = '0'	BCU Major Fault, '0' => No Major Fault, '1' => EVSOC = '0'	BCU Major Fault, '0' => No Major Fault, '1' => EVSOC = '0'
MINF	BCU Minor Fault, '0' => No Minor Fault,	BCU Minor Fault, '0' => No Minor Fault,	BCU Minor Fault, '0' => No Minor Fault,
ST_M1_HD1	Status Intarder Train axle 2 '1' => Intarder OFF		Status Intarder Train axle 9 '1' => Intarder OFF
ST_M1_HD2	Status Intarder Train axle 3 '1' => Intarder OFF		Status Intarder Train axle 8 '1' => Intarder OFF
WSP_5KMH	Train Speed <> 5 km/h '1' => Speed < 5 km/h	Train Speed <> 5 km/h '1' => Speed < 5 km/h	Train Speed <> 5 km/h '1' => Speed < 5 km/h
WSP_0KMH	Train Stand Still, '0' => train Stand Still	Train Stand Still, '0' => train Stand Still	Train Stand Still, '0' => train Stand Still

Annex D: Description of recorded IC4 DLU data.

This annex describe the recorded data from the IC4 Data Logging Unite (DLU)

Abbreviation	Description
Distance/km	Running distance in [km] measured at train axle 4
Time	Time
Hastighed [km/t]	Speed in [km/h] measured at train axle 4
Bremselednings tryk	Brake Pipe pressure in [bar]
Kørebremsekontroller position	Master Controller Position: 1 Effort Dec. High — 0 Cruse (Idle) 2 Effort Dec. Low — -1 Br. Step 1 3 Effort Maintain — -2 Br. Step 2 4 Effort Incr. Low — -3 Br. Step 3 5 Effort Incr. High — -4 Br. Step 4 11 Speed Dec. High — -5 Br. Step 5 12 Speed Dec. Low — -6 Br. Step 6 13 Speed Maintain — -7 Br. Step 7 14 Speed Incr. Low — -8 Br. Step 8 15 Speed Incr. High — -9 Isolation
TL Bremse aktiv	Train Line Brake, '0' => Brake applied
TL Nødbremse aktiv	Train Line Emergency, '0' => Emergency Brake applied
MG-bremsning	Magnetic Track Brake (MTB), '1' => MTB ON
Trækkraft udkoblet	Train Line Traction, '0' => Traction OFF
Dynamisk bremse traktionsanlæg 1	Dynamic Brake (Intarder)
Dynamisk bremse traktionsanlæg 4	Dynamic Brake (Intarder)
Dynamisk bremse traktionsanlæg 2	Dynamic Brake (Intarder)
Dynamisk bremse traktionsanlæg 3	Dynamic Brake (Intarder)
Aksel 1 bremset	Pressure Switch PFA train axle 1 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
Aksel 2 bremset	Pressure Switch PFA train axle 2 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
Aksel 3 bremset	Pressure Switch PFA train axle 3 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
Aksel 4 bremset	Pressure Switch PFA train axle 4 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
Aksel 5 bremset	Pressure Switch PFA train axle 5 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
Aksel 6 bremset	Pressure Switch PFA train axle 6 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
Aksel 7 bremset	Pressure Switch PFA train axle 7 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
Aksel 8 bremset	Pressure Switch PFA train axle 8 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
Aksel 9 bremset	Pressure Switch PFA train axle 9 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
Aksel 10 bremset	Pressure Switch PFA train axle 10 indication Brake ON/OFF, '0' => Cv < 0,5 bar => Brake ON
Hjulblokering	Slide indication on at least one of the axles, '1' => Slide active
Hjulslip	Wheel slip during traction detected at least at one Power Pack, '0' => Wheel slip active or traction suspended

Annex E: Description of recorded IC3 DLU data.

This annex describe the recorded data from the IC3 Data Logging Unite (DLU)

Abbreviation	Description
Distance/km	Running distance in [km] measured at train axle 4
Time	Time
Speed V_HLOG [km/h]	Speed in [km/h] measured at train axle 4
Træk-/bremsekraft [kN]	Traction - EP Controller Position: 1 -> 7 Traction Mode 0 Cruse -1 -> -8 Brake mode
Bremsetryk [bar]	Brake Pipe pressure in [bar]
MG-bremsning	Magnetic Track Brake '1' => Applied
Hjulblokering/slip	Wheel Slip or Slide '1' => Slip/Slide active
Trækkraft udkoblet	Traction Suspended '1' => Traction Suspension active

Annex F: Description of recorded IC4 TC data

This annex describe the recorded data from the IC4 Train Computer (DLU)

Analog data records

veh_speed	Train reference speed [km/h]
speed_ref	Speed request from Master Controller in Speed Mode [km/h] '0' => 0 km/h or Effort Mode
drvlvl	Torque request from Master Controller [0 - 250] (negative is fault indication)
lvr1_trac_value	Same as 'drvlvl' during traction. In Brake mode as: 0 Idle -37 Brake 1 -74 Brake 2 -111 Brake 3 -148 Brake 4 -185 Brake 5 -222 Brake 6 -255 Brake 7 -256 Brake 8
space	Running and braking distance [km]
drvlvl	Torque request from Master Controller [0 - 250] (negative is fault indication)

Digital data records

Some of the abbreviations of the TC digital records appear twice. First and second appearance is for the M1C car and M4C cars respectively.

N.	Record no. [1/4 Hz]
ATC_ABTRAC	ATC traction enabling; the signal is active high no emergency or service brake and if the ATC system is out of service. The contact is inactive (contact opened) during service or emergency brake)
P_REL_L	Desk Request Left doors release push button(7S01 e 7S08) (7S08 push button is in 0702/05)
ATC_OKEY	ATC in service. This signal is active high (contact closed) if the ATC is active
ST_9F03	State of 9F03(3Ampère) contactor
P_CLOSE_R	Desk Request Right doors close push button (7S04/7S07)
P_DSTART	Desk Request Start departure procedure push button (7S84/7S80)
P_CLOSE_L	Left doors close push button (7S04/7S09)
P_DSTOP	Stop departure procedure push button (7S85/7S81)
PEDAL	Driver’s safety device 5S96 and 5S91 pedal and mushroom [Intrefacciato Only m1c]
D_SH_BIS	Driver’s safety device 5S93 selector (Shunting mode bis signal for safety) [Interfacciato Only m1c]
ST_REL1	Driver’s safety device 5K21 relay status [Intrefacciato Only m1c]
ST_REL2	Driver’s safety device 5K22 relay status [Intrefacciato Only m1c]
L_PAR_I	Local line parking brake isolated (5S03)
PARK	train line parking brake applied
ST_4K11	Status Rele 4K11 train bracked
ST_HEADFLT	Status of Converter1 head light fault
TL_S_UND	Train line: Smoke underframe
P_LEFT_TRAF	Left traffic push button (8S40)
ST_WLFLT	Status of White Lamp Norm. fault
SLIDE_BCU	Slide Signal from BCU
P_DIFF	Push Button Diff, point of stop
ST_5F07	5F07 circuit breaker status

P_EME	Driver Emergency push button (5S20) must stop front cover sequence
ST_5K25	5K25 relay status
ST_5S21	Status 4S20 Handle Driver desk
ST_5K06	5K06 relay status Loop Shunt
ST_10F01	State of 10F01(3Ampère) contactor from Emergency line (Circuit braker dual mode power box 10A02)
ST_P_SL	Status Positive Powering Safety Loop (only m1c)
ST_5K07	5K07 relay status IRV Valve
ST_5F13	5F13 circuit breaker status for magnetic valve recharge brake pipe
P_SS_UND	Underframe Smoke sensors acknowledge push button estena
AVG	EVAPP1 insulation cock (5S72)
AXLE2_REL	4S07 Status manul release gear shift rear
AXLE2_PRES	Axle 2 m1c Axle 8 m4c diagnostic Pressure switch 4P01
ST_A2	Gear shift 2 position A
ST_N2	Gear shift 2 position N
ST_B2	Gear shift 2 position B
ST_L2	Gear shift 2 position L
EME	Emergency (train wire) [m1c Only]
EME_BR	Emergency Brake (train wire) [m1c Only]
ST_READYP	Ready status diagnostic signal positive if all relè close 4K50 4K55 4K56
BRAKE	Service Brake (train wire) [m1c Only]
TRAC	Traction (train wire) [m1c Only]
ST_READYN	Ready status diagnostic signal negative if all relè open 4K50 4K55 4K56
ST_RDYIDNP	Ready + idn status diagnostic signal 4k51
ST_4F11	status 4F11 circuit breaker
P_DRMODE	(Manual/Automatic) Driving mode (4S13 push button)
P_STOP	Motor stop push button (4S15) Pin1 Pin2
P_DIFF	Push Button Diff, point of stop
ST_5F07	5F07 circuit breaker status
P_EME	Driver Emergency push button (5S20) must stop front cover sequence
ST_5K25	5K25 relay status
ST_5S21	Status 4S20 Handle Driver desk
ST_5K06	5K06 relay status Loop Shunt
ST_10F01	State of 10F01(3Ampère) contactor from Emergency line (Circuit braker dual mode power box 10A02)
ST_P_SL	Status Positive Powering Safety Loop (only m1c)
ST_5K07	5K07 relay status IRV Valve
ST_5F13	5F13 circuit breaker status for magnetic valve recharge brake pipe
P_SS_UND	Underframe Smoke sensors acknowledge push button estena
AVG	EVAPP1 insulation cock (5S72)
SP_R2_C14_IN1	Spare RIO2 Connector14 Input 1
ST_CTRL_FLT	Cabin Hvac Controller fault
ST_REFR_FLT	Cab Hvac Refrigerator fault
ST_HEAT_FLT	Cab Hvac Heating fault
ST_SYS_ON	Cab Hvac System on
SP_R2_C14_IN6	Spare RIO2 Connector14 Input 6
ST_HATCH	Status from 3B100 to 3B110 Hatches Sensors
ST_TUNNEL	Tunnel mode Request 6S02
SP_R2_C14_IN1	Spare RIO2 Connector14 Input 1

ST_CTRL_FLT	Cabin Hvac Controller fault
ST_REFR_FLT	Cab Hvac Refrigerator fault
ST_HEAT_FLT	Cab Hvac Heating fault
ST_SYS_ON	Cab Hvac System on
SP_R2_C14_IN6	Spare RIO2 Connector14 Input 6
ST_HATCH	Status from 3B100 to 3B110 Hatches Sensors
ST_TUNNEL	Tunnel mode Request 6S02
Spare	
Alarm Toilette 13S100	Push Butten Alarm Toilette 13S100
Alarm Toilette 13S101	Push Butten Alarm Toilette 13S101
Alarm HK 13S23	Push Button Alarm HK 13S23
Spare	
Spare	
Status of 9F01	Status of 9F01(20Ampère) ATC Central ATC central computer box
9S01 Main Switch Selector	Driven by 9S01 Main Switch Selector Status
Status of ATC_OFF request	Driven by 9S01 Main Switch Selector, Status of ATC_OFF request
Status 10F03	Status 10F03 Powering Radio 10A01
Status 10F04	Status 10F04 Powering UIC radio 10A04
Spare	
ST_2FXX_MT	Status Circuit Braked MT (2F16 2F17 2F18 2F23 2F29 2F60 2F62 2F63 2F68 2F69 2F70)
ST_3F71	Status 3F71 Powering Auxiliaru MT BT Circuit Breaker Electric cabinet ECMV3
ST_2K22_T2	[ICQTCMS-360], SCR_ABPT273
ST_HATCH	Status from 3B100 to 3B110 Hatches Sensors
ST_2S01	Status Selector 2S01 for insulating 400 VAC on ECMV1
ST_7FXX	Status general Circuit Brrakers fam.7 (7F05 7F10 7F20 7F23)
ST_6FXX	Status general Circuit Brrakers fam.6 (6F02 6F04)
ST_THERM_PP_T2	Rear Thermostat PP(to the Slave node)
SP_R4_C11_INP1	Spare RIO4 Connector11 Input1
SP_R4_C11_INP2	Spare RIO4 Connector11 Input2
ST_5K08	5K08 relay status
ST_5F21	Status 5F21 Powering Diagnostic breaker
RIA5	axle 5open/insulating switch 5S41
PFA5	axle 5 relased/breaked status 5E12
RIA6	axle 6 open/insulating switch 5S42
PFA6	axle 6 relased/breaked status 5E13
ST_2FXX	Status Circuit Breaker Group 2 (2F16 2F18 2F19 2F20 2F23 2F24 2F29 2F36 2F39 2F40 2F60)
ST_3F121	Status 3F121 General powering BT
ST_2K22_T3	[ICQTMS-360[, SCR_ABTPT273
ST_HATCH	Status from 3B100 to 3B110 Hatches Sensors
ST_2S01	Status Selector 2S01 for insulating 400 VAC on ECMV1
ST_7FXX	Status general Circuit Brrakers fam.7 (7F05 7F10 7F20 7F23)
ST_6FXX	Status general Circuit Brrakers fam.6 (6F02 6F04)
ST_THERM_PP_T3	Thermostat Rear PP(to the Slave node)

Annex G: Test Participants

Ansaldo Breda:		Davide	Marandola
		Marco	Storri
		Gabriele	Casella
		Francesco	Caponi
		Alfredo	Avolietto
		Francesco	Perami
		Marco	Lacitignola
Faiveley:		Stefano	Rossi
		Alsandro	Botta
		Philippe	Vallec
DSB:	Testleder	Finn	Jensen
	Testleder	Ole	Mårtensson
		Erik	Just
		Flemming V.	Jensen
		Steen L.	Andersen
		Lars Slott	Jensen
		Jens	Madsen
		Martin B.	Lundberg
		Søren	Kårup
		Lars	Olesen
		Helle Kock	Di diego
		Bent C.	Van
	Lkf.	Jakob M.	Griffel
	Lkf.	Per	Isaksen
	Ptl.	Knud-Aage M.	Poulsen
	Ptl.	Torsten L.	Hansen
	Ptl.	Eigil	Bay
Havarikommissionen		Bo	Haaning
		Søren	Groth
DB Minden		Benjamin	Büche

Annex H: UIC 544-1, Appendix F.2

$$s_{jcorr} = \frac{3{,}933 \times \rho \times v^2_{jnom}}{3{,}933 \times \rho \times v^2_{jmeas} - i_m \times s_{jmeas}} \times s_{jmeas}$$

where:

s_{jcorr} = corrected braking distance, which corresponds to the nominal speed in the test j [m]

s_{jmeas} = braking distance measured in test j [m]

v_{jnom} = nominal initial speed in test j [km/h]

v_{jmeas} = initial speed measured in test j [km/h]

ρ = coefficient of inertia of the rotating masses, which is defined as follows:

$$\rho = 1 + \frac{m_r}{m}$$

where:

m = mass of the test train or test vehicle

m_r = equivalent mass of the rotating components (where no exact value is available then $\rho = 1{,}15$ for locomotives and $\rho = 1{,}04$ for coaches shall be used)

i_m = mean gradient over s_{jmeas} on the test track, with the plus sign for rising gradients and the minus sign for falling gradients [‰]

For IC4 and IC3 **ρ = 1,1**

Bilag 4.6
Havarikommissionen
611-2011-23

Technical Report
Rapporto tecnico

A-3992 Project
IC4 DSB - AnsaldoBreda

Analysis of sliding occurred on bogies 2 and 4

A01	18/01/12	Updated with probability of undue parking brake application event	.	S.Rossi	A.Peraboni	R.Tione
Issue Revisione	*Date* Data	*Description* Descrizione	*ECO* ECO	*Compiled* Compilato	*Checked* Verificato	*Approved* Approvato

REVISIONS / Revisioni						
Issue Revisione	Date Data	Description Descrizione	ECO ECO	Compiled Compilato	Checked Verificato	Approved Approvato
A00	05/01/12	Emission	.	S.Rossi	A.Peraboni	R.Tione
A01	18/01/12	Updated with probability of undue parking brake application event	.	S.Rossi	A.Peraboni	R.Tione
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Summary

1. Sliding analysis on bogies 2 and 4

1.1. Conditions of sliding on axles 3, 4, 7 and 8

During the WSP performance test (2 – 5 December 2011) on IC4 train 27, performed according to the FT technical specification FT3992-E00VTS, bogies 2 and 4 shown some complete **locking with consequent wheels flat**.
This issue is not related to the overshoot occurred on IC4 train (ref. to par 2.3 of this document).

