Final report on the results of the Joint Sector Group activities linked to the action plan defined under the Task Force Freight Wagon Maintenance

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1. Introduction

After the heavy railway accident in Viareggio in June 2009, the European Commission established a Task Force (TF, named "*Freight Wagon Maintenance*") under the leadership of the European Railway Agency, in order to examine the following technical subjects[1]:

- exchange and analyze information related to broken axles/fatigue issues and relevant testing methods;
- assist the Sector and NSAs to establish sound evidence and advice on the causes of the broken axles problem;
- propose and develop appropriate controls and monitoring tools;
- propose measures to review the different maintenance regimes existing across Europe and draw up a program for further harmonization;
- evaluate the role of standards for wheelsets in the different countries.

The TF developed its works through 7 meetings, since September 2009 till the end of June 2010, supported by the activities performed aside by the Joint Sector Group (JSG). A first agreement on the technical measures to be implemented in an Action Plan was reached on December 2009, during a meeting held in Viareggio.

A Final Report on the activities of the Task Force was emitted by ERA on 28th September 2010, describing the agreed technical measures and the expected results. The Joint Sector Group took over the task to supervise the running activities that were put in place, analyze the results and transfer the relevant outcomes into standards.

This JSG Final Report, therefore, describes the final results of the performed work and provides evidence on the conclusions drawn by the Sector within the frame of this task as a justification for JSG final recommendations. The relevant technical outcomes of this Action Plan are already under implementation into EN standards, showing the new *State Of The Art* concerning the maintenance of freight wagon wheelsets in Europe.

For a correct reading of this document and an appropriate evaluation of the technical measures mentioned hereunder, two elements need to be stressed:

- The Task Force activities focused, since the beginning, on **corrosion** and **traceability** as those issues were identified as main items and raised by some National Safety Authorities. All the measures of the Action Plan were defined under this framework. As a consequence, the goal of the JSG/TF works was not to address in general derailment issues. Therefore, the JSG activities described in this document are complementary to the work recently performed by DNV ("*Study of freight train derailments*") and other ERA activities concerning derailment in general.

- The technical measures of the Action Plan will contribute to further increase of the general railway safety level, but the induced costs might cause undesired shift to less safe road transportation. The safety level of railway and road are illustrated below:

[1] *source: ERA Final Report _Sept.2010*

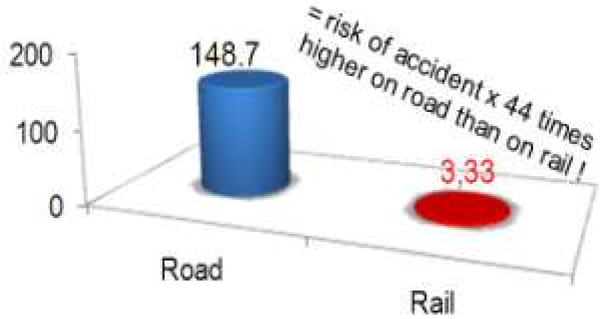

Figure 1: Number of accidents in freight transport in 2007 in Germany[2]
(# of accidents per billion tkm, source: German Federal Statistical Office)

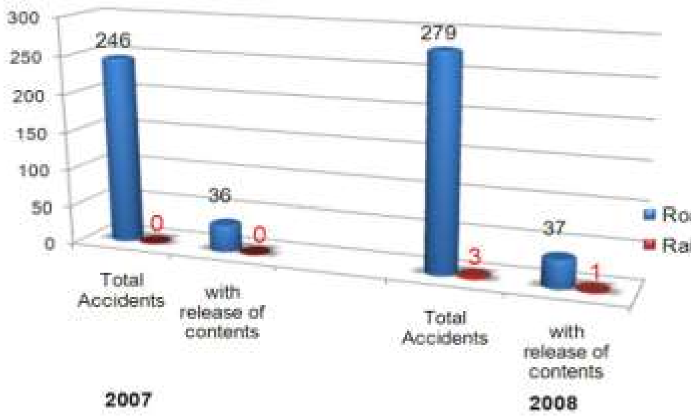

Figure 2 Accidents with Dangerous Goods in Germany
(*source: German Federal Statistical Office)* [3]

[2] source: presentation at Safety Conference 08/09, Lille, 20/08/09_CER-ERFA-UIP-UIC position
[3] source: presentation at Safety Conference 08/09, Lille, 20/08/09_CER-ERFA-UIP-UIC position

Although, we always work to reach the highest safety level, the absolute safety, zero accident for an indefinite period of time is unachievable. Thus, when enforcing any new safety measure, one should always take into account the consequences on the global transport safety.

In addition, the general tendency for railways over a long period of time indicates clear improvements for the railway safety system. As the next picture shows, the fatal train collisions and derailments involving 5 or more fatalities per decade, declined by almost 50% over the last 25 years.