1.2. Overview

A - Brake requested at entry speed around 180 kph and complete exhaust of the brake pipe (emergency brake);
B - Presence on the test track of oil (around 2 km). The quantity of oil was enough to allow the sever sliding of all axles alone the train consist creating even the complete exhaust of the brake cylinder pressure (measured adhesion around 1 %);
C - Locking of the wheels appear at a speed around 120 kph (highest value) and is maintained, despite the intervention of the WSP, down to 0 kph;
D - All instances of locking have been detected with presence of oil and therefore WSP intervention.
E - All instances of locking have been detected without Magnetic Track Brake application

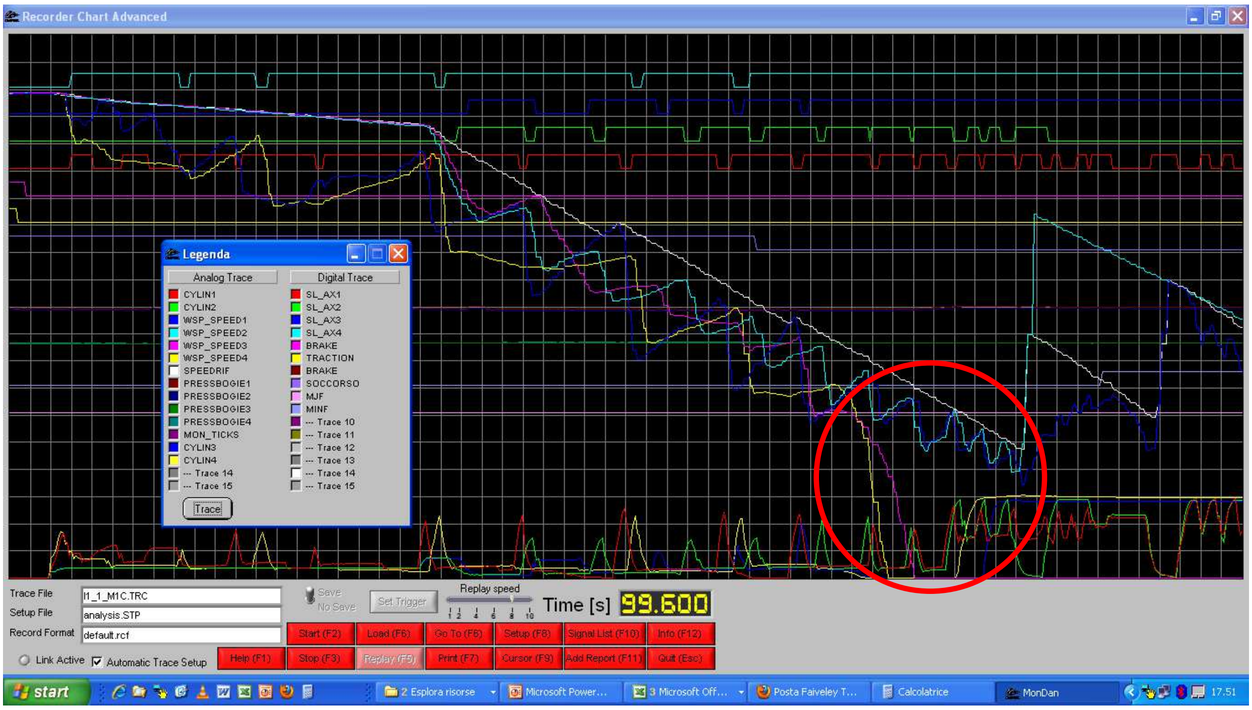
1.3. Record analysis

Below is reported an instance when the axles locking have been detected. Highlighted are the following signals:

- Speed of axle 3, 4 and 7
- Brake cylinder pressure of axle 3, 4 and 7
- Brake pipe pressure
- Reference speed of the WSP system

Records have been stored (during tests) by the monitoring software connected to the BCU (Brake Control Unit) located in the car M1C and M4C that control the axles 3, 4 and 7.

1.3.1. Locking happened on M1C bogie 2



1.3.2. Locking happened on M4C bogie 4

1.4. Record analysis

1.4.1. Traces analysis

1. Emergency brake trigger with beginning of severe sliding due to the oil presence on the track. On bogies 2 and 4 both axles 3, 4, 7 and 8 are sliding (axle speeds decreasing quickly)
2. Wheel Slide Protection (WSP) intervention. Dump valves activities and exhaust of the brake cylinder pressure to low value (< 1 bar) to recover the severe sliding.
3. Axle speed has been recovered.
4. Further severe slide occurs with consequent exhaust of brake cylinder pressure of all axles.
5. WSP intervention with consequent exhaust of brake cylinder pressure down to low values (< 1 bar).
6. Phenomenon becomes stacked when the axle speeds are not more recovered and the brake cylinder pressures are completely exhausted (on axle 3, 4, and 7).
7. Dump Valves exhausts the BC pressure continuously for 4,5 seconds (speed sensor fault timeout) and therefore, for safety reasons, brake cylinder pressure is again re-applied.

WSP behaviour during initial phases is correct; while as soon as the brake cylinder pressure decreases to low values (lower than 1 bar) WSP becoming not able to recover axle's speed anymore allowing wheels damage.

1.5. Locking explanation

The locking of the wheels despite the dump valves exhaust completely the BC pressure (until the speed sensor has been declared in fault due to difference between its speed and reference speed) is due to the undue application of parking brake. The reasons are explained below in the document.

1.5.1. Scenario of undue application of spring brake: explanation

Parking brake of the bogie 3 and 4 is driven by the pneumatic circuit as shown on the FT pneumatic scheme (SA-3993 and SA-4144).

Parking brake is automatically applied according to the following conditions:

1) Brake pipe pressure lower than 2,7 bar with consequent action of pneumatic valve 06.12 to exhaust.
2) Brake cylinder pressure values of axles 3, 4 7 and 8 lower than 2 bar with consequent action of the pneumatic valve 06.03 to exhaust

In order to apply automatically the parking brake all above conditions have to be verified contemporaneously.

In fact if both pneumatic valves 06.12 and 06.03 will be in exhaust position, the supply pressure to the spring brake will be exhausted, with consequent automatic application of the parking brake.

In detail during emergency brake application, when the brake pipe pressure is lower than 2,7 bar, the pneumatic valve 06.12 switches to exhaust position. Meanwhile the valve 06.09 continues to supply pressure to parking brake because a brake cylinder pressure (greater than its threshold) is still applied. BC pressure drives the pilot chamber of the valve 06.09 and the BC pressure value, according to the emergency brake application, is greater than 2,7 bar at anytime (on car M1C and M4C).

The effect of the driving of the dump valves 07.01/03 and 07.01/04 doesn't make action on the piloting of the valve 06.03 because this piloting is taken between IRV (Integrated Relay Valve) out-let and dump valve inlet. Under this condition the IRV outlet is stable even if the dump valve is driven and the BC pressure is exhausted.

From data recorded during tests is clear that, after opening on the valve 06.12 due to emergency brake application the system starts the malfunctions. In detail, as soon as the WSP exhaust the BC pressure below 2 bar due to the severe sliding, the recovery of the related speed axle becomes slow and slow. This is a clear symptom of the undue application of the parking brake.

On the base of the above considerations, a deep analysis of the piped panel **1/438390** (M1C) and **1/438398** (M4C) mounting the IRV valves, the pneumatic valve 06.03, the double check valve 06.09 and the dump valves has been done.

The result was that, due to a manufacturing mistake, the panel internal piping is not realized according to the pneumatic diagram but is according to the Figure 1:

PANEL 1/438390 PNEUMATIC SCHEME	REAL PANEL PIPING 1/438390 (WRONG)

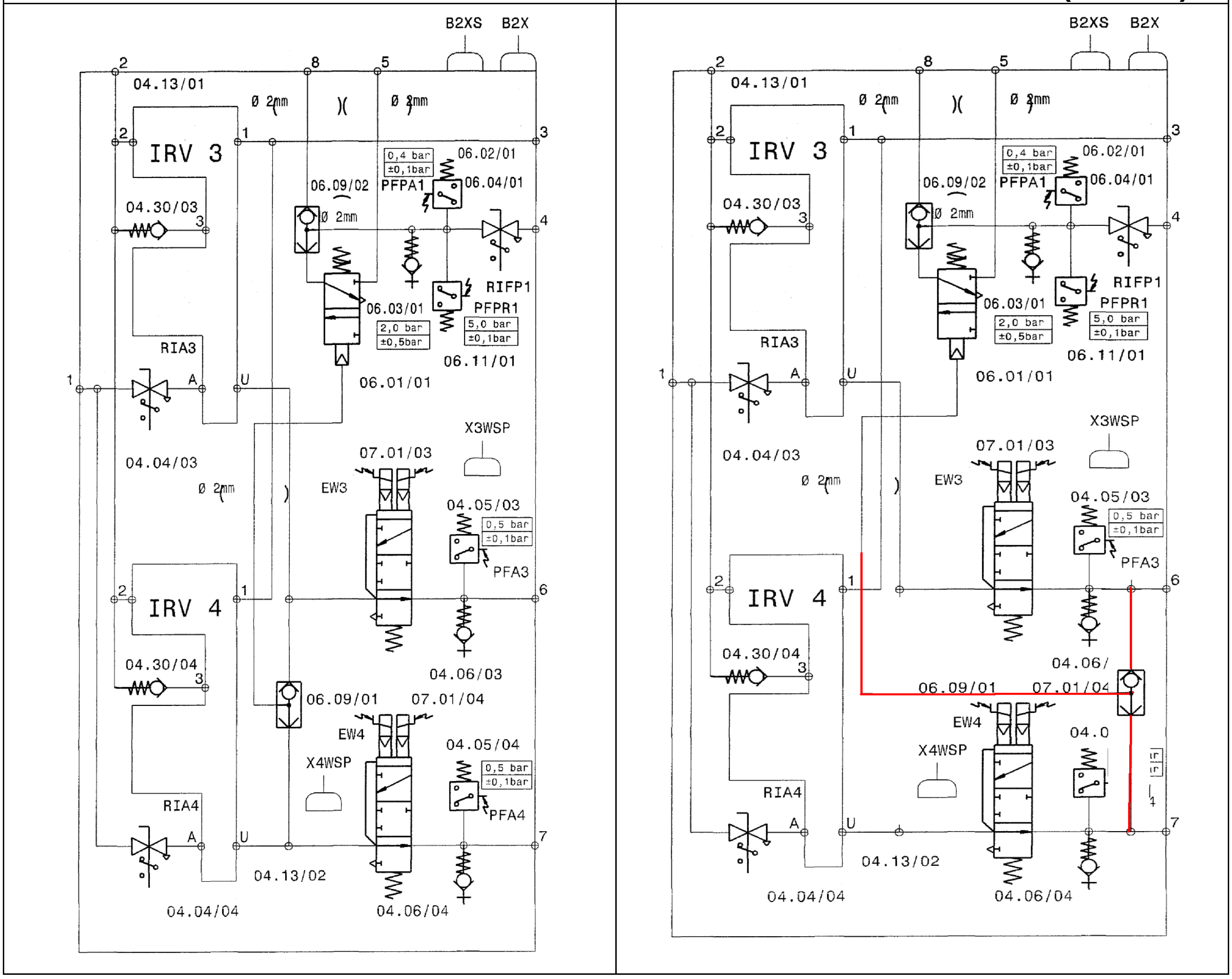


Figure 1: scheme and panel piping for parking brake on Bogie 2 (M1C)

Double check valve **06.09** that drives the parking brake application pneumatic valve 06.03 is connected between dump valve and brake cylinder and not, as it should be, connected between IRV outlet and dump valve inlet. The result is that, if the WSP detects a severe sling of axle 3 and 4 (motor car M1C) contemporaneous, the related action of the dump valves exhausts the BC pressure and even the pilot of the valve 06.03

If the above behaviour happens in case of emergency brake application, (even the valve 06.12 is driven to exhaust position due to a BP pressure value lower than 2,7 bar), the parking brake, after a short delay due to the presence of the calibrated coke, (some seconds), will be unduly applied.

This is the reason because the locking of the wheels doesn’t appear at the beginning of the brake. After the brake pipe is completely exhausted, only if **severe sliding** is present on both axles, all conditions for undue application of parking brake are achieved.

2. Safety impacts

System malfunction is not critical. No safety impacts are present.

WSP system protection prevents the complete continuous exhaust of the brake cylinder pressure. When axles are declared in fault, BC pressures are suddenly restored to the previous value until the brake action is finished and the related axle is not more protected versus sliding.

Only identified impacts are related to the functionality of the WSP. This system under determined and below summarized circumstances, can realise the undue application of the parking brake with consequent **damages of the wheels**.

Conditions of the malfunction are:

- **Very low adhesion**
- **Contemporaneous (both axles) very demanding sliding during an emergency brake application.**

The above conditions have a low probability during the normal operative train conditions, and have been found only during the very low adhesion WSP tests.

2.1. Event happening probability analysis: low adhesion condition (according to UIC)

The aim of this chapter is to give a qualitative evaluation of the probability to observe the locking of axle 3,4,7,8 considering the adhesion between wheel and track within the limit fixed by UIC 541-05 (5-8%), that are the contractual requirement based on the DSAT21 has been issued. The DSAT21 was the specification used to perform the homologation test on IC4 related to the WSP system.

The below analysis has been based on:

- Test performed in Vojens on train 27 under the UIC adhesion requirement (adhesion within 5-8%)
- Contemporaneous condition for verification of undue parking brake application
  - o brake pipe lower than 2,7 (-0,5) bar
  - o both brake cylinder pressure below 2 (– 0,5) bar
- Evidence that brake system and WSP capabilities are designed and tuned in order to respect contractual requirement. This evidence is given in the document FT3992-E00VTS rev A01.

The analysis considers the average brake cylinder pressure calculated according the following criteria

$$\frac{\int_{BCpressurestart}^{BCpressurestart+10s} BCpressureAxle(i)(dt)}{10};$$

Where:
BCpressure(i) = brake cylinder pressure axle 3,4,7,8
BCpressurestart = time point where BCpressure(i) moves from zero the first time

under the following circumstances:

- Brake pipe pressure lower than 2,7 (-0,5) bar when pressure is dropping
- Axle(i) slide present
- Comparison between average pressure that create the undue parking brake application with the average BC pressure that didn’t creates the fault, considering the setting of the valve 06.03 that’s 2,0 (-0,5) bar.

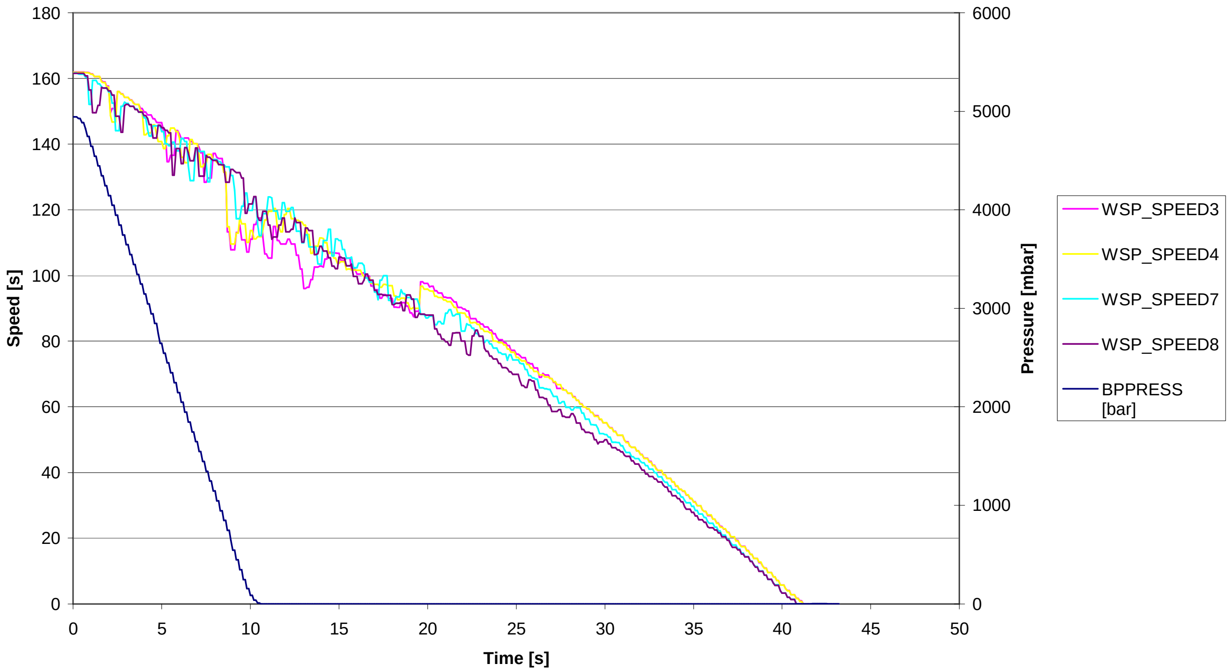
- Parking brake application time (around 10s due to the presence of choke in the parking brake circuit)

Test considered for above analysis is the E1_1 performed in December 2011. The test was an emergency brake application without MTB with entry speed @ 160 kph. The test has been chosen due to the consistent level of GM and the appropriate level of adhesion as reported in the table below.

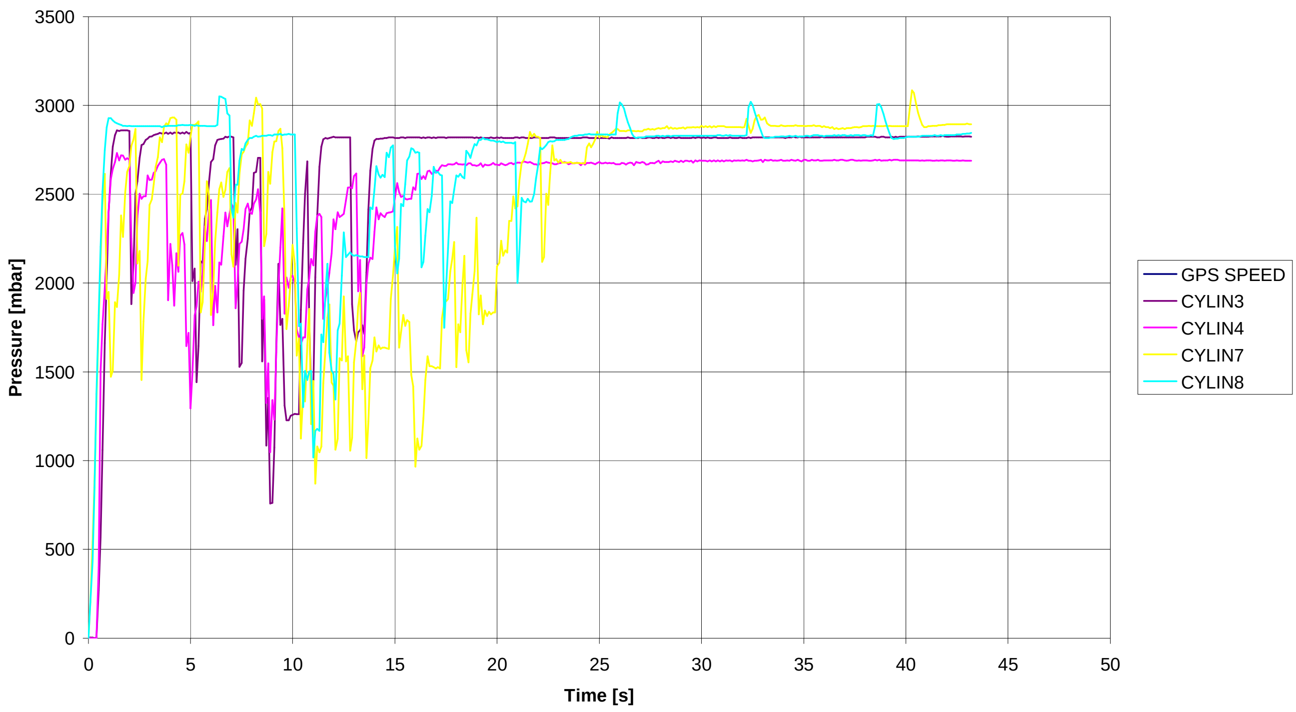
Manned cab.	Entry speed		Adhesion		GM		Stopping distance			File Name
	Exp. value	Act. value	Exp. value	Act. value	Exp. value	Act. value	Exp. value		Act. value	
M1C	160±3	**161,65**	$0,08 \geq \tau_a \geq 0,05$	**8%**	≥ 20%	**Axle 1 = 33%**	1143,11	≥	**1030,07**	**E1_1**
						Axle 2 = 26%				
						Axle 3 = 31%				**E1_1.vbo**
						Axle 4 = 22%				
						Axle 5 = 29%				**E1_1_M1C.TRC**
						Axle 6 = 32%				
						Axle 7 = 6%				**E1_1_T3bcu.TRC**
						Axle 8 = 7%				
						Axle 9 = 14%				**E1_1_M4C.TRC**
						Axle 10 = 20%				

Below are reported the charts of speed vs. time and pressure vs. time with the analysis of the average BC pressures.

Absence of undue application of parking brake: speed vs. time



Absence of undue application of parking brake: pressure vs. time



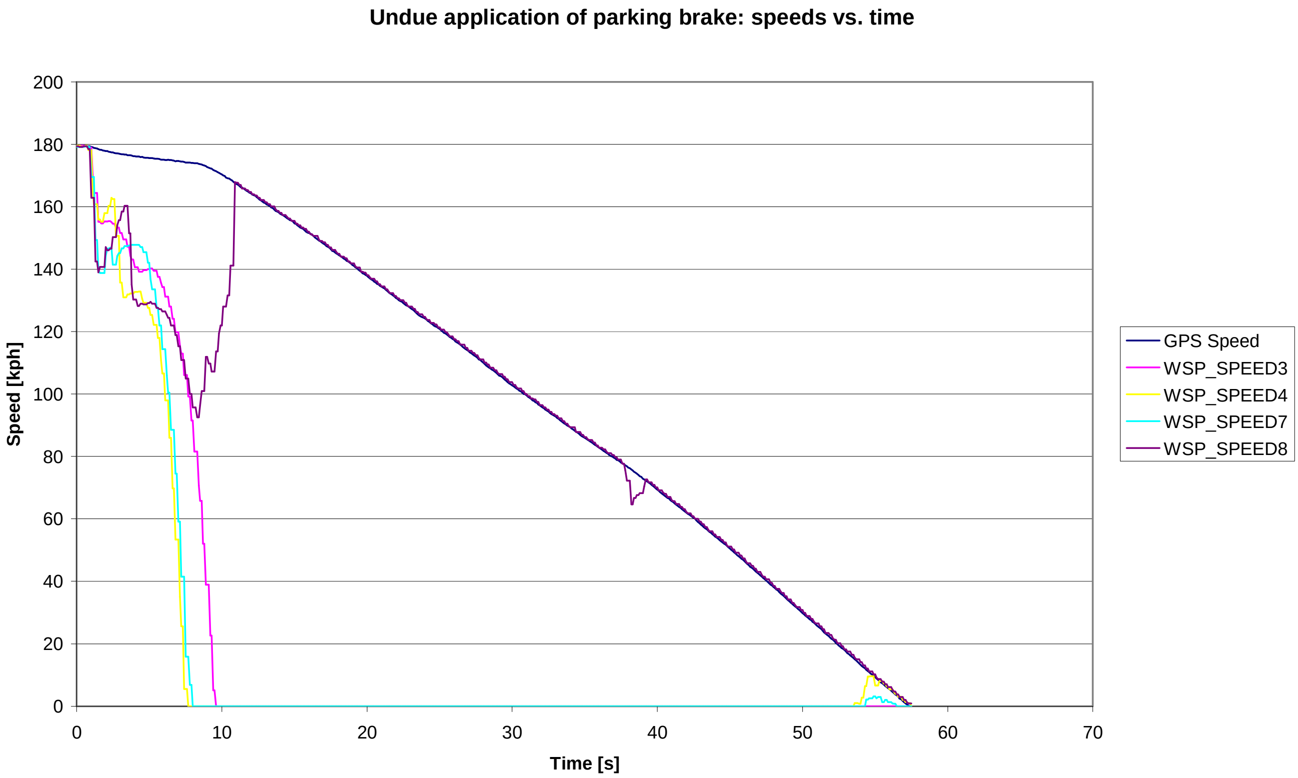
Average BC pressure axle 3: 2306 mbar (> 2000 mbar that's the setting of the valve 06.03)
Average BC pressure axle 4: 2174 mbar (>2000 mbar that's the setting of the valve 06.03)
Average BC pressure axle 7: 2500 mbar (>2000 mbar that's the setting of the valve 06.03)
Average BC pressure axle 8: 2771 mbar (>2000 mbar that's the setting of the valve 06.03)

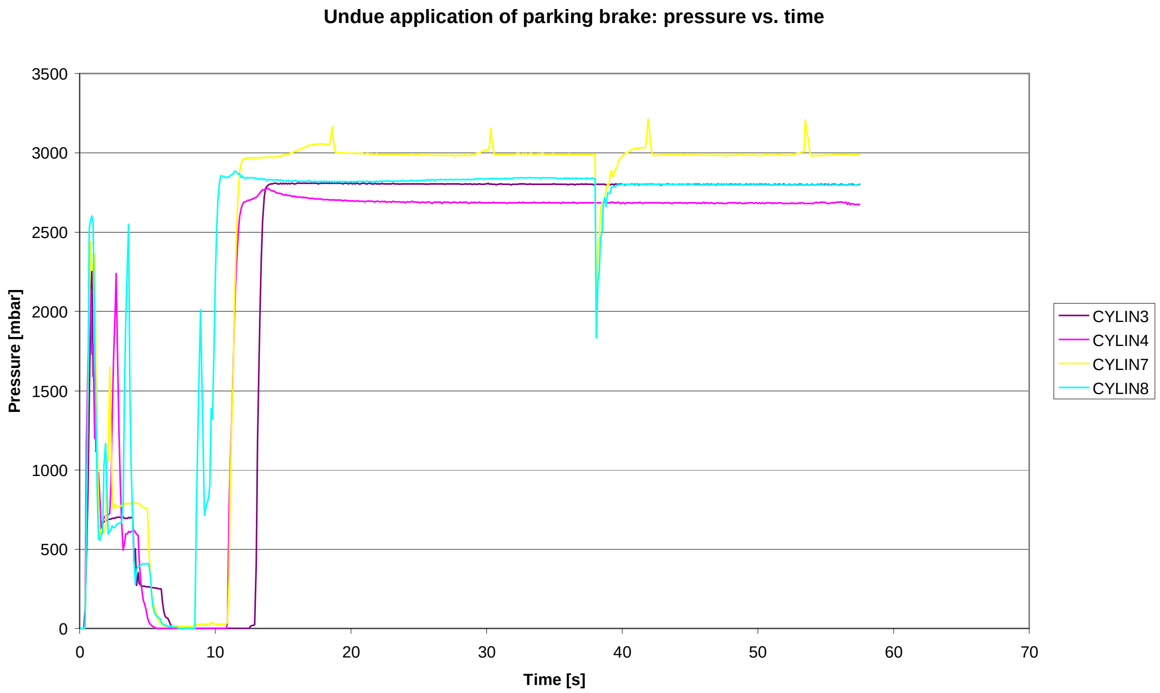
All test executed according the UIC 541-05 adhesion condition (5-8%), didn't show any pneumatic condition able to create the undue application of the parking brake (see FT3992-E00VTS rel. A01).

2.2. Event happening probability analysis: low adhesion condition (adhesion out of UIC)

Same evaluation as per chapter 2.1 has been done observing the axle locking 3,4,7,8 considering the adhesion between wheel and track below the limit fixed by UIC 541-05 (around 1-2%). This adhesion level has been realised spraying vegetal oil on the track.
According the above conditions, no requirements of stopping distance are foreseen neither by the contract nor by the UIC 541-05.
Same consideration and evaluation criteria has been adopted.

Test considered for above analysis is the E1_3 performed in December 2011. The test was an emergency brake application without MTB with entry speed @ 160 kph.
Below are reported the charts of speed vs. time and pressure vs. time with the analysis of the average BC pressures.

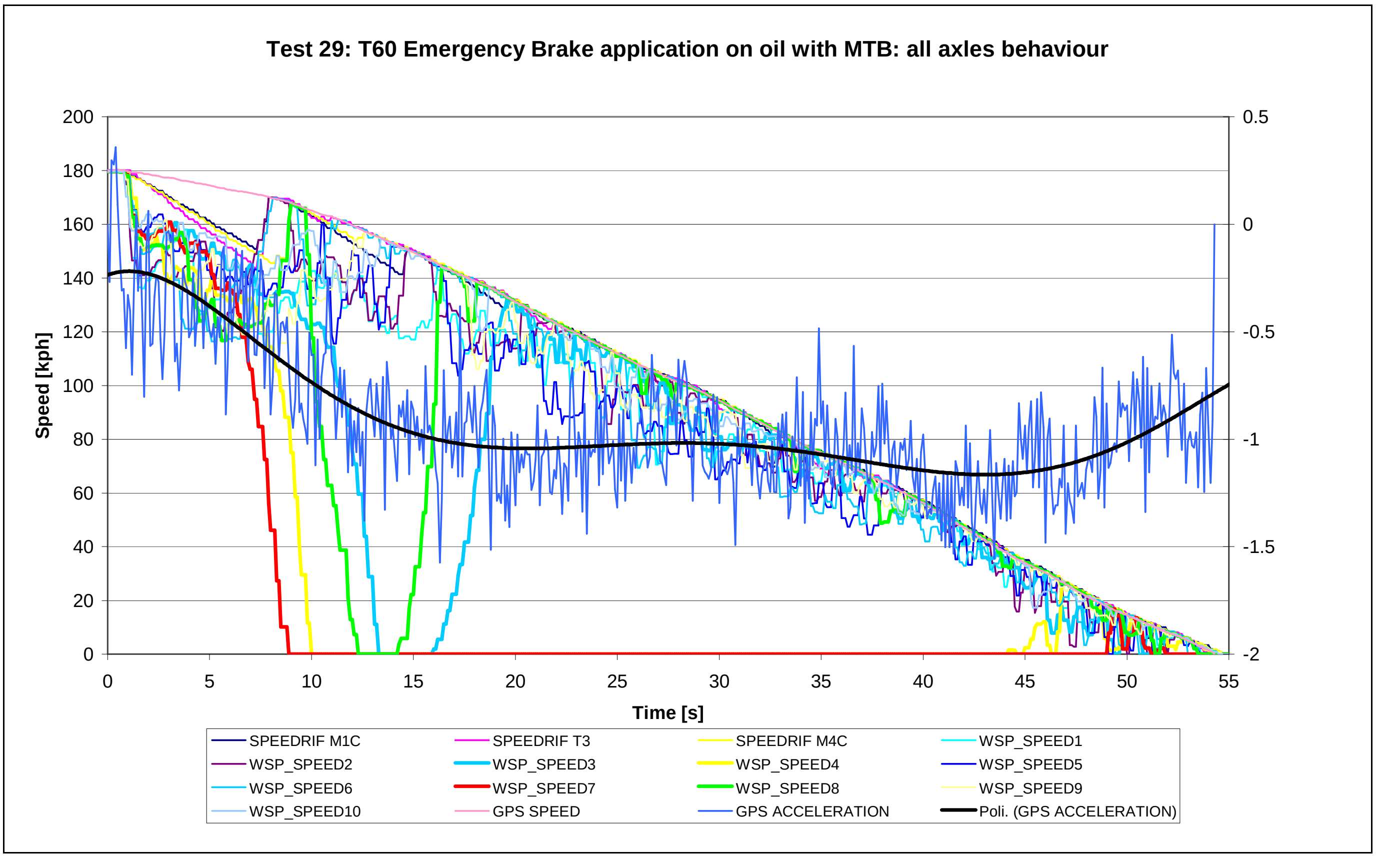




Average BC pressure axle 3: 397 mbar (< 2000 mbar that's the setting of the valve 06.03)
Average BC pressure axle 3: 462 mbar (< 2000 mbar that's the setting of the valve 06.03)
Average BC pressure axle 3: 524 mbar (< 2000 mbar that's the setting of the valve 06.03)
Average BC pressure axle 3: 851 mbar (< 2000 mbar that's the setting of the valve 06.03)

2.3. Intervention of undue parking brake vs. stopping distance

The aim of this chapter is to prove that the undue application of parking brake couldn't be considered as a root cause of the Marslev incident and, generally, doesn't make an extension of the stopping distance in low adhesion condition.
The below chart has been recorded during the dynamic test performed in Vojens in January 2012. The name of the test is Test29 and the brake demand was emergency brake application with MTB on vegetal oil.



As it's easily observable by the chart, the intervention of the undue application of parking brake (width line red, yellow, green and light blue), causes the increase f the retardation (blue line and black polynomial) with a consequent reduction of the stopping distance.

Above brake application gave a stopping distance of 1528 [m]

If the undue application of parking brake will be removed and, therefore, all cleaning effect of the sliding wheels will be missing, surely the brake distance will be greater. A purely qualitative evaluation of this eventual scenario would be to consider an average retardation as 0,6 m/s2 according to the following assumptions:

- Consider an instantaneous retardation by FT suggested retrofit, at the beginning of the brake as the average retardation between 0 and 8s (time before undue application of the parking brake) that's around 0,35 – 0,4 m/s2.
- Consider a smaller cleaning effect (purely qualitative) that could give an increase of retardation level around 0,2 m/s2.
- Therefore the global average adhesion level can be estimated in order to still give a retardation of 0,6 m/s2, on adhesion far lower than the expected, (compared with IC3 performances).

2.4. Conclusions of analysis

Contractual stopping distance requirements for IC4 fleet during emergency brake application without MTB and under tare load are the worse case considering the undue parking brake application event probability. Those requirements are below described.

Dry condition

Stopping distance <= 1250 [m] that will lead to have an average brake cylinder pressure of 2800 [mbar], far from the setting of the valve 06.03 that's 2,0 (-0,5) bar.

Low adhesion condition (5-8%) according to UIC 541-05 (k=25%)

Stopping distance <= 1562,5 [m] that will lead to have an average brake cylinder pressure of 2240 [mbar], far from the setting of the valve 06.03 that's 2,0 (-0,5) bar.

All above described data lead to conclude that:

- Undue application of parking brake cannot occur under dry conditions.
- Undue application of parking brake cannot occur under low adhesion condition (5-8%) according to UIC 541-05.
- Undue application of parking brake can ONLY occur under extreme low adhesion condition (measured values around 1-2%)
- For what above, the undue application of parking brake cannot be identified as root cause of the incident because the phenomenon aids to reduce the stopping distance.

2.5. Hazard analysis

Referring to the document AS3992 rev. D dated 05/05/2006, more specifically on Hazard n. 20 "Brake System performance degradation" we can state that this technical report demonstrates there are no adverse impact on stopping distances and hazard final rating.

Following the explanation included into the technical report and relevant consequences of undue parking brake application, FT recommends to risk assess at vehicle level possible impacts on running stability, considering occurrence on track's irregularities such as railroad switches, bends and obstacles of any nature.