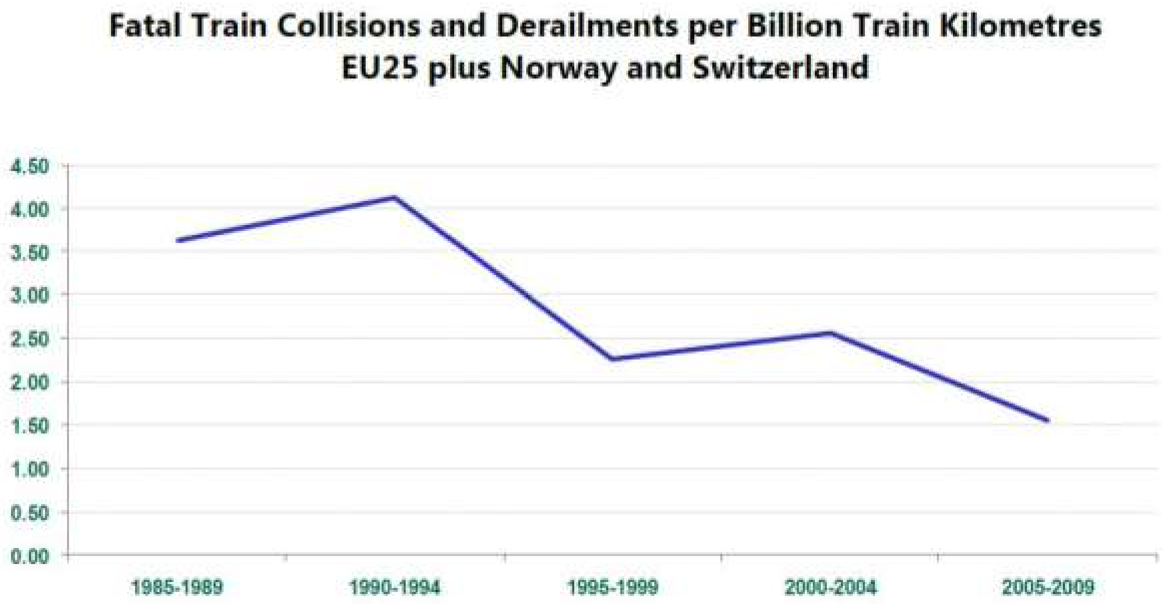

Figure 3: Number of fatal train collision and derailments involving 5 or more fatalities[4]

Right after the Viareggio accident and in the time of urgency, the TaskForce decided to define and implement additional measures dealing, as already stated above, mainly with the corrosion and traceability issues as well as addressing the need for harmonised rules on wheelsets maintenance criteria. This document describe the results and aftermaths.

The main results and detailed information about the program, as well as different documents issued by the JSG are available on ***http://www.jsgrail.eu.***

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[4] source: "Investigating links between historic accident rate reduction and underlying changes" – INTERFLEET TECHNOLOGY LIMITED – 06/12/2011

2. Broken axles: statistical analysis

Beside the work done for EVIC, ECCM and EWT, the JSG worked on a common risk analysis for wheelsets including bearings. Reviews among experts from various companies were held to analyze and quantify the risks linked to wheelset failures. The JSG, under this working topic, defined a FMEA in order to classify and sort out the risks linked to complete wheelset failures. In particular, a system definition, operational conditions, as well as a product breakdown structure were elaborated.

The risk assessment was conducted using the quantitative method “Fault Tree Analysis” (FTA) and the hazard identification was done using the semi-quantitative “Failure mode and effect analysis” (FMEA). Through the FTA, single root events were combined and assessed by defining the probability of occurrence. The risks, root causes and failure modes were listed, sorted and ranked depending on the severity and occurrence. The detailed results of the FMEA and FTA analysis are shown in Annex 2.

2.1. Joint Sector group: Results of failure mode and effect analysis (fmea) and Failure tree analysis (FTA)

The FMEA identified 152 root causes and quantified them by analyzing the linked factors of severity, detectability and frequency. The results were multiplied in order to define the according RPN (Risk priority number). As the maximum RPN for these three factors is defined by the value 1000, JSG decided for the purpose of the analysis and in order to keep the overview, to focus on RPN over 150. However, the number value of 150 should not be seen as a sector value or an absolute value for acceptable risks but only a limit to address the root causes with the highest priority (top priority). Except for visual clearness, there is no influence on the result of the FMEA due to this limitation. Based on these root causes a FTA was created.

“Derailment due to wheelset damages” was defined as top event . The top event was split up into 118 root events, structured on 6 hierarchic levels. Nine major players delivered data for the FTA analysis, based on inputs from technical experts experiences, groups and internally available statistics. It has to be noted that only one of these companies (counting for about 5% of all axles in this FTA) still uses **tyred wheels**. The sector itself agreed to stop tyred wheels operation by 2020 at the latest. Since January 2012 rehabilitation is stopped, from January 2013 the limit of tyre thickness will be extended by 20%. Having this in mind the result without tyred wheels is of interest.[5]

In summary, the results for the top event “derailments due to wheelset damages” are as follows:

- 57% due to an axle failures (thereof 47% consequently to a hot axle box, 2% to deformed axles, 8% to other axle causes)
- 32% due to wheels failures
- 11% due to wrong tread profile

The most critical path identified and linked to the axle was:
Mechanical shock ➔ spalling in the bearing ➔ hot axle box ➔ broken axle journal ➔ broken axle ➔ derailment.

[5] For more details (www.jsgrail.eu): see JSG letter from 01.11.2011: Use of tyred wheels in tread braked freight wagons with vmax>80km/H

2.2. Results comparisons: DNV Derailment, ERA/Eurostat, Bochumer Verein (D)

In order to assess further the relevance of the results, the JSG undertook a comparison of the findings with 3 other statistical sources for accidents linked to broken axles.

Den Norske veritas: derailment study

The results of the study of Den Norske Veritas (DNV): “Intermediate results of derailment study of DNV”, in the part: „Analysis of past derailments“, 06.May 2011, are very close to what the JSG found out via FMEA/FTA: wheels contribute to the same “portion of risks” for wheelset based derailments: 32%, and axles counting for 54% (JSG) resp. 68% (DNV). Two independent studies leading to the same results increase the reliability of the JSG FMEA results.

Statistics ERA/EUROSTAT

Today we still have sourcing and processing differences for the statistical data collected by ERA and EuroStat on railway accidents. For 2013 harmonization is planned. An example for inconsistent data is the accident of 2009 near St-Peter-Seitenstetten, which was collected twice: once in the Austrian and once in the German statistics. Even if it would have been possible to get results out of historical data for Europe, the JSG decides to concentrate only on Germany and on the efforts of Dr. Köhler from Bochumer Verein, who is a renowned axle expert, who collected the number of broken axles, for both freight and passenger, and the corresponding mileage for the period from 1880 till 2010!