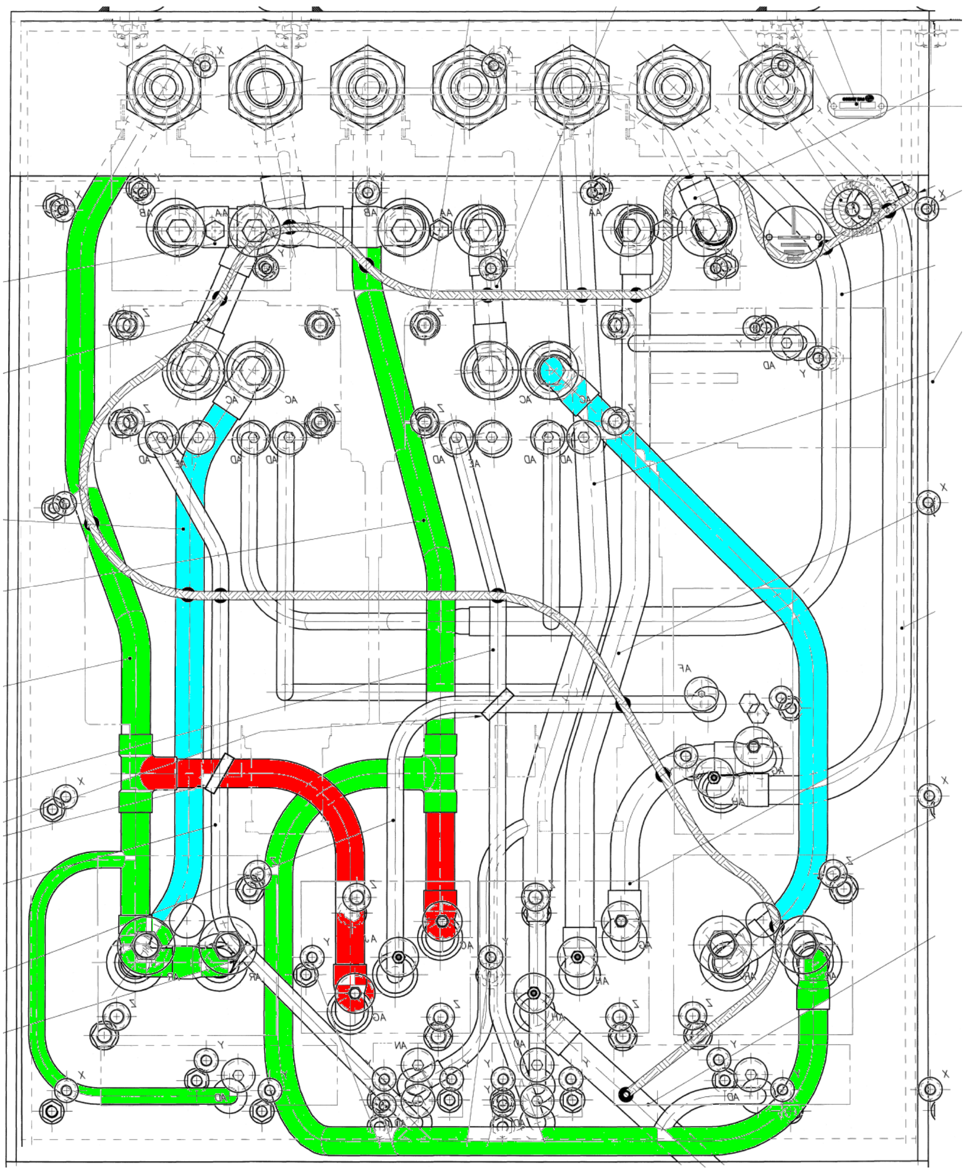
FT therefore recommends to correct the root cause of the undue parking brake application in order to lower the frequency of occurrence of such kind of failures and further mitigate this hazard.

3. Problem solution

3.1. Wrong connection of the valve 06.09 inside the panel 1/438390 and 1/438398

- LIGHT GREEN -> pipes between brake cylinder and dump valves
- CYAN -> pipes between IRV and dump valves
- RED -> pipe that drives the valve 06.09. This pipe should be taken from the cyan pipe and not from the green pipe.

BACK VIEW



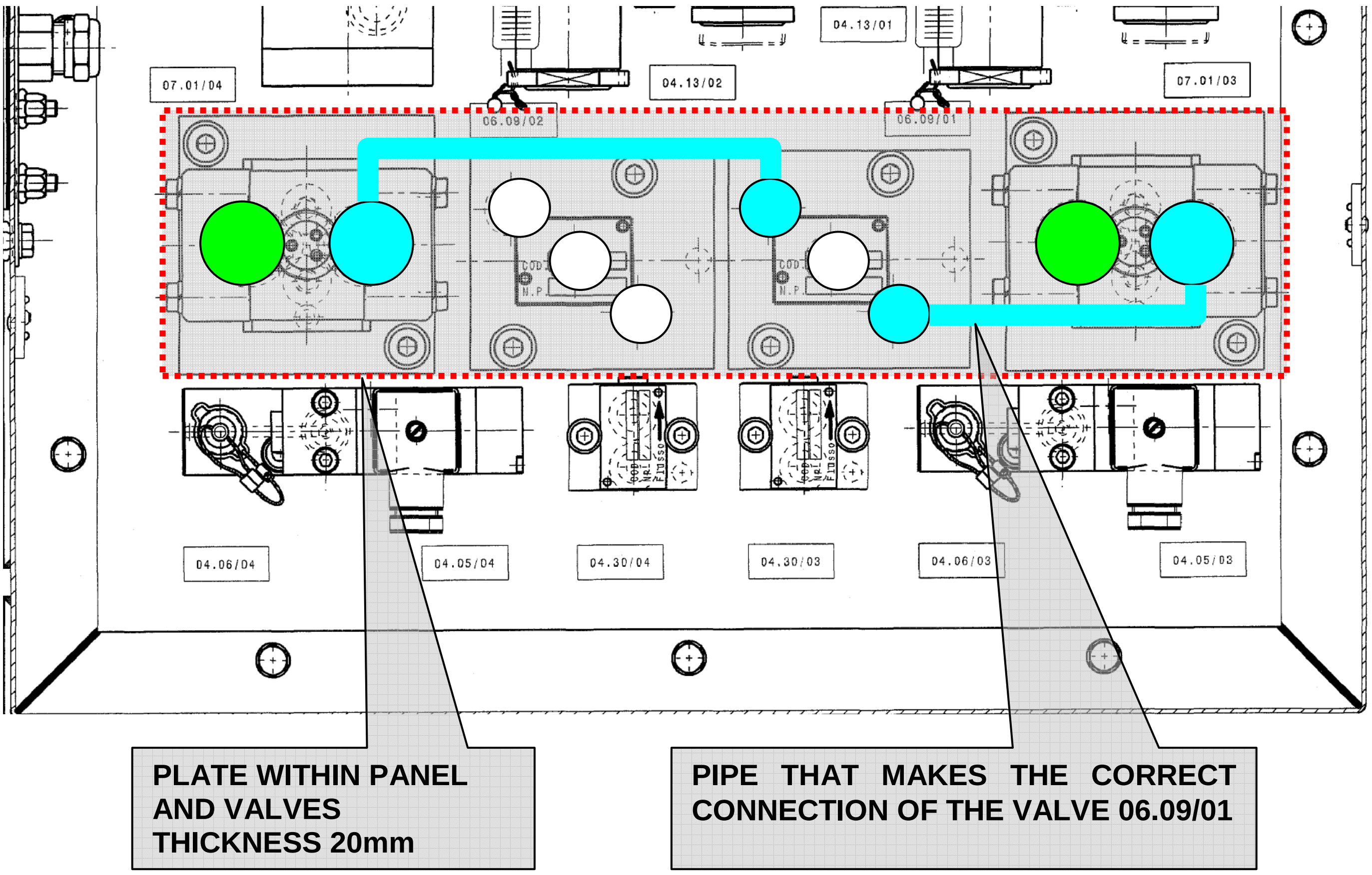
3.2. Solution to be applied on the panel 1/438390 and 1/438398

Acting on the internal piping would be difficult. Solution identified by FT would be to insert a middle flange (thickness around 20mm) within the dump valves, the double check valves and the panel plate.

Middle plate will correct:

- Both red piping (wrong) will be made blind.
- Inside the middle flange the correct piping will be realised (according to pneumatic scheme) and the pilot of the valve 06.09 will be taken between IRV and dump valve.
- Other correct connections will be not modified.
- Middle flange will be fixed to the panel by means of the same already present fixing holes of the dump valves 07.01/03 and 07.01/04 and the double check valves 06.09/01 and 06.09/02. Longer screws will be provided.

FRONT VIEW



3.3. Test to be performed after the retrofit.

The tests that have to be performed after implementation of the modification are:

- Static test according to DRDT15, (partial, only emergency brake application), in order to verify that parking brake will not be applied anymore under following conditions:
    - Emergency brake applied (BP <= 2,7 bar)
    - Axle 3 cylinder pressure < 2 bar, (test related to bogie 2)
    - Axle 4 cylinder pressure < 2 bar, (test related to bogie 2)
    - Axle 7 cylinder pressure < 2 bar, (test related to bogie 4)
    - Axle 8 cylinder pressure < 2 bar, (test related to bogie 4)

Havarikommissionen
Accident Investigation Board Denmark

REDEGØRELSE

MG 5631 kollideret med anden MG under rangering på Klargørings-center Kastrup (KAC)

HCLJ 620-2012-2	**Hændelse**	Kollision	Rangering
Dato:	06.08.2012	Tidspunkt:	04:41
Sted	KAC		
Infrastrukturforvalter:	DSB	Jernbanevirksomhed:	DSB

1 Underretning

Havarikommissionen blev kl. 06.14 underrettet om at et IC4-togsæt under rangering ved KAC havde kollideret med et parkeret IC4-togsæt. Der blev oplyst at togsættet ikke havde bremset som forventet under den sidste del af rangeringen.

2 Fakta

Hændelsesforløb

IC4-togsæt MG 5631 skulle parkeres i spor 52 ved KAC's parkeringsområde "Sibirien" som lå syd for KAC.

Umiddelbart foran IC4-togsættet rangerede et IC3-togsæt som skulle parkeres i nabosporet (spor 53).

Under rangering fra spor 43 til spor 52 standsede MG 5631 ved to betjeningsstandere til sporskifte-omstillingsanlægget inden togsættet kørte ned imod enden af spor 52 hvor IC4-togsæt MG 5642 holdt parkeret. Ved nedbremsning til standsningsstedet bremsede MG 5631 ikke som forventet og kolliderede med MG 5642.

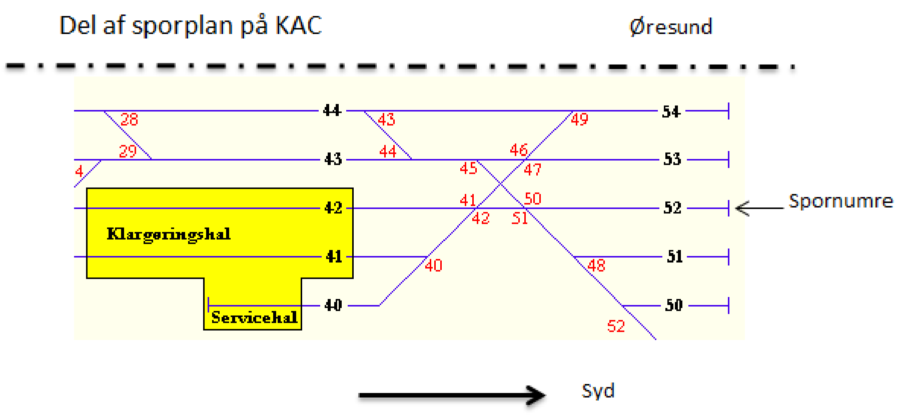
Infrastruktur

"Sibirien" var et usikret rangerområde beliggende syd for til Klargøringscenteret. Den maksimale rangerhastighed på området var 25 km/t. Området blev brugt som parkerings- / henstillingsområde for IC4- og IC3-togsæt. Området var udstyret med lokalbetjent sporskifteomstillingsanlæg med SMUTO (sikring mod utidig omstilling).

Omkomne, kvæstede og skader i øvrigt
Der var ingen personskade. Der var mindre materielle skader på fronten af begge IC4-togsæt.

Ydre forhold

Hændelsen skete ca. kl. 04.41 om morgenen. Vejret var let diset/havgus. Sporområdet "Sibirien" var beliggende tæt på Øresund, og spor 52 lå ca. 40 meter fra strandkanten.



3 Undersøgelser

Interview af involverede

Køremanden (stationsbetjent) har oplyst at han rangerede efter et IC3 togsæt som skulle i spor 53. På vej fra spor 43 mod spor 52 standsede han to gange uden problemer ved standerne for omstilling af sporskifterne. Efter omstilling af den sidste del af rangertogvejen var der mere end 400 meter til holdested, og han mente at hastigheden kom op på omkring 20 km/t. Køremanden tog derefter trækkraften fra togsættet og lod det "trille" ned imod MG 5642. Han anslog at hastigheden var omkring 15 km/t, da han begyndte at bremse ca. en toglængde [86 m] før stopmærket ved forsyningsstanderen i spor 52. Køremanden følte at togsættet bare gled og ikke bremsede. Han fuldbremsede derefter, og umiddelbart efter farebremsede han uden at kunne mærke den forventede bremseeffekt, og togsættet kolliderede med MG 5642 med lav fart.

Der blev ikke konstateret problemer med bremsning eller hjulblokering ved nedbremsning ved de to betjeningsstandere. Køremanden oplyste at han under sin vagt havde flyttet flere togsæt på området uden at han havde observeret tegn på glatte skinner.

Det blev oplyst at IC4-togsættene generelt sænker hastigheden når trækkraft tages fra (køre-/bremsekontrolleren sættes i "0"). Under rangering er man derfor nødt til at køre over 8-10 km/t for at undgå at parkeringsbremsen utilsigtet bremser togsættet når trækkraft tages fra.

Det IC3-togsæt som rangerede umiddelbart foran IC4-togsættet, oplevede ingen problemer med bremsning under rangeringen.

Der havde ikke kørt tog i området siden omkring kl. 02.00

Tekniske undersøgelser

Data fra havarilog viste at MG 5631 kørte ca. 455 meter fra den sidste betjeningsstander og frem til kollisionen. Opmåling på stedet viste at MG 5631 kørte ca. 475 meter fra den sidste stander til kollisionen skete.

Data fra havarilog viste at MG 5631 kørte ca. 755 meter fra rangering blev påbegyndt og frem til kollisionen. Togets GPS-system har registreret at MG 5631 kørte ca. 783 meter fra rangering blev påbegyndt og frem til kollisionen.

Togsættets havarilog har registreret flere tilfælde af hel eller delvis hjulblokering begyndende i bremsetrin 2 af 8. Den maksimale hastighed under rangeringen blev registreret til 22 km/t. Der var 2 kortvarige (under eller lig med 2 sekunder) registreringer af hjulslip og 1 kortvarig registrering af hjulblokering fra rangering påbegyndes og frem til den anden betjeningsstander. Efter betjeningsstanderen og frem til kollisionen var der bl.a. registreret 7 kortvarige og 1 længerevarende tilfælde af hjulslip og 2 kortvarige og 1 længerevarende tilfælde af hjulblokering. Den sidste registrerede hjulblokering varede frem til kollisionen.

På grund af hjulblokering kunne hastigheden i kollisionsøjeblikket ikke aflæses i havariloggens registreringer, men Havarikommissionen vurderede at hastigheden var ca. 5 km/t.

Der blev konstateret mindre hjulflader på akslerne 4, 7, 8 og 9.

På skinnehovedet kunne der konstateres tegn på hjulblokering ca. 26 meter bagved MG 5631 og tegn på rust samt belægning på skinnehovedet bag ved MG 5631.

Foto: Havarikommissionen

MG-bremserne var ikke blevet aktiveret under rangeringen. MG-bremserne aktiveres automatisk ved farebremsning hvis hastigheden er over 20 km/t. Når hastigheden falder til under 20 km/t, hæves MG-bremserne automatisk. Ved hastighed under 20 km/t kan MG-bremserne aktiveres manuelt med lampetryktast på førerbordet.

Der blev taget enkelte materialeprøver fra skinnehovedet ca. kl. 06.35 og flere prøver ca. kl. 07.30. Prøvningsresultaterne fra Teknologiske Institut viste at *"det mørke materiale opsamlet fra overflade af jernbaneskinner alle er dannet af en blanding af rust (jernoxid), sandkorn, små sten (silikater) og en meget lille mængde olie/fedt. Det var sandsynligt at den mørke belægning indeholdte vand. Mængden af vand i belægningen vurderedes at kunne vokse med mængden af belægning. Det har på grund af den relativt lille prøvemængde ikke været muligt at bestemme det præcise vandindhold i belægningsprøverne. De mørke belægninger indeholdte en meget lille mængde kulstof, hvilket indikerede et meget lille indhold af organisk materiale. Der blev påvist et meget lille indhold af olie/fedt i prøverne. Der var intet i de opnåede resultater, der indikerede at prøverne indeholdte andre organiske materialer end olie/fedt."*

Trafikale undersøgelser

Der var den 4. juli 2012 udsendt lokal mail med advarsel om at der periodevis kunne være glatte skinner på sporområdet "Sibirien". Mailen var udsendt på baggrund af en hændelse hvor glatte skinner som følge af ukrudt mentes at have været årsagen til at et IC3 togsæt havde svært ved at bremse.

Sporområdet lå i et åbent område tæt på Øresund. Spor 52 lå ca. 40 meter fra strandkanten, og medarbejdere har oplyst at der ofte var havgus fra Øresund ind på sporområdet.

Uddannelse

Køremanden var i besiddelse af gyldigt licens og certifikatet men kunne ved hændelsen ikke fremvise det. Han havde bestået IC4 køremands-uddannelse i januar 2012.

Human factor

Køremanden blev ansat i DSB efteråret 2009. Han mødte den 5. august 2012 kl. 21:26 Denne vagt var den femte nat i træk. Køremanden fortalte at han foretrak at have nattjeneste.

4 Analyse og konklusion

Analyse

Kombinationen af:
- sporområdets beliggenhed tæt ved Øresund hvor der kan forekomme havgus,
- rester af rust på skinnehovedet,
- rester af andet materiale på skinnehovedet,
- hjulslip under igangsætning og begyndende hjulblokering fra bremsetrin 2
  sandsynliggør at skinnerne i et vist omfang har været glatte da kollisionen skete.

Konklusion:

Det var sandsynligvis glatte skinner som kombineret med bremsesystemets funktionalitet medførte hjulblokering ved bremsning og medførte en difference mellem havariloggens registrering og den tilbagelagte afstand.

Havarikommissionen vurderer at hændelsen og omstændighederne, i forbindelse med bremsesystemets funktionalitet, har lighedspunkter med tidligere hændelser og gennemførte test af IC4 togsættene i december 2011 og i januar 2012.

5 Bemærkning

Denne hændelse afsluttes som en selvstændig undersøgelse. Undersøgelse af bremsesystemets funktionalitet indgår i den igangværende undersøgelse vedrørende "IC4-togsæt passeret signal i ”stop” ved Marslev den 7. november 2011", ref. HCLJ611-2011-23.

Bilag 6.1
Havarikommissionen
611-2011-23

DB Minden testrapport (forside).

Originalrapport er låst

DB Mobility Networks Logistics

Test Report

IC4 diesel multiple unit operated by DSB
Wheel-slide protection system
Bench testing on WSP test rig

Document ID No.: 12-17435-T.TVI12-122428-PR01
Date: 30 October 2012

Testing laboratory: Prüfungen Bremse und Kupplungen
[Testing of brake and coupler systems]

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611-2011-23

Mobility
Networks
Logistics

Rubriken

IC4 Marslev Investigation
Conclusions from WSP Rig Tests

DB Systemtechnik GmbH
TVI 1 - Brakes, Couplers
Peter Spiess
Benjamin Büche

Version 1.1, 13.06.2013

Inhaltsverzeichnis

1 Introduction

On 07th November, 2011, an IC 4 train of DSB passed a signal at danger near Marslev, still having a speed of roughly 140 km/h at the location of the signal. The train finally came to stop approximately 651 m behind the signal where it should have stopped and 542 m behind the danger point /1/.

The incident was investigated by Havarikommissionen, leading a group of technicians from DSB, the train manufacturer Ansaldo Breda, the brake system manufacturer Faiveley Transport and DB Systemtechnik GmbH as consultants. Preliminary findings of the investigation are documented in /1/ and /2/.

After the incident, the whole fleet of IC 4 trains was taken out of service due to the fact that the cause of the SPAD was unclear and a fault in the train's brake system could not be excluded. Following the results of the investigation, Trafikstyrelsen granted permission to reinstate the trains into service, subjected to a set of technical barriers and without passengers, on February 27th, 2012.

In addition to the investigation led by Havarikommisionen, an independent investigation into the topic was carried out by the Danish Technical University (DTU), whose preliminary results have in the meanwhile been published /3/. The findings of DTU basically matched and did in no way contradict the previous findings of Havarikommisionen. After the presentation of DTUs results, on July 1st 2012, Trafikstyrelsen permitted IC4 operation with passengers.

Both investigations found the WSP system of the train to be a factor contributing to the incident. In order to shed more light into the issue, the testing department of DB Systemtechnik GmbH in Minden was commissioned to carry out tests of the IC4 WSP system on their test rig. The resulöts of these tests are documented in /4/.The WSP hard- and software used in the test was taken directly from the train (Trainset 27) involved in the Marslev incident, in order to identify possible hardware failures on that specific train as well as software malfunctions.

This document serves to interpret the test results from the rig-tests /4/ and to indentify possible flaws in a more detailed way than allowed by the sparse data from the incident. It shall be viewed as an accomplishment to the test report as well as a supporting document to the final investigation report by Havarikommissionen /5/.

2 Test Report

2.1 Test objects

Object of the tests were part of the IC4 trainset No 27, which was involved in the incident in Marslev at Nov. 7th, 2011. The tested subsystems were

1. The M1 brake control unit (BCU), controlling axles 1 to 4 of the train
2. The T3 BCU, controlling axles 5 and 6 of the train

Both BCUs were tested together with their speed sensors and their WSP valves. All components were uninstalled from the train on May 30th, 2012 and had not been in service since trainset No 27 had been taken out of service in November 2011. Thus, it can be concluded that the state of the tested subsystems during the tests was as close as possible to their state during the Marslev-incident. Since, by order of Havarikommissionen, no manipulations on trainset No 27 were allowed between the incident and the time when the subsystems had been uninstalled, the same can be concluded for the WSP software implemented in the BCUs.

2.2 Testing conditions

The tests have been carried out at the WSP test rig at DB Systemtechnik GmbH in Minden during the period between 02.07.2012 and 24.08.2012. Since railhead conditions were simulated as mathematical models, the external conditions during the tests had no effect on the results obtained.

2.3 A note on rail/wheel conditioning

WSP operation under moderately low adhesion conditions[1] relies on the effect of rail/wheel conditioning. Under such conditions, the friction power generated by the sliding motion between wheel and rail improves the adhesion level by partly breaking up the film between the contact partners. As a consequence, the brake deceleration increases during the course of the brake application. Although the inner workings of this effect are not fully understood, its existence is empirically proven time and again during WSP tests.

Under extremely low adhesion conditions (levels of about 0.03 and below), the conditioning effect plays a minor role – if any at all. The reasons for this are twofold: First, the friction power between wheel and rail is much smaller, since the power input is proportional to the adhesion level itself. Secondly, grease films leading to such adhesion conditions – e.g. leaf films in autumn – are harder to break up mechanically.

WSP test rigs usually have a built-in empirical model for the conditioning effect, which can be switched on or off, depending on the goal of testing.

2.4 Tests on dry rail

According to the test report, there were no unintended WSP activities during the dry rail tests. This statement holds for both subsystems tested (M1 and T3) and is documented in /4/, appendix 3.1 to 3.4.

Non-activity of the wheel slide protection is a basic and general requirement on such systems /6/, preventing unenforced brake distance extensions. Thus, the WSP system does work properly under these conditions.

2.5 Low adhesion

This section describes the tests performed under low adhesion conditions with initial adhesion levels between 0.05 and 0.08, i.e. similar to track tests with soap/water mixture (adhesion levels higher than experienced in Marslev). Graphical displays of the relevant WSP behavior can be found in the test report /4/ in appendix 3.5 to 3.8.

The low adhesion tests were performed without a simulation of the conditioning effect. Thus, the brake distances in the simulations are longer than one would expect in field tests, where under low adhesion conditions such an effect is clearly present. However, the absence of conditioning during the simulation poses more challenging conditions to the WSP system, and thus reveals additional information on its ability to control wheel slip.

Under these circumstances the WSP already becomes very active, and the wheel speeds oscillate between the vehicle speed and a maximum slip level. No qualitative difference is found between the behavior of the M1 and T3 WSP unit.

At some points, a brake cylinder is completely vented in order to get the reference speed back to vehicle speed, but does not immediately refill the brake cylinder after that target is reached. In fact, the refilling started up to 1.5 seconds after the axle speed reached the vehicle speed.

An analysis of the impact of this phenomenon on the brake distance reveals the following: Since these venting takes place about every 10 seconds on one axle per WSP-system, i.e. that every 10 seconds for 1.5 seconds there are 3 out of 10 axles which are not braking. In terms of figures the brake force lost through this (F_{lost}) can be displayed as:

$$F_{lost} = \frac{1.5s}{10s}\frac{3axles}{10axles} = 0{,}045 = 4{,}5\%$$

So over the complete time of the braking up to 4,5% of the brake force is lost. This phenomenon leaves room for optimization.

---

[1] i.e. initial levels of adhesion between 0.05 and 0.08, as recommended in /6/ for low adhesion tests. Note that these conditions do not reflect the adhesion conditions present at Marslev.

Though this effect is also seen on adhesion levels below 0.05, it only occurs when the axle speed equals the vehicle speed. During the 'Marslev incident' the reference speed and therefore the axel speeds where mostly below the vehicle speed. So this behavior had little to no impact on the Marslev incident.

2.6 Tests with sudden decrease of adhesion

The tests simulate a train encountering a short section of extremely low adhesion, with dry rail before and after.

The aim of these tests is to find out if the WSP algorithm reacts correctly to the sudden changes in adhesion, i.e. that it first vents the brake cylinders quickly enough to prevent flat spots, and after adhesion is reinstated, it refills the brake cylinders as quick as possible to prevent unnecessary brake distance extensions. Graphical displays of the relevant WSP behavior can be found in the test report /4/ in appendix 3.9 to 3.10.

Both WSP units react properly on the adhesion changes in the simulation. Although the axles go into deep slip (with slip levels above 30 km/h), the vehicle speed is reached shortly after a higher level of adhesion is reestablished. In addition to that, there is no slip of over 30 km/h for more than 30 s, a requirement from /4/.

2.7 Low adhesion tests at low initial speed

These tests are again performed at moderately low adhesion levels and serve to judge if the WSP works properly on low speeds, i.e. if efficient in the prevention of flat spots. Although of no relevance to the Marslev-incident, the tests were performed and are discussed here for completeness. Graphical displays of the relevant WSP behavior can be found in the test report /4/ in appendix 3.11 to 3.12. Again, both WSP units react properly on the given conditions.

2.8 Test with 500 m of extremely low adhesion

The tests simulate a longer section of extremely low adhesion, which in field tests is usually created by laying oil on the track. Graphical displays of the relevant WSP behavior can be found in the test report /4/ in appendix 4.1 to 4.2.

In all test of this sequence, the reference speed falls down to zero before the end of the low adhesion section, which in terms leads to locked axles. The reference speed of the T3 WSP falls at a slightly higher rate than that of the M1, otherwise the behavior is qualitatively the same.The faster locking on T3 is due to a higher deceleration of the reference speed than on M1. On T3 the maximum deceleration of the reference speed is almost 1.6 m/s^2, while on M1 the maximum deceleration of the reference speed is about 1.3 m/s^2.

The tests explicitly demonstrate that under certain conditions, the WSP algorithm, as implemented in the IC4, is not able to recover the reference speed. Under extreme low adhesion levels, the reference speed is still lifted up from time to time, but not to the same amount it has fallen down below the train speed. Multiple repetition of this process can lead to axles locking before the train comes to halt.

2.9 Additional tests on very low adhesion

The tests described here were performed to simulate WSP behavior in situations similar to the Marslev incident. Adhesion levels were below 0.05 and constant for track lengths of 1000 m and 2000 m, and the adhesion curve used was independent of slip level. For the 1000 m sections, an initial velocity of 120 km/h was used and for 2000 m, the initial speed was 180 km/h.

All tests were carried out with and without simulated wheel/rail conditioning. The main difference of the tests on very low adhesion with activated conditioning effect and those without was that with conditioning effect, the WSP acted comparable to the behavior without conditioning effect, but on a slightly higher adhesion level.

For reasons stated in section 2.3, we will only discuss results of tests performed without conditioning effect here.

2.9.1 Track section with adhesion level of 0.05

On an adhesion level of 0.05 the WSP is able to maintain a good reference speed (close to vehicle speed and regularly adjusted to it), so there are no locked wheels on these test sequences. The corresponding graphics are displayed found in Appendix 5.21 and 5.22 (M1, T3, 1000 m section) and Appendix 5.31 and 5.32 (M1, T3, 2000 m section) of the test report /4/.

The overall behavior on this adhesion level is very similar to those on low adhesion levels. Even on 2000 m of low adhesion the reference speed is held close to the vehicle speed.

2.9.2 Track sections with adhesion levels 0.04, 0.03

At these adhesion levels, the WSP still manages to adjust the reference speed to the train speed on a regular basis. No locked axles are observed. Overall, the results are very similar to those described in section 2.9.1, with lower mean deceleration levels of the train due to lower adhesion.

Graphics of the appropriate tests can be found in Appendix 5.23 and 5.24 (μ=0.04, 1000 m section), 5.25 and 5.26 (μ=0.03, 1000 m section) as well as Appendix 5.33 and 5.34 (μ=0.04, 2000 m section), 5.35 and 5.36 (μ=0.03, 2000 m section).

2.9.3 Track section with adhesion level 0.02

Beginning at an adhesion level of 0.02, the WSP algorithm has difficulties to recover the reference speed correctly. Slip levels reach values well above 50%. This reference speed problem is more significant for the T3 WSP unit, which is due to the higher deceleration level of the reference speed. No locked wheels are observed since the low adhesion track sections end before the reference speed falls below a critical value. At the transition to the dry part of the track, the WSP recovers reference speed and brake cylinder pressures immediately. The graphics of the tests can be found in Appendix 5.27 and 5.28 as well as 5.37 and 5.38 of the report /4/.

2.9.4 Track section with adhesion level 0.015

At this adhesion level, the reference speed completely fails to recover on the slippery track section and consistently drags down the axle speeds. The behavior of the reference speed is similar to what has been observed on field tests with oil preparation. Again, the axle speeds of the T3 unit fall down more quickly than those of the M1, ultimately leading to a wheel standstill on the 2000 m slippery track section. This case is regarded to be the closest approximation to what has happened with axle speeds during the Marslev Incident. The graphics of the tests can be found in Appendix 5.29 and 5.30 as well as 5.39 and 5.40 of the report /4/.

2.10 Changing adhesion conditions

The last set of tests represents very low adhesion conditions of varying degree. The first track section (600 m length) has an adhesion level of 0.056, and the section following it has a level of 0.037. Initial speed is 180 km/h. The test results reveal nothing new, since the adhesion levels chosen are well above the value critical for the reference speed. Test graphics are displayed in Appendix 5.41 and 5.42 of the report.

2.11 Summary of findings from test results

The results of the test-report /4/ show that there is no major fault in the WSP behavior that would require immediate action.

Overall, the test results show a good reproducibility. All brake applications have been repeated four times with very similar results and no sudden erratic behavior of the WSP has been observed.

Anyway, there are two issues with the WSP algorithm as it is implemented into the IC4 at this moment:

I. Under low adhesion conditions, the time lag between axle speed recovery and reapplication of brake force leads to a small loss of brake power, as described in section 2.5 of this report.

II. Below a certain adhesion level, the reference speed is not able to fully recover, and thus decreases faster than the train speed. This may ultimately lead to locked wheels and flat spots, such as observed after the Marslev-Incident. The levels of adhesion below which this behavior is observed has been identified to be approximately 0.02.

2.12 A note on the management of reference speed under extreme low adhesion conditions

Under extreme low adhesion conditions, the WSP system of the IC4 trains is not capable to keep the reference speed at levels close to the real train speed. This has been established by the test results on the test rig /4/, the Marslev-incident itself and on-track tests on extreme low adhesion that have been performed to reproduce the Marslev-incident /5/. As a consequence, under such conditions flat spots might occur and an erroneous speed signal is produced and transmitted, as has been the case during the Marslev-incident.

The technical reason for this failure to keep an accurate reference speed can be described by the following process:

1. The train encounters extreme low adhesion conditions, and thus all axles controlled by one WSP unit begin to slide.
2. The WSP system detects the slide of all axles due to the fact that the axle decelerations are beyond a certain threshold value a_{th}, which corresponds to the maximum train deceleration on dry rail plus a safety margin that takes into account possible track gradients as well as uncertainty in the deceleration measurement.
3. At this point, an artificial reference speed is built by integration of the threshold deceleration a_{th}. This leads to an “artificial” reference speed that is higher than the axle speeds but lower than and decelerating faster than the train speed. Would the reference speed continue to decelerate at this level, it would reach zero way before the train stands still and result in locked wheels after a short time.
4. In order to prevent wheels from locking, the brake cylinder pressure of one axle is vented on a regular basis, resulting in a rise of the axle speed of the corresponding axle. As soon as the speed of the axle exceeds the artificial reference speed, the reference speed increases.
5. After some additional criteria – which are not known in detail to the author – are satisfied, brake force is applied again on the vented axle and its speed decelerates again. This step is necessary to make sure that the vented axle contributes to the brake force at all times.

The cycle 2-5 is repeated as long as the adhesion is very low. It can be observed on different graphs of the test report /4/, e.g. Appendix 5.40. In the case of the IC4 WSP system, the criteria for step 5 of the process are fulfilled before the reference speed reaches the full train speed. As a consequence the reference speed on average decreases at a faster rate than the train speed and thus reaches zero before the train stops, leading to locked axles.

In comparison to the IC4 WSP system, the most modern WSP systems have a different set of criteria that lead to step 5. These systems basically make use of the fact that, as long as the vented axle (step 4) accelerates, it is sure that the axle is still sliding and thus contributing to the brake force. Step 5 is initiated when the axle stops accelerating, which indicates that it has reached the real vehicle speed. This makes sure that the reference speed is lifted up to the train speed on a regular basis and the reference speed and train speed reach zero at the same time.

2.13 Conclusions with regard to the Marslev Incident

The issues found during the tests have the following relation to the Marslev Incident:

- Issue I had – if any – only a very minor impact on the Marslev Incident. The reason for this conclusion is that all evidence /1/, /2/, /3/ points to very high slip levels during most part of the incident, where issue I plays no role at all. Nevertheless, during the initial part of the brake application, where reference speed recovery might still have been possible, and during the final part, where adhesion had improved from the extremely low levels in between, issue I might have lead to a few meters of brake distance extension.

- Issue II had a major impact on the accuracy of speed signals transmitted to the driver and the ATC system during the Marslev Incident. This ultimately lead to a late application of the emergency brake, which in case of an activated magnetic track brake would have shortened the brake distance significantly. Besides that, the test results confirm that adhesion in Marslev was below 0.02 for a significant distance, since otherwise the wheels would not have locked. In order to prevent the train from receiving wrong speed information, the issue of reference speed recovery under extreme low adhesion conditions should be addressed.

As a consequence, both issues should be investigated on a technical basis.