Bochumer Verein: Germany

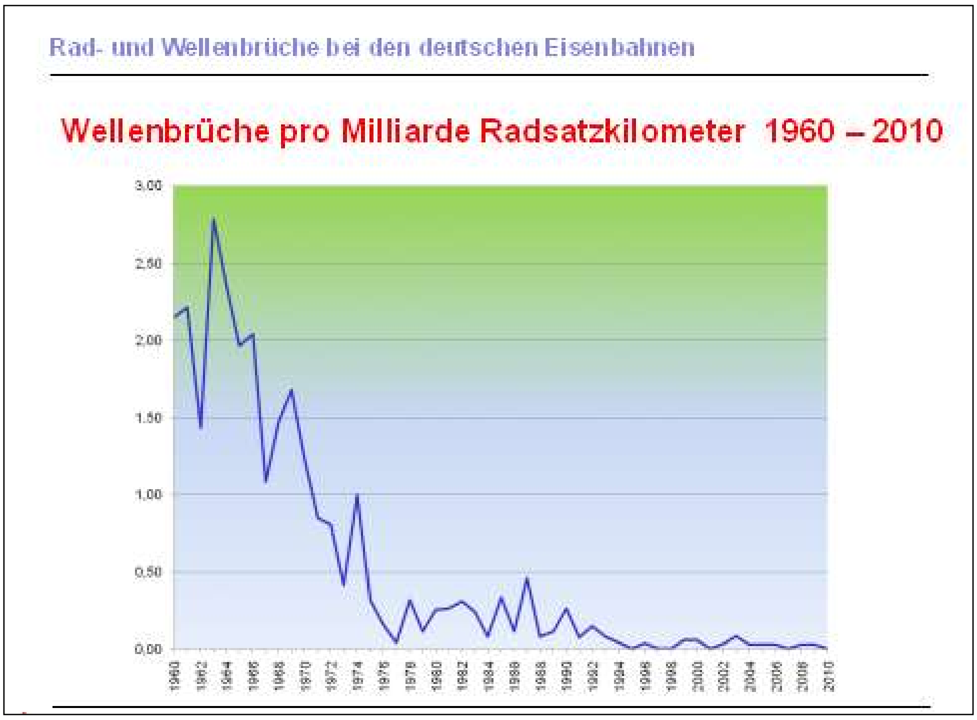

Figure 4: number of axle breaks per billion wheelset kilometers between 1960 - 2010

As graphically represented in figure 4, the statistical data collected for Germany shows a massive reduction of the number of axle breakages in the past 50 years and confirms the statements of this final report[6]: today's railway traffic relies on a very high level of safety.

Furthermore, an analysis on the evolution of total mileage of all German axles until one could break was conducted. The results show that the mileage has increased significantly since 1980[7]. For the years 2006 to 2010 there is a gap between the number of broken axles in total and the figures of the DBAG which owns the majority of axles.

Rad- und Wellenbrüche bei den deutschen Eisenbahnen

Wie hat sich die Sicherheit von Radsätzen in den letzen 130 Jahren entwickelt ?

Jahr	Wellenbrüche	Laufleistung zwischen zwei Wellenbrüchen
1880	80	100 Mio. km/Wellenbruch
1900	94	256 Mio. km/Wellenbruch
1930	88	414 Mio. km/Wellenbruch
1940	277	380 Mio. km/Wellenbruch
1955	225	117 Mio. km/Wellenbruch
1960	57	465 Mio. km/Wellenbruch
1970	35	826 Mio. km/Wellenbruch
1980	7	3 972 Mio. km/Wellenbruch
1990	7	3 866 Mio. km/Wellenbruch
2006	9 ?	4 383 Mio. km/Wellenbruch
2007	4 ?	10 099 Mio. km/Wellenbruch
2008	9 ?	4 513 Mio. km/Wellenbruch
2009	1	39 040 Mio. km/Wellenbruch
Durchschnitt Deutschland 2006 – 2010 **(Zahlen der DB AG)**		**63 486 Mio. km/Wellenbruch**
Durchschnitt EU-Bahnen 2006 – 2009		**1 983 Mio. km/Wellenbruch**

Figure 5: average mileage between two broken axles

Based on ERA's data for Germany[8], the average wheelset-mileage till an axle may crack has increased to 39'040'000'000 km in 2009. Based on the data collected by DBAG, the average mileage for the years from 2006 to 2010 increased even to 63'486'000'000 km. The difference confirms the need for a further harmonization on collecting and defining statistical data.

Finally, the results confirmed that in 90% of the cases the reason for an axle to break is linked to the bearings.

As stated above, for 2009 we assume that one single axle cracked in Germany, although the break has occurred in Austria with a German wagon. Taking into account the mileage of 39'040'000'000 km till an axle may crack, the total mileage of 1'002'900'000 Trainkm in 2009 in

[6] See 1. Introduction
[7] See Figure 5 hereunder
[8] Figures from ERA for the 4 years 2006, 2007, 2008, 2009

Germany[9] and a low average speed of 50 km/h, there could be an axle crack after 780’000’000 operating hours of a wheelset in Germany (average figure for freight and passenger operation).

Applying the same principles to the whole of Europe, with an average wheelset-mileage till an axle may crack of 1’983’000’000 km for the years 2006 till 2009, a total mileage of 4’071’900’000 Trainkm and an average speed of 50 km/h, there could be an axle crack after 39 Mio operating hours of a wheelset. With the calculations above the whole wheelset (including axle, bearings and other frunctions) achieves an equivalent safety level as defined by the SIL 4 criteria 10^{-9}, which originally applies for electronic devices.

In conclusion and with regard to the whole railway system, the most effective measures for a further reduction of risks, may be those linked to level crossings, improving shunting yards and signaling systems. In general and compared with the aviation sector, the safety level for technical systems in railways is considered high.

After this detailed analysis of the Joint Sector Group, the linked comparison and coming back to the freight wagon wheelsets as the object of the works of the TF, the most critical element is not seen as being the axle itself, but the bearings having an impact on the axle. As such, the JSG attest that the impact of measures linked to derailments due to broken axles as for reducing fatalities and serious injuries risks is very low[10].

While in the last three years the major efforts of the sector were linked to axles and especially axles corrosion where only a moderate effect (at high costs) on the general safety level can be expected, the JSG has called for a closing of the reporting on the subject.

3. Action plan of the Task Force on Freight Wagon Maintenance

3.1. TF Final Report

As mentioned in the introduction, the constitution of the ERA Task Force was a reaction to the Viareggio accident and its consequences. The moment was peculiar: there was a strong demand to quickly identify technical solutions able to reduce the risk or the probability of similar accidents, even if not 100% scientific based. The effects of the accident were dramatically evident but the causes were not exactly known at that moment.