3 Signatures

P. Spiess

B. Büche

4 References

/1/ Havarikommissionen - “IC4 train passed signal in position ‘stop’ at Marslev on 7 November 2011”, Preliminary Statement, updated version, Roskilde, 30.01.2012

/2/ DB Systemtechnik GmbH - “Incident Investigation IC 4 Status by 2012-01-13”, Minden, 13.01.2012

/3/ Danmarks Tekniske Universitet - “Undersøgelse af IC4-togets bremseevne - midtvejsrapport”, Kopenhagen, Denmark, 20.07.2012

/4/ DB Systemtechnik GmbH - Test Report: “Triebzug IC4 der DSB - Gleitschutzgerät - Prüfung auf dem Gleitschutz-Prüfstand“, Document N° 12-17435-T.TVI12-122428-PR01, Minden, Germany, October 2012

/5/ Havarikommissionen - “IC4 train passed signal in position ‘stop’ at Marslev on 7 November 2011”, Final Statement, Roskilde, to be published

/6/ Union Internationale des Chemins de Fer - UIC Leaflet 541-05 “Wheel Slip Prevention equipment”, 2nd ed. Paris, 2005

/7/ Faiveley Transport - “General Description - Brake Equipment for DMU GTA IC4 Denmark”, Document N° DG3992, revision P, Piossasco, Italy, 10.04.2009

Bilag 6.3
Havarikommissionen
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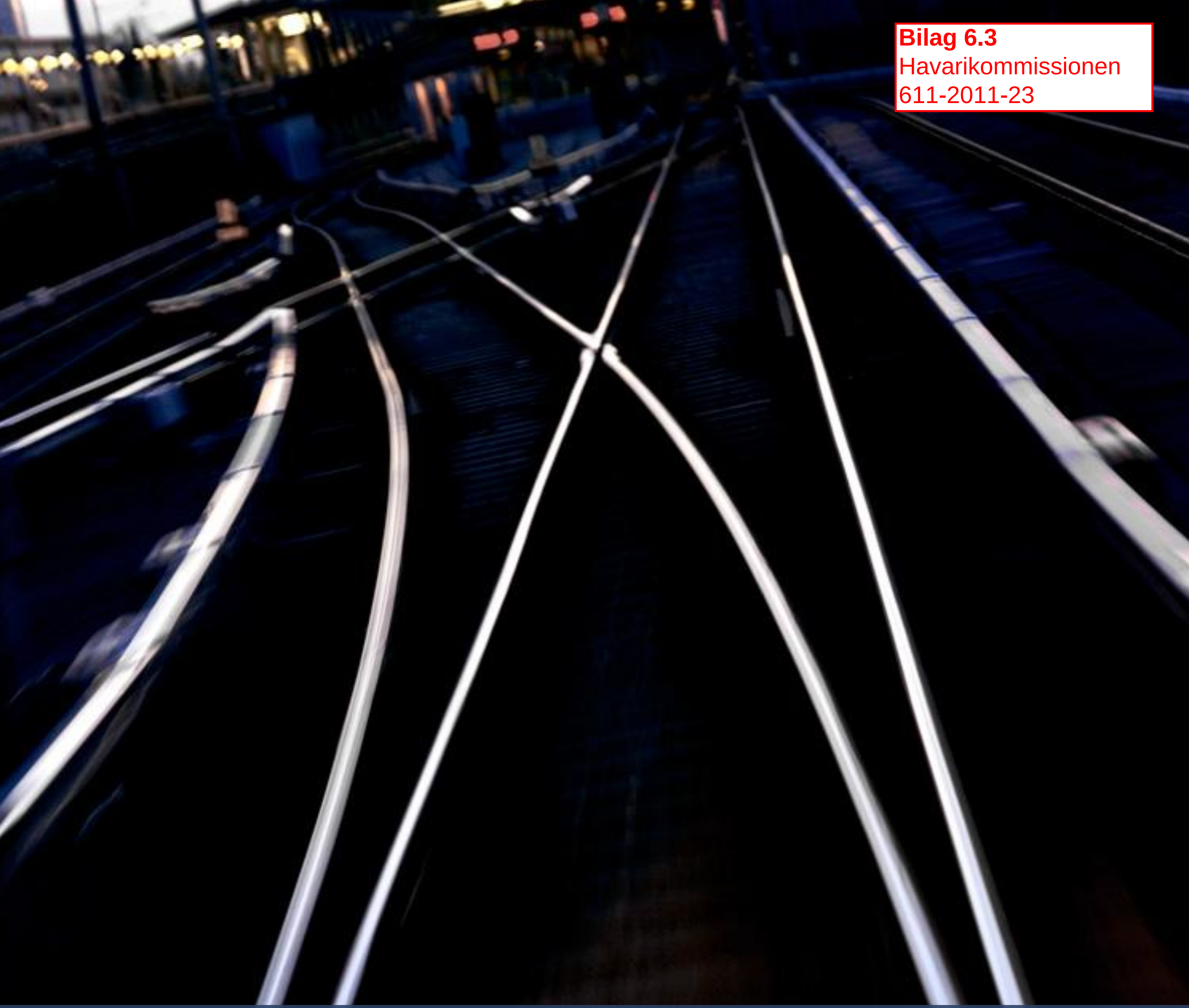

Glatte skinner

September 2012

Trafikstyrelsen
Danish Transport Authority

banedanmark

Glatte skinner

Indhold Side

1 Indledning

1.1 Baggrund og formål

Den 7. november 2011 passerede et IC 4 tog et stopvisende signal mellem Ullerslev og Marslev med 651 m. Af Havarikommissionens foreløbige rapport fremgår, at:

"Havarikommissionen vurderer at særlig glatte skinner kombineret med WSP-systemets funktionalitet, udkoblede MG-bremser og de manglende data (aktuel hastighed og kørt distance) til ATC systemet har været de væsentligste årsager til hændelsen den 7. november 2011."

I juni 2012 fremlagde DTU på foranledning af DSB en midtvejsrapportering, som ad teoretisk vej dokumenterer, at der var meget glatte skinner i Marslev.

På den baggrund har Transportministeriets departement bedt Trafikstyrelsen og Banedanmark klarlægge, om risikoen for glatte skinner giver anledning til at foretage ændringer af sikkerhedsmæssig karakter. Dette behandles i nærværende rapport, hvis perspektiv er generelle sikkerhedsmæssige risici foranlediget af glatte skinner. Enkelte litras (togtypers) sikkerhedsmæssige performance er således ikke genstand for denne rapport.

Rapporten belyser indledningsvist hvad glatte skinner er. Derefter ses på hvornår glatte skinner er potentielt farlige. Dette holdes op imod de registrerede situationer, hvor glatte skinner har resulteret i en potentiel farlig situation. På denne baggrund konkluderes, hvorvidt glatte skinner kalder på ændringer af sikkerhedsmæssig karakter samt Trafikstyrelsens og Banedanmarks anbefaling til initiativer i relation til glatte skinner.

1.2 Hørte interessenter

Rapporten er blevet forelagt DSB og Dansk Jernbaneforbund, som begge kunne tilslutte sig de overordnede konklusioner.

DSB havde følgende overordnede kommentar: "På det foreliggende grundlag er det DSB's opfattelse, at der er behov for indførelse af et system for varsling af glatte skinner i løvfaldsperioden. DSB kan generelt støtte rapporten."

Dansk Jernbaneforbund havde følgende overordnede kommentar: "Dansk Jernbaneforbund mener ikke, at der er et sikkerhedsmæssigt problem knyttet til glatte skinner, som kræver, at der iværksættes indsatser på banen generelt."

2 Glatte skinner og bremseevne

2.1 Glatte skinner

I løvfaldsperioden[1], hvor løv bliver mast mellem hjul og skinne, kan der i fugtigt vejr opstå: "Glatte skinner". Kombinationen af organisk materiale og fugt danner en biofilm, som sidder så godt fast på skinnen, at det både er vanskeligt at fjerne og let kan forveksles med en del af skinnens overflade.

Glatte skinner pga. løvfald er primært et nordeuropæisk og mellemeuropæisk problem. Nedenstående billede viser et eksempel med løvfald på en skinne.

Fotografi af løvfald på skinner.[2]

Glatte skinner vanskeliggør acceleration og bremsning af toget, hvilket er et velkendt problem. Glatte skinner har dog primært været set som et regularitets-relateret problem grundet udfordringen med at accelerere toget. Den vanskeliggjorte nedbremsning af toget har typisk ikke været anskuet som et sikkerhedsmæssigt problem, idet krav til lokomotivføreren bl.a. er, at denne altid skal køre efter forholdene, så der ikke opstår farlige situationer.

Glatheden af skinner, eller rettere mellem hjul og skinner, benævnes adhæsionen. Togvejslængderne[3] ved Banedanmark er baseret på en deceleration på 0,6 m/s^2, hvilket forudsætter en adhæsion på 0,06, såfremt bremseevnen alene baseres på overførelsen af kræfter mellem hjul og skinner[4].

[1] I andre lande er glatte skinner registreret i andre situationer. Se bilag.
[2] Kilde til billedet: Enchancing brake performance under low adhesion conditions, 21.04.2006, Dr. P Spiess, Deutsche Bahn
[3] En togvej er en sikret rute fra et punkt til et andet. Se også afsnit 3.4.
[4] Jf. afsnit 7.1 i "SODB, Sikringsanlæggene og deres betjening"

Reduceret adhæsion opdeles ofte i to kategorier[5]:

Lav adhæsion (0,05 – 0,09) som typisk opstår i efterårsmånederne i forbindelse med dug/fugt kombineret med begyndende dannelse af rust i løbet af natten.

Meget lav adhæsion (0,02 – 0,04) som typisk opstår i løvfaldsperioden, men også kan opstå af andre årsager.

Da man ved udregningen af togvejslængden i Banedanmark forudsætter en adhæsion på 0,06, kan man forvente, at lokomotivførerne i de fleste situationer med lav adhæsion vil kunne bremse toget ned inden togvejens udløb. Ved meget lav adhæsion vil det ofte ikke være muligt at bremse indenfor den påkrævede bremseafstand, såfremt hastigheden er det maksimalt tilladte og bremsningen påbegyndes i sidste øjeblik.

2.2 Bremseevne

Et togs bremseevne er først og fremmest afhængig af togets bremsesystem. Bremsesystemet dimensioneres bl.a. ud fra: togets masse, togets maksimale hastighed og adhæsionen mellem tog og skinne.

Den minimale bremseevne, der er nødvendig for at køre et tog på en strækning ved en given hastighed, afhænger af strækningens egenskaber (dvs. signalsystem på strækningen, stigninger/fald, maksimalhastighed og lignende).

[5] Informationerne er bl. a. baseret på oplysninger fra rapporten ”New Rail Materials and Coatings”, University of Sheffield, July 2003, forelæsningsmateriale ”Enchancing brake performance under low adhæsion conditions”, d. 21. april 2006, Dr. Peter Spiess, Deutsche Bahn samt referat fra møde mellem Peter Spiess, Banedanmark m. fl. d. 27. juni 2012 vedr. lav adhæsion.

3 Hvornår er glatte skinner farlige?

Der er indbygget en række barrierer i jernbanesystemet, som forhindrer, at glatte skinner fører til ulykker. Det drejer sig overordnet om udrustningen af det rullende materiel, lokomotivførernes køreteknik og de indbyggede barrierer i jernbanesystemet, som sikrer imod kollision eller afsporing pga. signalforbikørsler.

3.1 Udrustning af det rullende materiel

Nedenfor nævnes et udpluk af de elementer i udrustningen af det rullende materiel, som kan have betydning for togets mulighed for at bremse på glatte skinner.

Magnetskinnebremser består af et antal bremseklodser, der med elektromagneter kan "suges" fast til skinnerne og derved bidrage til bremsningen. Derudover kan anvendelsen af magnetskinnebremser have en rensende effekt på skinnerne, således at adhæsionen forbedres for de efterfølgende hjul. Der er forskel på om, og i hvilken grad de forskellige operatører og lande udstyrer deres tog og togsæt med magnetskinnebremser. Der kan derfor være forskel på, hvor meget effekt en magnetskinnebremse har på bremseevnen. De fleste tog og togsæt i Danmark er udstyret med magnetskinnebremser.

Dansk Jernbaneforbund mener, at alle tog, der kører mere end 140 km/timen bør udstyres med virksomme magnetskinnebremser. Dansk Jernbaneforbund deltog i arbejdet med at teste bremseevnen på IC3-togene, da de blev indført. Udkommet af det arbejde var en 140 km/t-grænse.

Anvendelse af sandingsudstyr på tog kan øge adhæsionen. Sanding er en velkendt metode, der anvendes i udstrakt grad i bl.a. England og Tyskland, hvor stort set alle tog, både lokomotiver og togsæt, er udstyret med sandingsanlæg. Anvendelsen af sandingsudstyr i Danmark er primært relateret til lokomotiver samt enkelte typer af togsæt.

På samme måde som en bil, der kører i glat føre, vil hjulene på et tog kunne blokere, hvis man forsøger at bremse toget ned på glatte skinner. WSP (Wheel Slide Protection) er indbygget i de fleste nyere bremsesystemer. WSP løsner bremserne, når hjulene begynder at glide. Derved undgås, at togets bremser blokerer ved nedbremsning. Man kan sammenligne WSP med ABS-systemet i en bil. De fleste nyere togsæt i Danmark har WSP.

3.2 Køreteknik

Lokomotivførerens generelle erfaring udgør sammen med hans viden om aktuelle køreforhold og erfaring med den konkrete litra (”togtypen”) en central barriere imod, at glatte skinner kan føre til en sikkerhedsmæssig hændelse.

I tilfælde af glatte skinner er der risiko for:

- at lokomotivføreren ikke vil kunne bremse toget før signalet, hvis han kører med maksimal tilladt hastighed og påbegynder nedbremsningen på det seneste tidspunkt, han under normale omstændigheder ville starte nedbremsningen.

- ATC-systemet heller ikke vil kunne nedbremse toget, før sikkerhedsafstanden er gennemløbet.

I sådanne situationer er det afgørende, at lokomotivføreren ud fra sin erfaring er opmærksom på, hvornår der er risiko for glatte skinner, og ud fra sin viden om konkrete forhold og litra ved, hvordan han sikkert fremfører toget under disse omstændigheder.

Statistik fra England viser, at de fleste episoder med glatte skinner sker for lokomotivførere med mindre end 5 års erfaring, hvilket indikerer, at køreteknik er vigtig. Derfor er det i England anbefalet, at der i uddannelsen af lokomotivførere enten bør være kørsel i efteråret eller en tilsvarende simulering heraf.

Der findes ikke danske data, der viser, at lokomotivførere med mindre end 5 års anciennitet har flere signalforbikørsler end andre lokomotivførere.

Dansk Jernbaneforbund mener: at lokomotivføreren skal opfordres til at prøve at bremse sit tog efter overtagelse, for at mærke, hvordan det enkelte togsæt bremser, da togsæt indenfor samme litra kan opføre sig forskelligt.

DSB mener: at kørsel under glatte forhold bør medtages som et element i den offentlige uddannelse af lokomotivførere.

3.3 Forebyggende vedligeholdelse og rensning af skinner

Forebyggende vedligeholdelse af flangesmøring på tog og smøreapparater i sporet medvirker til at reducere risikoen for, at smøremidlet fejlagtigt placeres på skinnehovedet, i stedet for på indersiden af skinnerne/flangerne af hjulene som tiltænkt.

Forebyggende vegetationskontrol/ukrudtsbekæmpelse medvirker til at mindske risikoen for reduceret adhæsion, ved at vegetationen holdes i en passende afstand på hver side af sporet.

Banedanmark har positive erfaringer med at rense skinnerne i løvfaldsperioden. Rensningen består i at spule skinnerne på de mest belastede strækninger, baseret på erfaringerne fra de foregående år samt indmeldinger fra lokomotivførerne. Rensningen foregår primært af regularitetshensyn.

3.4 Indbyggede barrierer mod kollision og afsporing i jernbanesystemet som følge af signalforbikørsel

I en situation, hvor et tog har vanskeligt ved at standse, skal der være flere barrierer, der svigter, før en farlig situation kan opstå.

Lokomotivføreren skal altid køre efter forholdene. Er der risiko for glatte skinner, vil lokomotivføreren ofte justere hastigheden og/eller påbegynde nedbremsningen tidligere end normalt, for at kompensere for den lavere adhæsion. Dette forudsætter selvfølgelig, at lokomotivføreren er opmærksom på, at der er risiko for glatte skinner.

Når et tog får signal til at køre, er der i sikringsanlægget lagt en *togvej* for toget. Altså en sikret rute fra et punkt til et andet. På denne måde sikres imod kollision og afsporing som følge af signalforbikørsel, så længe toget er på togvejen.

For enden af togvejen er et signal på stop. Lokomotivføreren vil allerede ved det signal, som han møder før signalet på stop, blive advaret om, at det næste signal er på stop. Dette muliggør, at lokomotivføreren kan tilpasse sin fart efter forholdene[6].

Togvejen er sikret frem mod signalet på stop og et stykke efter. Det ekstra stykke kaldes *sikkerhedsafstanden*. Sikkerhedsafstanden sikrer, at selvom toget kører et begrænset antal meter forbi signalet[7], så opstår der alligevel ikke en potentiel farlig situation. Først hvis toget kører forbi signalet på stop og igennem hele sikkerhedsafstanden, er der risiko for kollision og afsporing. En kollision eller en afsporing efter en signalforbikørsel sker dog kun, hvis der faktisk er et andet køretøj eller sporskifte på den anden side af sikkerhedsafstanden.

Opsummerende kan man sige, at der er en række barrierer, som forhindrer en kollision:

1. Lokomotivføreren har erfaring med at køre efter forholdene og strækningskendskab.
2. Lokomotivføreren advares om, at næste signal er på stop vha. forsignalering.

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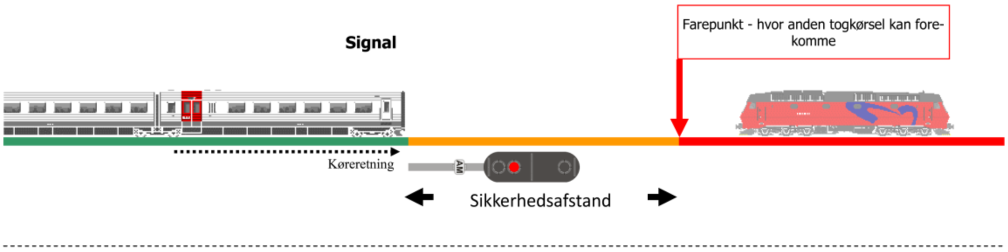
[6] En situation, hvor et tog kører for langt i forhold til det normale standsningssted ved en perron, betragtes normalt ikke som en sikkerhedsmæssig farlig situation. Så længe toget ikke passerer et stopvisende signal, er sporet foran toget frit.

[7] Sikkerhedsafstandens længde varierer afhængigt af flere forhold, men er i de fleste tilfælde mindst 50 meter. Ofte er hensyn til oversigtsforhold medtaget i udformningen af sikkerhedsafstanden. Er der f.eks. en risiko for, at lokomotivføreren først sent vil opdage, hvor togvejens endepunkt er placeret, eller er der en risiko for, at lokomotivføreren først sent erkender mindre gunstige bremseforhold, så vil det præge udformningen af sikkerhedsafstanden.

3. Stopsignalet.
4. Sikkerhedsafstanden.
5. For at der sker en ulykke, skal der desuden være et objekt eller et andet køretøj på den anden side af sikkerhedsafstanden, som toget kan kollidere med, eller et sporskifte i en stilling som kan resultere i afsporing.

Ydermere sikres mod signalforbikørsler, der kan føre til kollision og afsporing, vha. strækningens togkontrolanlæg[8]. Et togs bremseevne indkodes i togets ATC-anlæg[9], hvor det danner baggrund for ATC-anläggets beregninger af bremseveje. ATC-anlægget påbegynder automatisk nedbremsningen af toget på det tidspunkt, hvor data om hastighed og togets bremseevne indikerer, at toget skal nedbremses, for at undgå, at toget gennemkører hele sikkerhedsafstanden.

For at ATC-anlægget kan sikre, at toget bringes til standsning indenfor sikkerhedsafstanden, kræves en minimumsgrad af adhæsion.



Figur. Illustration af sikkerhedsafstand. Farepunktet er afslutningen af sikkerhedsafstanden og det punkt, hvor der *kan* ske kollision eller afsporing, hvis der er et objekt eller et sporskifte i forkert stilling på den anden side.

[8] Ikke alle strækninger har et togkontrolanlæg.
[9] ATC-anlæg anvendes på fjernbanen, mens HKT-anlæg anvendes på S-banen. Der er dog strækninger på både S-banen og Fjernbanen, hvor der ikke er togkontrolanlæg, eller hvor der er et forenklet togkontrolanlæg.

4 Hvor ofte er glatte skinner farlige i Danmark?

4.1 Engelske data

I DTU´s midtvejsafrapportering er anslået[10]:

"… at skinneforholdene ved Marslev var usædvanlige, men dog ikke mere end at hændelser af denne type kan forekomme i gennemsnit ca. 1 gang årligt i Danmark"

Vurderingen er baseret på oplysninger fra England, hvor antallet af denne type hændelser samt antallet af kørte togkilometre er sammenholdt med antallet af kørte togkilometre i Danmark[11]. Vurderingen er en "ubehandlet" overførsel af data, og DTU vil arbejde videre med vurderingen i den senere rapport WP5.

Der er da også en række forhold, der kan have stor betydning ved skaleringen fra engelske til danske forhold:

Der er forskel på udrustningen af tog i England og Danmark, idet det i England ikke er tilladt at anvende magnetskinnebremser på togene, på grund af de særlige engelske akseltællere. I England anvendes der i stedet i høj grad sandingsudstyr. I Danmark er der magnetskinnebremser på de fleste tog og togsæt, der anvendes på fjernbanen, mens udbredelsen af sandingsudstyr er mere begrænset.

Krav til bremsevejen/-længden ved en given hastighed er desuden ikke ens i de to lande, hvilket bl.a. betyder, at risikoen for alvorlige signalforbikørsler for et givet tog ikke direkte kan sammenlignes.

Ovennævnte indikerer, at en direkte overførsel af data fra England bør ske med varsomhed. I det følgende gennemgås Banedanmarks og Trafikstyrelsens data om situationer, der er opstået som følge af glatte skinner.

4.2 Hvor ofte?

Der findes ingen danske undersøgelser, som har haft til formål at anslå, hvor ofte glatte skinner opstår, og hvor reduceret adhæsionen er. Den bedste kilde til at afdække, hvor ofte fænomenet opstår, er derfor Banedanmarks Regularitets og Driftssystem, hvor forsinkelser registreres sammen med deres årsag.

[10] I afsnittet "Resultater overordnet"
[11] Oplyst ved DTU`s fremlæggelse af midtvejsrapporten d. 27. juni 2012

I situationer, hvor skinnerne er glatte, opstår typisk forsinkelser forårsaget af togenes dårligere accelerationsevne og lokomotivførerens tilpasning af hastigheden som følge af mindre gunstige bremseforhold.

Lokomotivførerne skal indrapportere forsinkelser og angive årsagen. En gennemgang af indrapporteringer af forsinkelser pga. glatte skinner i perioden 2009 - 2011 viser en markant koncentration af driftsrapporter i månederne september – november, hvilket kan henføres til løvfaldssæsonen.

4.3 Signalforbikørsler

En anden kilde til oplysninger om omfanget af glatte skinner er signalforbikørsler.

Antallet af signalforbikørsler siger noget om, hvor ofte visse barrierer (se kap 3), som skal forhindre kollision og afsporing af toget, har svigtet.

Signalforbikørsler er ikke i sig selv sikkerhedskritiske. Kun hvis sikkerhedsafstanden gennemkøres, er der risiko for kollision eller afsporing.

4.3.1.1 Registrering af signalforbikørsler

En signalforbikørsel betragtes som en ”sikkerhedsmæssig hændelse”, som ifølge Sikkerhedsreglementets § 90 straks skal anmeldes til stationsbestyreren. Stationsbestyreren registrerer fakta angående hændelsen i Banedanmarks registreringssystem. Her angiver stationsbestyreren også, hvis lokomotivføreren har angivet en årsag til signalforbikørslen – f.eks. glatte skinner.

Alle infrastrukturforvaltere og jernbanevirksomheder er forpligtede[12] til at videreindberette ulykker og sikkerhedsmæssige hændelser til Trafikstyrelsen. Trafikstyrelsen samler disse data i en database og anvender dem i det forebyggende sikkerhedsarbejde og til at føre statistik.

På baggrund af beskrivelserne af signalforbikørslerne er det i nogle tilfælde muligt at vurdere, hvor langt toget cirka er kørt forbi signalet. Om en signalforbikørsel resulterer i en farlig situation, fordi sikkerhedsafstanden gennemkøres, er det også muligt at sige noget om ud fra beskrivelsen. Der behøver ikke være nogen sammenhæng mellem de to forhold, da sikkerhedsafstanden varierer.

4.3.1.2 Sammenhæng mellem glatte skinner og signalforbikørsler

Man kunne forvente, at antallet af signalforbikørsler ville variere med årstiden, så antallet ville være højere i månederne med løvfald. Det er dog ikke tilfældet i Danmark. Nedenstående diagram viser antallet af signalforbikørsler på Banedanmarks net i årene 2009-2011:

[12] ifølge indberetningsbekendtgørelsen BEK nr. 575 af 25/05/2010

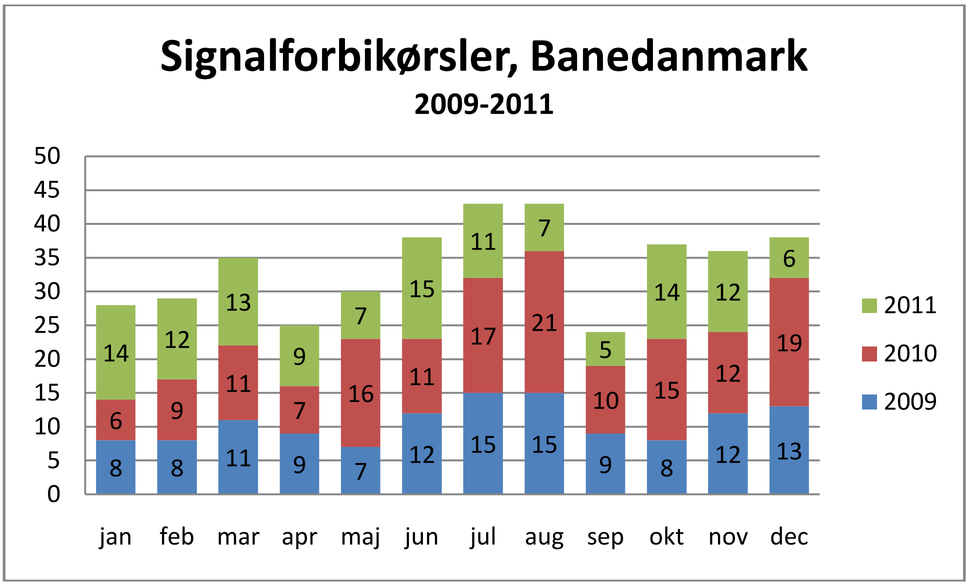


Diagram med antallet af registrerede signalforbikørsler på Banedanmarks net i 2009-2011 fordelt på måneder. Bemærk, at signalforbikørsler på rangerområder ikke er medtaget, da hastigheden på rangerområdet er begrænset og glatte skinner på rangerområder derfor har et begrænset farepotentiale.

For ingen af årene er der registreret et øget antal signalforbikørsler i løvfaldsmånederne. Modsat er der i England i perioden 1998-2003 registreret i størrelsesordenen 1/3 flere signalforbikørsler i oktober og november måned (løvfaldsperioden) i forhold til de øvrige måneder[13].

Tallene indikerer således, at der i Danmark ikke er den samme sammenhæng mellem glatte skinner og signalforbikørsler, som der er i England. Det må skyldes, at nogle af de barrierer, der er gennemgået i kapitel 3 fungerer mere effektivt i Danmark, end de gør i England.

Det tyder altså på, at enten forskelle i udrustningen af de tog, der kører i Danmark og England, eller forskelle i køreteknik eller lignende mellem de engelske og de danske lokomotivførere medfører færre sikkerhedskritiske forhold i forbindelse med løvfald i Danmark. Det kan også være samspillet mellem disse barrierer, der resulterer i en bedre effekt.

4.4 Glatte skinner som resulterer i mere end 50 meters signalforbikørsel

Banedanmark har gennemgået registreringerne af signalforbikørsler for perioden 2000 – 2011 og fundet 219 signalforbikørsler, hvor glatte skinner angives som medvirkende årsag. Det svarer til ca. 18 hændelser pr. år.

[13] *New Rail Materials and Coatings*. Prepared for the Railway safety and standards Board By G. Vasic, F. J. Franklin and A. Kapoor. University of Sheffield. July 2003.

Ingen af de 219 signalforbikørsler (bortset fra hændelsen ved Marslev) giver anledning til at tro, at der har været en egentlig kollisionsrisiko, hvilket indikerer en størrelsesorden på 0 alvorlig hændelse pr. år (bortset fra Marslev-hændelsen).

Trafikstyrelsen har gennemgået hændelsesdatabasen og fundet frem til et lignende resultat ift. signalforbikørsler i perioden 2006-2011. I udtrækket er dog identificeret fire hændelser[14], hvor tog ud fra beskrivelsen er kørt mere end 50 meter forbi signalet, og hvor der derfor må forventes at være en vis sandsynlighed for, at toget kan have gennemkørt sikkerhedsafstanden. Ingen af de fire situationer har dog standsningslængder, der ligner standsningslængden ved Marslev-hændelsen. Trafikstyrelsens vurdering er derfor ligesom Banedanmarks, at ingen af de identificerede hændelser ud fra deres beskrivelse har medført en reel kollisionsrisiko.

Trafikstyrelsen har også identificeret en række episoder, hvor tog er kørt forbi standsningssteder (f.eks. en perron) pga. glatte skinner. Disse episoder er medtaget, fordi de bidrager til at give et billede af, hvor ofte glatte skinner resulterer i situationer, hvor lokomotivførerens viden om og erfaring med kørselsforholdene ikke er tilstrækkeligt til at standse toget. Medtagningen af både signalforbikørsler og episoder, hvor tog er kørt forbi et standsningssted, passer desuden overens med den måde, som DTU har udvalgt engelske data til at anslå omfanget af glatte skinner.

Man skal være opmærksom på, at episoder, hvor tog kører forbi et standsningspunkt, ikke umiddelbart kan sammenlignes med signalforbikørsler. Før et stopsignal advares lokomotivføreren i signalgivningen på det forrige signal om, at næste signal er på stop. Der er ikke samme for-signalering før standsningssteder. Der er heller ikke noget farepotentiale i at passere et standsningssted. Så længe toget ikke passerer et stopvisende signal, er sporet foran toget frit.

Tabellen på næste side viser registreringen i Trafikstyrelsens hændelsesdatabase. Heraf kan det udledes, at der i 6-årsperioden 2006-2011 er registreret nedenstående antal forbikørsler af et signal uden tilladelse eller et standsningssted med mere end 50 meter, hvor årsagen er angivet som glatte skinner.

[14] Bemærk, at hvis Marslev-hændelsen tælles med, er der fem episoder.

Forbikørsler i perioden 2006-2011, Trafikstyrelsen

År	Dato	Passagertrafik Fjern og regionaltog	Godstog	S-tog	I alt
2006	28. oktober	Hobro Forbi standsningssted			2(0)
	29. november	Nyborg Forbi standsningssted			
2007	20. oktober	Lejre Forbi standsningssted			2(0)
	08. december	Stenstrup Syd Forbi standsningssted			
2008	05. januar	Støvring Forbi standsningssted			3(1)
	22. september			Friheden Forbi standsningssted	
	06. november	Skodsborg – Rungsted Kyst Forbi signal på stop			
2009	28. oktober	Mørkøv Forbi standsningssted			2(1)
	04. oktober	Give Forbi signal på stop			
2010	18. december			København H Forbi signal på stop	1(1)
2011	13. august	Viby Sjælland Forbi standsningssted			3(2)
	03. november		Snekkersten Forbi signal på stop		
	07. november	Marslev Forbi signal på stop			
I alt		10 (3 forbi signal på stop)	1 (1 forbi signal på stop)	2 (1 forbi signal på stop)	13 (5)

Tabel med forbikørsler i perioden 2006-2011 med mere end 50 meter af et signal uden tilladelse eller et standsningssted på grund af glatte skinner. Marslev-hændelsen er inkluderet i oversigten.

Antallet af registrerede hændelser/forbikørsler synes således at stemme nogenlunde overens med DTU's estimat lavet på baggrund af data fra England.

Der er dog ikke noget i beskrivelserne af ovenstående hændelser, der indikerer, at de ligner episoden i Marslev ift. standsningslængde. Tilsvarende er der ikke noget der indikerer, at ovenstående situationer har resulteret i andet end potentielle faresituationer.

Forbikørslerne er identificeret ved at gennemgå Trafikstyrelsens hændelsesdatabase. Hændelserne er udvalgt, hvor:

- Toget er kørt forbi et stopsignal eller et standsningssted
- forbikørslen i hændelsesbeskrivelsen er tilskrevet glatte skinner
- det af beskrivelsen fremgår eksplicit, eller det kan udledes af beskrivelsen, at toget er kørt mere end 50 meter forbi.

Hvor der ud fra beskrivelsen er tvivl om, hvorvidt hændelsen kan tilskrives glatte skinner er den medtaget i oplistningen. På trods heraf vurderes der dog at være et antal faktiske forbikørsler, som ikke er omfattet af oplistningen. Det skyldes, at mange hændelsesbeskrivelser er så kortfattede, at det er vanskeligt at udlede, hvorvidt forbikørslen skyldes glatte skinner og hvor langt toget er gledet. Samtidig indrapporteres kun en del forbikørsler af standsningssteder, da forbikørsel af et standsningssted ikke betragtes som værende sikkerhedskritisk i sig selv, og derfor kun i nogle tilfælde registreres af infrastrukturforvalterne og jernbanevirksomhederne.

Hændelser, hvor tog er kørt mindre end 50 meter for langt ved standsningssteder og stopsignaler, og hvor glatte skinner er angivet som årsag eller medvirkende årsag, indgår ikke i ovenstående beregning. Det skyldes, at hastigheden i forbindelse med disse forbikørsler er lav og der ikke er registreret situationer med mere alvorlige konsekvenser end let kollision med en stopbom.

5 Konklusion og anbefalinger

I denne rapport har Banedanmark og Trafikstyrelsen taget udgangspunkt i registreringer af sikkerhedsrelaterede hændelser i Banedanmarks registrerings-database og i Trafikstyrelsens hændelsesdatabase i perioden 2006-2011.

Hverken Banedanmark eller Trafikstyrelsen har identificeret ulykker, som har glatte skinner som medvirkende årsag.

Banedanmark og Trafikstyrelsen har heller ikke identificeret hændelser, hvor standsningslængden har lignet standsningslængden ved Marslev den 7. november 2011.

Banedanmark og Trafikstyrelsen har ikke fundet, at der er flere signalforbikørsler i løvfaldsperioden end i den øvrige del af året.