The items that were first raised after the accident were:

- Corrosion on the broken section
- Difficulties in tracing immediately the history of the component
- A need for harmonized maintenance criteria

Consequently and to address specifically those items, the following measures were identified and constitute the Task Force Action Plan :

- EVIC: an European Visual Inspection Catalogue
- SAMPLING: for comparison of NDT results on Visual Inspection results: EVIC validation

[9] See ERA Railway Safety Report of 2011
[10] See ERA report in RISC62 on prevention and mitigation of freight train derailments

- EWT: an European Wheelset Traceability
- ECCM: harmonized European Common Criteria for wheelset Maintenance

Each of these measures/tools, which were developed and implemented "into the field" under different timeframes, contributed to a better understanding of the issues by the sector and the authorities and has given the expected answers in the SHORT, MID and LONG term periods.

A detailed description of the different actions and of their results is given in the following sections.

The final and stabilized effects on the general railway safety level linked to the implementation of the measures will be more evident after the completion of the ongoing maintenance intervals for the whole European rolling stock material (considering the different maintenance plans currently applied, around 6 to 10 years after the start of the Action Plan).

3.2. Short-term measure: The European Visual Inspection Catalogue (EVIC) for freight wagon axles

The EVIC - program, as one of the common decisions under the TF, is a quick response to improve the axle surface status of the European freight wagon fleet. This harmonized maintenance program of inspection on axles was developed in 2009 and is running since April 2010.

Visual inspection aims to increase the cumulative probability of service defects detection by introducing a visual inspection of the axle surface. The provisions of EVIC define, for the maintenance workshop staff, the criteria to visually inspect axles against corrosion and mechanical damages. EVIC inspections are carried out in maintenance workshops during wagon light maintenance (i.e. without dismounting the wheelsets from the wagon). An axle which does not meet the EVIC-criteria will be sorted out and removed from service. As such the wheelset will be handed over to medium or heavy wheelset maintenance or if it's possible in accordance to the criteria repaired in situ.

In the wheelset maintenance, the axle surface will be treated in accordance with ECCM criteria [11] and non-destructive tests (NDTs) on all parts of the axle will be performed. Through this procedure, the EVIC program aims at improving the general quality level of the axles in Europe. The visual inspections are applicable for painted and unpainted axles.

To ensure a harmonized reporting, the results of an EVIC visual check are classified under the following categories.

- EVIC OK – axle without defect
- EVIX C – axle with coating damage (only for painted axles)
- EVIC X – axle with mechanical or surface defect
- Other – axle sorted out by regular maintenance rules (e.g GCU)

In order to trace the results on a Pan European Level, the JSG introduced a monitoring program with the Joint EVIC Body of the respective country. From April 2010 to April 2012

[11] See Chapter 3.3

more than 1.4 Million axles and 375.000 freight wagons from 16 countries and 163 keepers have been checked in accordance to the EVIC criteria defined in Annex 3.2.A.

Through the reporting activities, the JSG could observe an evolution in the number of axles reported in each EVIC category, showing an increase of "EVIC-OK" axles from about 50 % to 60 % and a decrease of "EVIC-C" axles. The number of "EVIC-X" axles has been nearly constant and very stable over 2 years, staying at a very low level of 2 %.

The level of "EVIC-Other" axles of about 8 % confirms that the today's common maintenance requirements work well already. Due to the collection of the data from a large fleet from the whole of Europe and the presentation of the figures "per month", there are natural differences in the evolution. However, the figures show clearly the improvement of the surface status of the European freight axle population. In service it is not possible to reduce the number of defects – especially for "EVIC X" and "EVIC C" - to zero, but in combination with the rest of the European program it is the right way to ensure safe service of axles mounted on freight wagons.

The detailed content of EVIC is described in the documents "EUROPEAN VISUAL INSPECTION CATALOGUE (EVIC) FOR FREIGHT WAGON AXLES" (Annex 3.2.B) and the "IMPLEMENTATION GUIDE FOR THE EUROPEAN VISUAL INSPECTION CATALOGUE (EVIC) FOR FREIGHT WAGON AXLES" (Annex 3.2.C).

According to the figures, collected during nearly two years, the JSG can confirm that the EVIC program is well implemented in Europe and has become a natural standard-of-work performed by maintenance workshop staffs. In addition, the EVIC requirements have been integrated in the GCU and will be part of the revised EN 15 313.

In this sense, and because the main financial burden is linked to the pan European EVIC tracing program[12], impacting and preventing the competitiveness of the sector, the JSG will stop the tracing of the whole European axles population, bearing in mind that:

1. the reporting structure for "EVIC-X" will be done under the GCU rules and that
2. any issue linked to it may be raised via the ECM certification process to the authorities.

EVIC differentiation between corrosion (x), oxidation (c) and requirements for abutment

In order to better understand the differentiation made from the beginning between EVIC axles categories, the JSG took into account the different types and forms of corrosion for different material in particular for steel. In the EVIC the distinction was made between:

- Atmospheric corrosion or oxidation: uniform and thin layer on the axle surface (case C) does not create stress concentration

  AND

[12] from the workshop, to the keeper, to the EVIC bodies, to the JSG, to the authorities

- Chemical corrosion: concentrated patterns, creating many craters often very deep and locally creates stress concentration (case X).

This distinction was validated further by the sampling program: there is no significant difference between “EVIC-OK” or “-C” axle in terms of NDT defects. This distinction was also validated by the return of experience of the former incumbent railways for painted axles in France and unpainted axles in Belgium. As an example, picture 11 of the EVIC catalogue is an atmospheric corrosion without crater (oxidation). It has to be categorized under EVIC class “C”,not “X”. Taking into account the results of the collected data and the results of the sampling program, the JSG can attest that the differentiation remains valid and that there is no need to adapt it, bearing in mind that uniform corrosion does not create higher risks!

Regarding the discussions on the abutment area and as written in the EVIC, this area is not always easily visible when the wheelset is under a wagon. However, the stress safety margin is higher in abutment areas than in other areas, for all type of axles. Moreover, the sampling program shows that in the abutment area no special risk is indicated.

Furthermore, some countries have already integrated parts of the EVIC program and have taken the corrosion and oxidation differentiation into account in their maintenance schemes for a long time now. This is one reason, why there are some differences in the EVIC results from the different European countries.

Not all the countries started at the same level when EVIC checks were introduced.So one of the best achievements of the works discussed in the TF and within the JSG, was to learn from best practices in the involved countries, to adapt and apply them in a harmonized way all over Europe.

EVIC sampling

In order to assess the efficiency and measure the accuracy (i.e the probability of finding defects) by the means of the visual checks of the EVIC program, the EVIC sampling program was introduced. Its purpose was to check if there is an increase in the cumulative probability of service defects detection by the means of visual checks between two NDT. In this EVIC sampling program, a comparison of the NDT results of “EVIC failed” and “EVIC passed” axles was performed. The details of the program are shown in Annex 3.2.2 A. For the purpose of clarity, a summary of the results is provided below:

For “EVIC-OK” *axles* (5’971 sampled): 4 are NDT NOK before treatment, 3 are NDT OK after treatment and 1 NDT NOK after treatment with a defect on the journal, which can in fact not be detected by an EVIC visual inspection on the axle itself.

For “EVIC-C” axles (4’566 sampled): 17 are NDT NOK before treatment,14 are NDT OK after treatment, and 3 are NDT NOK after treatment (but only 1 showing a defect in the EVIC zone).

For “EVIC-NOK” axles (2’979 sampled): 322 are NDT NOK before treatment, 318 in EVIC zone and 4 out of EVIC zone):

- 289 are NDT OK after treatment;
- 15 are NDT NOK after treatment;
- 18 cannot be treated due to too small shaft diameter

From the 13'516 wheelsets included in the sampling program, the application of normal maintenance rules implied the scrapping of 560 wheelsets. It should be noted that all the wheelsets with incomplete data are not included in the sampling analysis.

The results of the sampling program show clearly that the **EVIC program** is valuable, because the probability to find an NDT positive axle in the "EVIC-NOK" set is higher than the probability to find an NDT-positive axle in the "removed by EVIC population" (i.e. "EVIC-Ok" or "EVIC-C"). The classification under the different risk domains shows no significant distinction between the NDT – results. EVIC is an efficient tool to sort out potentially NDT-positive axles and thus enhances the general safety level of freight traffic in Europe. However, it has to be mentioned that an axle showing a NDT indication after treatment is not automatically a potential risk and doesn't imply a crack or a growing capable crack. Detailed informations of the statistical relevance of the analysed results are provided under ANNEX 3.2.2.B: EVIC Sampling: statistical procedure and relevance.

Center Punch Mark on Wheelset Shaft

At the start of the EVIC checks it was noted that certain wheelsets showed a conical punch mark of about 2 mm width and 2 mm depth in the middle of the wheelset shafts between the wheels. As such they bear the danger of being classified as EVIC X axles.

East European railways companies (both public and private) have in service "punched axle". Its purpose was to have a mark on the central axles in order to identify the central position and the symmetry of the wheelset.

This information may have been helpful in the past, but nowadays this information is totally useless.

According to the EVIC catalogue, this type of machining is to be considered as a defect, so the axles must be checked, machined in order to eliminate the defect (according with the minimum axle body admissible diameter),or scrapped.

Referring to European EN13261 standard for axle manufacturing dimension and tolerance surface, this type of mark is not allowed and must be avoided. Following the recommendations of the EN standards, the central marking on new products must be prohibited because it is incoherent with axle calculations, design, manufacturing and maintenance prescriptions.

In conclusion, as none of the European Standards dealing with axle design and axle maintenance have taken into account these marks, the JSG strongly recommends to remove this type of marking by grinding or turning the axle during wheelset maintenance, in compliance with minimum tolerances allowed on the body to the particular axles considered.

3.3. Mid-term measure: The European Common Criteria for Maintenance (ECCM) for freight wagon axles

Harmonization of maintenance criteria for freight wagon axles has been defined as a key element of the mid-term measures.

Wagon maintenance timeframe and wheelset maintenance timeframe are usually dis-sociated. But these 2 maintenance stops represent the same opportunity to check the axle status. The JSG decided to harmonize the maintenance criteria as described in Annex 3.3. The main content of the ECCM are summarized below:

Wagon_maintenance

Wagon Maintenance is divided into 2 levels: light maintenance as defined by the GCU and heavy maintenance corresponding to revision or major overhaul of wagon. The follow-ing criteria apply:

EVIC catalogue as the visual checks criteria for axles
EVIC criteria are more restrictive for corrosive conditions operation, only cases A or B apply

Freight Wagon Wheelset maintenance

Maintenance of freight wagon wheelsets is divided into 3 maintenance levels:

- light maintenance corresponding to reprofiling of wheels
- medium maintenance corresponding to overhaul of wheelset (revision of bearing and reprofiling of wheels)
- heavy maintenance corresponding with change of wheels

Harmonized activities in wheelset maintenance

Light Maintenance level

The triggering of this maintenance level depends on the operating conditions (wheel wear). Usually, this operation occurs several times between 2 overhauls of wheelsets.

Treatment or withdrawal of axles with local and severe defects (UIC category 4) is now the EU wide harmonized criteria during reprofiling.

Medium maintenance level

Maximum interval between 2 overhauls depends on the mileage (for example max.600,000 / 700,000 km) and the period of time (for example average 12/13 years).

Criteria about UIC category 4 apply also in Medium maintenance. In addition, axles with large and heavily corroded areas, strongly and uniformly pitted surfaces, are treated or withdrawn.

High Maintenance level

Same criteria as for Medium maintenance apply. Furthermore, a 182 mm minimum wheel set diameter for axles type A operated at 20t has been decided.

Harmonized NDT rules

Complete Non Destructive Test – NDT - on all axle sections in the „Medium Maintenance Level" has been decided, complete Magnetic Test – MT - on the total axle surface in the highest maintenance level as well.

Further developments are on-going under Euraxle Project (handling of painted/non painted axles, need for Harmonization of NDT techniques: deliverables expected in 2014).

Traceability

ECCM deals also with harmonized traceability criteria: EVIC logging and European Wheelset Traceability (EWT).

These 2 requirements are further developed under the EWT and EVIC chapters.

ECCM defines also what has to be done in case of lack of traceability in order to ensure a minimum level of available data.