Banedanmark og Trafikstyrelsen har med basis i danske registreringer af signalforbikørsler i perioden 2006-2011 identificeret omkring 18 hændelser om året, hvor glatte skinner angives som medvirkende årsag til en signalforbikørsel. Samlet for perioden er identificeret fem episoder inklusiv Marslev-hændelsen, hvor toget anslås at være kørt forbi et stopsignal med mere end 50 meter. Derudover er der identificeret otte episoder, hvor tog er kørt mere end 50 meter forbi et standsningssted. Kun forbikørslerne af stopsignalerne kan have haft et farepotentiale, og kun, hvis toget har gennemkørt sikkerhedsafstanden.

Data kunne dog have haft en større grad af pålidelighed mht., hvor langt togene er kørt forbi stopsignalerne pga. glatte skinner. Vurderingen af, at kun fem tog i perioden 2006-2011 er kørt forbi et stopsignal med mere end 50 meter, er lavet på baggrund af beskrivelserne af forbikørslerne og indeholder derfor et element af usikkerhed.

Vigtige barrierer for at glatte skinner ikke får sikkerhedsmæssige konsekvenser, synes at være togenes udrustning og lokomotivførerens erfaring med at køre på glatte skinner og viden om køreforholdene. Disse barrierer og deres samspil lader til at være generelt tilstrækkelige, hvilket bl.a. kan ses ved, at ”glatte skinner” ofte optræder som årsag i forsinkelsesstatistikken i løvfaldsmånederne, men ikke ofte optræder som årsag til forbikørsler af stopsignaler i løvfaldsmånederne.

En vigtig forudsætning for, at rapporten kan bruges til at sige noget om fremtiden, er, at datagrundlaget kan sammenlignes hermed, herunder at barriererne er lig eller tilsvarende de barrierer, der har været til stede i perioden 2006-2011.

Banedanmark og Trafikstyrelsen vurderer således på baggrund af registreringerne, at der ikke er et akut behov for at foretage sikkerhedsmæssige ændringer, hvis de barrierer, der imødekommer forekomsten af forbikørsler foranlediget af glatte skinner, opretholdes på (mindst) samme niveau som i dag.

For at skærpe datas pålidelighed og omfang vil Banedanmark og Trafikstyrelsen dog et forsøg på fjernbanen, hvor glatte skinner varsles i en servicemeddelelse og hvor tog, der forbikører et standsningssted eller et stopsignal med mere end 50 meter, og angiver ”glatte skinner” som årsag, tages ud af drift, imens havariloggen aflæses.

Trafikstyrelsen vil på foranledning af DSB’s og Dansk Jernbaneforbunds bemærkninger undersøge, i hvilket omfang der tages hånd om køretekniske færdigheder ved fænomenet glatte skinner i lokomotivføreruddannelsen.

Banedanmark og Trafikstyrelsen vil dog afvente Havarikommissionens endelige rapport om Marslev-hændelsen, som forventes færdig i år, med henblik på at foretage en endelig vurdering af, om der er behov for yderligere tiltag.

Hensigten er at søge at opnå yderligere eksakt viden om, hvad adhæsionen var på strækningen og hvor langt toget passerede signalet.

En potentiel utilsigtet konsekvens ved forsøget kan være, at der kan opstå en mindre klar ansvarsdeling mellem lokomotivføreren og personalet i fjernstyringscentralen om, hvem der er ansvarlig for at være opmærksom på glatte skinner.

Det skal derfor understreges, at forsøget med at varsle glatte skinner ikke ændrer ved, at lokomotivføreren har ansvar for at køre efter forholdene. Lokomotivførernes køretekniske erfaring og kunnen er central for at undgå sikkerhedsmæssige hændelser pga. glatte skinner.

Forsøget vil forløbe over to måneder. Banedanmark vil sammen med DSB og Dansk Jernbaneforbund løbende evaluere forsøget og derefter sammen med Trafikstyrelsen vurdere, om forsøget skal fortsætte til næste år.

5.1 Forsøg med varsling af ”glatte skinner”

Banedanmark vil gennemføre et forsøg med varsling af glatte skinner i løvfaldssæsonen 2012.

Forsøget kan etableres umiddelbart ved udsendelse af en Trafikmeddelelse fra Banedanmark til alle jernbanevirksomheder. Når en lokomotivfører erfarer, at skinnerne er glatte på strækningen, kalder han stationsbestyreren som i dag og meddeler dette. Stationsbestyreren skal da indsætte varslingsmeddelelse på strækningsradioen, som alle øvrige lokomotivførere på samme strækning vil høre. Varslingen stoppes når mindst to lokomotivførere meddeler, at glatte skinner ikke længere forekommer på strækningen.

Forsøget fastholder lokomotivførerens ansvar for togets førelse og tager udgangspunkt i, at væsentligste faktor for at undgå sikkerhedsmæssige hændelser samt forsinkelser er, lokomotivførerens køretekniske erfaring og kunnen.

Udkast til Trafikmeddelelse findes i Bilag 6.2.

Dansk Jernbaneforbund mener, at det af Trafikstyrelsen og Banedanmark foreslåede forsøg med varsling af glatte skinner over radioen med fordel kan erstattes af et forsøg med medhør på radioen. På den måde bliver det ikke personalet på fjernstyringscentralens ansvar at give beskeden om glatte skinner videre.

Medhør er ikke teknisk muligt med det nuværende radiosystem.

5.2 Forsøg med aflæsning af havariloggen på tog, der kører for langt på grund af "glatte skinner".

Banedanmark vil gennemføre et forsøg med aflæsning af havariloggen på tog der kører for langt pga. glatte skinner i løvfaldssæsonen 2012.

Havariloggen skal udlæses, når årsagen til kørsel ud i en overkørsel, som ikke er sikret, passage af standsningssted eller et signal passeres i stop med mere end 50 meter, opgives til at være glatte skinner.

Når Banedanmarks togleder underrettes om passage af en ikke sikret overkørsel, et standsningssted eller et stopvisende signal og årsagen angives at være glatte skinner, skal undersøgelsesvagten underrettes.

I samarbejde med DSBs sikkerhedsvagt, aftales hvorledes togets havarilog udlæses, således at data på forbikørslen kan analyseres.

5.3 Lokomotivføreruddannelsen

Lokomotivførerens generelle erfaring udgør sammen med hans viden om aktuelle køreforhold og erfaring med den konkrete litra ("togtypen") en central barriere imod, at glatte skinner kan føre til en sikkerhedsmæssig hændelse.

DSB har påpeget, at kørsel under glatte forhold bør medtages som et element i den offentlige uddannelse af lokomotivførere.

Endvidere har Dansk Jernbaneforbund påpeget, at lokomotivføreren skal opfordres til at prøve at bremse sit tog efter overtagelse, for at mærke, hvordan det enkelte togsæt bremser, da togsæt indenfor samme litra kan opføre sig forskelligt.

Trafikstyrelsen vil på baggrund heraf undersøge, i hvilket omfang der i regi af lokomotivføreruddannelsen tages hånd om køretekniske færdigheder ved fænomenet glatte skinner.

6 Bilag

6.1 Europæiske erfaringer med glatte skinner – primært baseret på tilbagemeldinger fra andre jernbaneforvaltninger ifb. forespørgsel

I juni 2012 har Banedanmark fremsendt følgende spørgsmål til øvrige jernbaneforvaltninger i Europa.

1. *Do you know of any cases where other weather / humidity conditions causes rail adhesion problems with a safety risk?*
2. *Do you have a practice where you reduce speed either generally for a period or temporarily when it is judged that there is a risk of adhesion problems? If you know of the phenomenon and don't apply any precautions, I would also like to know."*

Banedanmark har modtaget tilbagemeldinger fra i alt 9 lande (Norge, Finland, England, Kroatien, Slovakiet, Schweiz, Belgien, Spanien og Bulgarien) på de fremsendte spørgsmål. Derudover er modtaget generelle informationer om emnet fra senioringeniør Dr. P Spiess, Deutsche Bahn.

Tilbagemeldingerne fra de 9 lande vurderes generelt set, at være karakteriseret ved at være kortfattede og sporadiske, der ikke nødvendigvis forholder sig præcist til selve spørgsmålene.

Tilbagemeldinger på spørgsmål 1 vedr. andre forhold end løvfald, der kan give adhæsionsproblemer med betydning for sikkerheden:

- Måske, ifb. anvendelse af kemikalier til bekæmpelse af græs (Kroatien)
- Luftfugtigheden (Slovakiet)
- Hvis skinnerne er forurenet med olie fra togene (Slovakiet)
- Glykol til forhindring af frostproblemer kan give glatte skinner (Finland)
- Støvregn kan frigøre rust, der kan give glatte skinner (Finland)
- Rust, kan ifb. længevarende aflysninger af togdriften på en strækning føre til forhold, der er næsten lige så kritiske som løvfald* (P Spiess)
- Støv* (P Spiess)
- Forurenede stoffer, typisk fra visse fabrikker f.eks. savværker* (P Spiess)
- Olie, fedt, f.eks. ifb. funktionsfejl af flangesmørringssystem (P Spiess)
- Jet fuel (P Spiess)
- Aske fra skovbrande, information fra Australien (P Spiess)

*: Aktiveres ved små mængder vand.

Hidtil har glatte skinner primært været betragtet som et problem i løvfaldsperioden, hvor det er velkendt, at der kan/vil opstå problemer med at få overført kræfterne mellem hjul/skinne ved acceleration. Erfaringer ved

Banedanmark baseret på vendespor indikerer dog også, at utilstrækkelig ukrudtsbekæmpelse måske kan give anledning til glatte skinner.

Tilbagemeldinger på spørgsmål 2 om hvorvidt infrastrukturforvalteren reducerer hastigheden midlertidigt ifb. risiko for adhæsionsproblemer:

- Nej. Hvilket er relateret til 6 af de 9 lande der har svaret på Banedanmarks forespørgsel og ligeledes Tyskland ifølge P Spiess. I flere af tilbagemeldingerne er angivet, at dette er operatørens/lokoføreren ansvar.

Ovennævnte tilbagemeldinger stemmer fint overens med den nuværende praksis/regler i Danmark, hvor det ligeledes er operatørens/lokoførerens ansvar, at sikre, at toget kan forventes at standse på rette sted.

6.2 Udkast til Trafikmeddelelse om varsling af glatte skinner i løvfaldsperioden 2012

Udkast til Trafikmeddelelse om varsling af glatte skinner i løvfaldsperioden 2012:

Varsling af "glatte skinner"

1. **Baggrund**

Med det formål at nedbringe antallet af sikkerhedsmæssige og regularitetshæmmende hændelser har Banedanmark og jernbanevirksomhederne besluttet at udføre et forsøg med varsling af "glatte skinner".

2. **Form**

Stationsbestyreren i FC udsender via strækningsradioen varsel om "glatte skinner" ved brug af tekstmeddelelsen "*Glatte skinner"*.

Varslet er en servicemeddelelse og ikke en sikkerhedsmelding.

Uden yderligere angivelse gælder varslet på hele den banestrækning, som er omfattet af den pågældende radiokanal, jf. TIB.

Varslet kan ved anvendelse af forkortelser for togekspeditionssteder eller kilometreringer dække mindre dele af banestrækningen, f.eks.

- *Glatte skinner - Vj-Bk*
- *Glatte skinner - Kl-Vb*
- *Glatte skinner - 54,0-55,0*
- *Glatte skinner - Ks-Rt og Væ-Kb*

Et varsel gælder i begge køreretninger og i alle hoved- og togvejsspor.

3. **Stationsbestyrerens forhold**

3.1. **Generelt**

Varslet udsendes på baggrund af indberetning fra én eller flere lokomotivførere. Stationsbestyreren skal ikke selv vurdere forholdet.

Meddelelsen udsendes, når tjenesten i øvrigt tillader det. Kvittering fra lokomotivføreren registreres ikke.

Varslet forbliver aktivt, indtil én eller flere lokomotivførere - eventuelt på forespørgsel - har oplyst, at forholdet ikke længere er aktuelt.

3.2. **Funktion**

Varsel udsendes ved hjælp af strækningsradioens repeterfunktion og udsendes således til alle tog på en given radiokanal samt alle trækkraftenheder, der - indtil meldingen annulleres - efterfølgende tilmeldes på kanalen.

Brugen af repeterfunktionen er beskrevet i brugervejledningen og gentages i punkt 5 herunder.

4. **Lokomotivførerens forhold**

4.1. **Generelt**

Forsøget med varsling af "glatte skinner" fritager ikke lokomotivføreren for at fremføre toget jf. SR § 3 punkt 8.1.1. og andre sikkerhedsbestemmelser. Fravær af varsel om "glatte skinner" kan ikke tages som udtryk for, at forholdet ikke kan forekomme.

4.2. Meldinger fra lokomotivføreren

En lokomotivfører, som konstaterer glatte skinner for eksempel på grund af løvfald, melder forholdet til stationsbestyreren i FC.

En lokomotivfører, som ikke oplever glatte skinner på et sted, hvor det er varslet, melder dette til stationsbestyreren.

4.3. Modtagelse af varsel

Varslet "Glatte skinner" er en servicemeddelelse. Betjening af det mobile radioanlægs kvitteringsfunktion registreres ikke af stationsbestyreren.

Efter modtagelse af varsel skal lokomotivføreren have særlig opmærksomhed rettet mod forholdet. Eventuel ekstra instruktion vedrørende lokomotivførerens reaktion på varslet kan gives af jernbanevirksomheden.

5. Betjening af repeterfunktionen

5.1. Udsendelse af varsel

Da repeterfunktionen ikke er almindeligt anvendt, gentages betjeningsvedledningen i korte træk herunder.

Tekst i firkantede parenteser på gul baggrund, [ ], angiver en tast/knap på skærmen. Det er nødvendigt, at skærmen er indstillet til at vise alle knapper - hvis dette ikke er allerede er tilfældet, tastes [VAK].

Radioens skærmbillede skal vise tilmeldingsbilledet. Hvis dette ikke allerede er tilfældet, tastes [B3/B4].

Tast:

[A/D-Tog x] [ALLE] [TXT]

- herved vises et tastatur, hvor meddelelsen kan skrives.

Skriv:

Glatte skinner *(evt. efterfulgt af afgrænsning)*

Tast:

[LUK]

- herved vendes tilbage til det "almindelige" skærmbillede.

Tast:

[REP] [AKT]

Teksten udsendes på den aktuelle kanal, og den indtastede meddelelse vil blive stående i skærmens nederste område, indtil den annulleres. Herved vises, at også trækkraftenheder, som senere tilmeldes kanalen, vil modtage meddelelsen uden yderligere handling fra stationsbestyreren. Hvis der skal varsles på flere strækninger omfattet af flere radiokanaler, skal ovenstående gentages for hver kanal.

5.2. Annullering af varsel

Tast:

[REP] [NED] [AKT]

Hvis varslet er udsendt på flere radiokanaler, skal overstående gentages for hver kanal.

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Oversigt over gyldige trafikmeddelelser kan ses på www.bane.dk, "Om jernbanen" / "Jernbanesikkerhed" / "Jernbanesikkerhedsregler"

6.3 Evaluering af Banedanmarks forsøg med varsling af glatte skinner i løvfaldsperioden 2012

Fælles evaluering mellem DSB og Banedanmark, Kvalitet & Sikkerhed af Banedanmarks forsøg med varslingssystem af glatte skinner i løvfaldsperioden 2012

Banedanmark har sammen med jernbanevirksomhederne besluttet at afholde et pilotforsøg med varsling af glatte skinner i løvfaldssæsonen 2012, dvs. fra 1. oktober til 30. november 2012.

Det er aftalt med DSB, at der skal ske opfølgning undervejs i forsøget.
Trafikal Analyse og Opfølgning i Trafikal Drift, Banedanmark trækker en daglig statistik på alle RDS indmeldinger om glatte skinner alle hverdage senest kl. 09.00.

RDS indmeldingerne går på antal hændelser, hvor glatte skinner er angivet som forsinkelses begrundelse eller som årsag til en signalforbikørsel. Denne sendes til DSB ved underdirektør, Sikkerhed Jeppe Juul Lauridsen, og internt i Banedanmark til områdechef for Kvalitet & Sikkerhed, Kirsten Kornerup Jehrbo.

Banedanmark undersøger inden 1. oktober 2012, om det er muligt at trække en log fra radiosystemet for fjernstyring med henblik på at se det samlede antal udsendte 'fast meldinger' om glatte skinner pr døgn i samme periode.
Det meddeles DSB ved Jeppe Juul Lauridsen om dette er muligt inden 1. oktober 2012.

DSB indsamler erfaringer fra lokomotivførere via et fast udarbejdet skema, eller ved fast interview skema som kørerlære/lki interviewer lkf ud fra.

Banedanmark vil 2 gange i perioden, hhv.ultimo oktober og ultimo februar bede trafiklederne evaluere varslingssystemet via en Enalyzer med få velvalgte spørgsmål til brug for en samlet evaluering, når pilotforsøget er gennemført.
DSB vil gennemføre tilsvarende undersøgelse blandt involverede lokomotivførere.

Når de daglige indmeldinger kommer op på et vist niveau eller der i samme periode er en signalforbikørsel, hvor årsagen er angivet af lokofører til at være glatte skinner, mødes DSB's underdirektør, Sikkerhed og Banedanmarks områdechef for Kvalitet & Sikkerhed for at drøfte eventuelle korrigerende handlinger, en sådan kunne være ekstra ordinær information til lkf om køreteknik, eller en ekstra ordinær indsamling af erfaringer fra de lokomotivførere, som har kørt på de mest belastede strækninger.

Kirsten Kornerup Jehrbo	Jeppe Juul Lauridsen
Banedanmark	Underdirektør
Kvalitet & Sikkerhed	DSB Sikkerhed