Continued high performance operation

ECCM defines the limit for high performance operation for types A (I, II, III(1) and III(2)) and type B. For each scope of use a limited mileage and corresponding maintenance actions are associated.

Example: Type A-I cannot be operated at a load higher than 20t.
Type A-III(2) operated between 20,6t and 21t will be checked by NDT and limited to 400,000 km (compared to 600,000 km in normal maintenance plan)

Migration of the JSG rules

The content of the European Common Criteria for Maintenance (ECCM), developed by the Sector, will be implemented by the CEN as European standardization body via the migration of the JSG proposals into the EN standards, in particular EN 15313.

EN15313 revision is on-going. The Maintenance criteria will be included and new adopted version scheduled to be published as enquiry in 2012.

Conclusions

ECCM is the results of a large study and a common effort within the Sector. Former maintenance rules were defined on national level. With the development of the ECCM program the maintenance criteria have been harmonized from the top and increase the trust in the European maintenance system.

3.4. Long-term measure: The European wheelset Traceability Catalogue (EWT) for freight wagon axles

The European Wheelset Traceability (EWT) system, worked out by the Joint Sector Group, was agreed with the European Railway Agency (ERA) and the National Safety Authorities (NSAs) after the Task Force meeting on 22nd June 2010.

The purpose of the EWT System is to record safety related wheelset maintenance data, based on harmonized parameters all across Europe, to further improve and harmonize traceability requirements, as well as to reduce the time for analysis in case of incidents.

The data to be collected, the timeframes, as well as explanations and further information are laid down in the EWT Implementation Guide, available in Annex 3.4.A.

The EWT Implementation Letter and the EWT Implementation guide was submitted via the national EWT bodies in the Member states and Switzerland. As a consequence the keepers' respectively the ECM's have invested lot of resources (time, people and money) to obtain and gather the data defined as requirements and written down in the EWT.

To verify the implementation status of the EWT in Europe, the Joint Sector Group was asked by the NSA's to carry out a monitoring system and to report on the results. Two surveys have been conducted by the JSG and showed, that the level of Traceability is very high. Furthermore, between the first and the second survey the JSG showed a further improvement of the Traceability Level within the whole railway Sector linked to rail freight wagons and components, in particular regarding the axle item. The details and further information on both surveys can be found in the presentations hold in the frame of the different ERA TaskForce meetings and are available on the ***www.jsgrail.eu*** homepage and in ANNEX 3.4.B.

Regarding the implementation of the EWT, the JSG is convinced that, based on the given data in both surveys, the Keeper respectively ECM's took their responsibility and the Sector improved its ability to trace axle data and axle events.

The high level of traceability shown in the surveys is based on a self-obligation of the Sector. However, in order to create a legal basis for the EWT requirements all over Europe, the details are implemented in the European Standards, EN 15313. The implementation itself is now finalized and was supported by the work of the CEN WG11-members. Further steps linked to the publication of the new EN standard will take place in accordance with the CEN-procedure.

Moreover, according to the requirements of the new ECM regulation 445/2011/EC, EWT is an integrated part of the ECM certification process and subject to the periodical control of the certification bodies.

4. Conclusions

Although an accident as in Viareggio is always a shock for the Sector and the public, it should not be forgotten that the transportation of goods on rail is multiple times safer than the transportation on road. It is however commonly accepted that after such an accident, measures have to be identified and taken in order to reduce the likelihood of similar incident, starting from the examination of the conditions leading to the event.

The measures identified in the discussions within the Sector and with the members of the TF Viareggio are described in this document and were implemented by the JSG on a pan-European base. Those measures are as such a genuine response to the overall goal of reducing safety risks.

The EVIC campaign as a visual examination of around 2 million axles mounted on freight wagons around Europe will continue till April 2016. However, the analyses of the current EVIC tracing reports show already a step-by-step improvement of the overall axle surface state. In addition, it has to be considered that EVIC implies a removing out of service of the axles with worst surface condition impacting also positively the general state. The NDT examinations following these removals (carried out in anticipation to standard maintenance intervals) complete the list of actions performed for the safety of the components. The final and stabilized effect of EVIC, considering also the effect of harmonized maintenance criteria (ECCM) and their implementation in the relevant EN standards, will be a general higher quality level of the surface condition of the axles in service.

It has to be also clearly understood that, not only during the transition period, but also after , it is technically impossible to guarantee that such an accident will never happen again.

On the other hand, the risk analysis of the Sector, as well as published Annual Safety Reports and other studies on safety clearly show that accidents caused by broken axles, as it happened in Viareggio, are not the main safety relevant issue in terms of preventing and mitigating freight train derailments. Most of the derailments are caused by infrastructure defects or mistakes during operation.

Looking at the limited resources of the Sector and of the authorities, the JSG, supported by the stakeholder's associations recommends therefore:

- to focus the efforts on additional improvements on the other causes of accident and derailments;
- to follow the implementation of the measures via the ECM activities, in particular in the unlikely event of similar accident;
- to discuss any safety relevant issue on a European level before issuing national measures and to make use of the ERA structures since any decision impacts the ability of stakeholders to operate freight trains and to have as a first and immediate effect a modal shift to the road with an impact on the global safety level of the European transportation system.

Coming at an end of its task, the Joint Sector Group has released a number of very important measures contributing to globally increase the safety level of freight in Europe and to build grounds for a harmonized Wheelset Axle Maintenance Plan. The coherence and consistency of the system taking into account the work of the Task Force is based on the technical standards EN13103:2009+A2:2012 for new build axles and EN15313pr for axles' maintenance.

The successful results of the Joint Sector Group activities under the Task Force Freight Wagon Maintenance show an appropriate way to find common solution for discussing technical solutions to safety relevant issues and as such may strengthen the acceptance of rail freight traffic around Europe.

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Expert	Expert	JSG coordinator	Expert	ERWA TC Chairman
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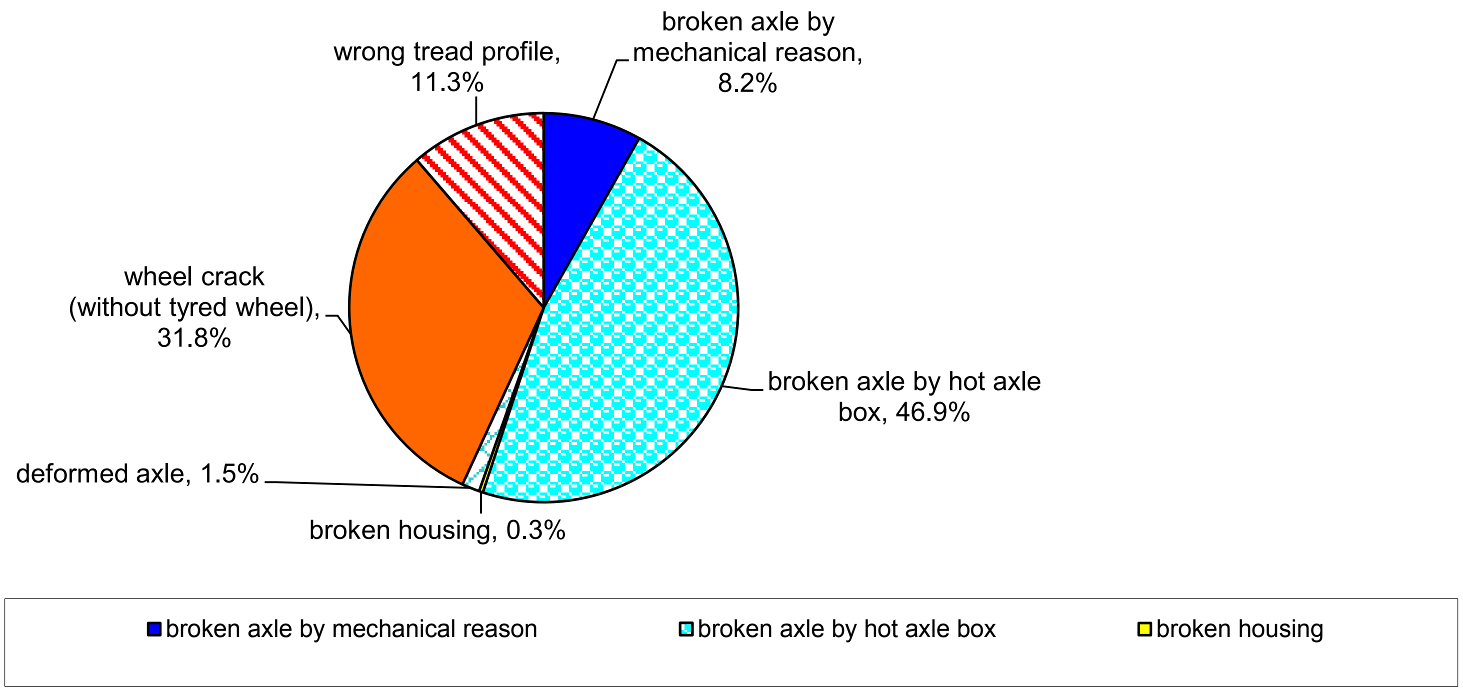
Results and details for JSG FMEA and FTA Analysis

Joint Sector Group for ERA Task Force on wagon/axle maintenance

Fault Tree Result (2nd level):
Percentage of events for derailments due to wheelset damages



Severity

Source:	based on EN 60812, Analysis techniques for system reliability – Procedure for failure mode and effects analysis (FMEA) [11/2006]

Rank	Impact	Criteria	Example
1	no impact	No recognizable effect.	
4	very low	Error is noticed by customers. Due to the failure there is an impact on the quality of rolling stock and on the infrastructure in long term.	
6	moderate	Error is noticed by most customers. Due to the failure there is an impact on the quality of rolling stock and on the infrastructure in short term.	
8	very high	Risk of some injured people and servere impact on environment. There is a high impact on operation.	
10	unsafe without warning	Risk of many dead and numerous injured people: The impact on environment is catastrophic. Operation on the line is closed for weeks.	derailment ("Viareggio")

153					Risk Priority Number (RPN) limit for intensive proovings:						250
Component level IV	**Final failure: effect on the wheelset**	**Failure mode resulting next**	**Failure mode**	**Root cause**	**Severity**		**Detectability**		**Frequency**		**Risk priority number**
311 axle	derailment	axle crack	broken abutment	corroded axle (or surface roughness)	unsafe without warning	0	low		low: relative few failures		240
311 axle	derailment	axle crack	broken abutment	hot axle box	unsafe without warning	0	little		moderate: sometimes there are failures		480
311 axle	derailment	axle crack	broken abutment	mechanical damage	unsafe without warning	0	low		low: relative few failures		240
311 axle	derailment	axle crack	broken abutment	not reported derailment in the past	unsafe without warning	0	moderate high		moderate: sometimes there are failures		240
311 axle	derailment	axle crack	broken abutment	overloading by dynamic effects	unsafe without warning	0	low		moderate: sometimes there are failures		360
311 axle	derailment	axle crack	broken abutment	overloading of the wagon	unsafe without warning	0	low		low: relative few failures		240
311 axle	derailment	axle crack	broken abutment	quality of production - geometrical	unsafe without warning	0	nearly certain		little: failure is probable		10
311 axle	derailment	axle crack	broken abutment	quality of production - material	unsafe without warning	0	nearly certain		little: failure is probable		10
311 axle	derailment	axle crack	broken journal	corroded axle (or surface roughness)	unsafe without warning	0	low		little: failure is probable		60

Com-ponent level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
311 axle	derailment	axle crack	broken journal	hot axle box	unsafe wit-hout warning	0	little		moderate: sometimes there are failures		480
311 axle	derailment	axle crack	broken journal	mechanical damage	unsafe wit-hout warning	0	low		little: failure is probab-le		60
311 axle	derailment	axle crack	broken journal	not reported de-railment in the past	unsafe wit-hout warning	0	moderate high		moderate: sometimes there are failures		240
311 axle	derailment	axle crack	broken journal	overloading by dy-namic effects	unsafe wit-hout warning	0	low		moderate: sometimes there are failures		360
311 axle	derailment	axle crack	broken journal	overloading of the wagon	unsafe wit-hout warning	0	low		low: relative few failures		240
311 axle	derailment	axle crack	broken journal	quality of produc-tion - geometrical	unsafe wit-hout warning	0	nearly certain		little: failure is probab-le		10
311 axle	derailment	axle crack	broken journal	quality of produc-tion - material	unsafe wit-hout warning	0	nearly certain		little: failure is probab-le		10
311 axle	derailment	axle crack	broken shaft	corroded axle (or surface roughness)	unsafe wit-hout warning	0	moderate high		low: relative few failures		160
311 axle	derailment	axle crack	broken shaft	mechanical damage	unsafe wit-hout warning	0	moderate high		moderate: sometimes there are failures		240
311 axle	derailment	axle crack	broken shaft	not reported de-railment in the past	unsafe wit-hout warning	0	moderate high		moderate: sometimes there are failures		240

Com-ponent level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
311 axle	derailment	axle crack	broken shaft	overloading by dy-namic effects	unsafe wit-hout warning	0	low		moderate: sometimes there are failures		360
311 axle	derailment	axle crack	broken shaft	overloading of the wagon	unsafe wit-hout warning	0	low		low: relative few failures		240
311 axle	derailment	axle crack	broken shaft	quality of produc-tion - geometrical	unsafe wit-hout warning	0	nearly certain		little: failure is probab-le		10
311 axle	derailment	axle crack	broken shaft	quality of produc-tion - material	unsafe wit-hout warning	0	nearly certain		little: failure is probab-le		10
311 axle	derailment	axle crack	broken wheel seat	mechanical damage (mounting / dismounting)	unsafe wit-hout warning	0	low		little: failure is probab-le		60
311 axle	derailment	axle crack	broken wheel seat	not reported de-railment in the past	unsafe wit-hout warning	0	moderate high		moderate: sometimes there are failures		240
311 axle	derailment	axle crack	broken wheel seat	overloading by dy-namic effects	unsafe wit-hout warning	0	low		moderate: sometimes there are failures		360
311 axle	derailment	axle crack	broken wheel seat	overloading of the wagon	unsafe wit-hout warning	0	low		moderate: sometimes there are failures		360
311 axle	derailment	axle crack	broken wheel seat	quality of produc-tion - geometrical	unsafe wit-hout warning	0	nearly certain		little: failure is probab-le		10
311 axle	derailment	axle crack	broken wheel seat	quality of produc-tion - material	unsafe wit-hout warning	0	nearly certain		little: failure is probab-le		10

Com-ponent level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
311 axle	derailment	axle damages without crack	deformed axle	not reported de-railment in the past	unsafe wit-hout warning	0	moderate high		low: relative few failures		160
311 axle	derailment	axle damages without crack	deformed axle	overloading of the wagon	unsafe wit-hout warning	0	moderate high		low: relative few failures		160
311 axle	derailment	broken abut-ment (axle)	hot axle box	broken cage	unsafe wit-hout warning	0	low		low: relative few failures		240
311 axle	derailment	broken abut-ment (axle)	hot axle box	broken inner ring	unsafe wit-hout warning	0	low		little: failure is probab-le		60
311 axle	derailment	broken abut-ment (axle)	hot axle box	broken outer ring	unsafe wit-hout warning	0	low		little: failure is probab-le		60
311 axle	derailment	broken abut-ment (axle)	hot axle box	corrosion of bearing	unsafe wit-hout warning	0	low		low: relative few failures		240
311 axle	derailment	broken abut-ment (axle)	hot axle box	loose inner ring	unsafe wit-hout warning	0	low		low: relative few failures		240
311 axle	derailment	broken abut-ment (axle)	hot axle box	spalling bearing	unsafe wit-hout warning	0	low		low: relative few failures		240
311 axle	derailment	broken abut-ment (axle)	hot axle box	wrong axle box as-sembly	unsafe wit-hout warning	0	moderate high		low: relative few failures		160
311 axle	derailment	broken abut-ment (axle)	hot axle box	wrong bearing as-sembly	unsafe wit-hout warning	0	low		low: relative few failures		240
311 axle	derailment	broken abut-ment (axle)	hot axle box	wrong clearance	unsafe wit-hout warning	0	low		low: relative few failures		240

Component level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
311 axle	derailment	broken journal (axle)	hot axle box	broken cage	unsafe without warning	0	low		low: relative few failures		240
311 axle	derailment	broken journal (axle)	hot axle box	broken inner ring	unsafe without warning	0	low		little: failure is probable		60
311 axle	derailment	broken journal (axle)	hot axle box	broken outer ring	unsafe without warning	0	low		little: failure is probable		60
311 axle	derailment	broken journal (axle)	hot axle box	corrosion of bearing	unsafe without warning	0	low		low: relative few failures		240
311 axle	derailment	broken journal (axle)	hot axle box	loose inner ring	unsafe without warning	0	low		low: relative few failures		240
311 axle	derailment	broken journal (axle)	hot axle box	spalling bearing	unsafe without warning	0	low		low: relative few failures		240
311 axle	derailment	broken journal (axle)	hot axle box	wrong axle box assembly	unsafe without warning	0	moderate high		low: relative few failures		160
311 axle	derailment	broken journal (axle)	hot axle box	wrong bearing assembly	unsafe without warning	0	low		low: relative few failures		240
311 axle	derailment	broken journal (axle)	hot axle box	wrong clearance	unsafe without warning	0	low		low: relative few failures		240
3121 Solid wheel	derailment	bearing damage, damage of other components	wheel out of round	quality of production - process (e.g. geometrical reason / heat treatment)	unsafe without warning	0	low		low: relative few failures		240
3121 Solid wheel	derailment	broken solid wheel	overloading by dynamic effects	other effects of dynamic overloading	unsafe without warning	0	low		low:relative few failures		240

Component level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
3121 Solid wheel	derailment	broken solid wheel	overloading by dynamic effects	wrong tread profile	unsafe without warning	0	moderate high		low: relative few failures		160
3121 Solid wheel	derailment	broken wheel center (tyred wheel)	overloading of the wagon	other effects of dynamic overloading	unsafe without warning	0	low		low: relative few failures		240
3121 Solid wheel	derailment	broken wheel center (tyred wheel)	overloading of the wagon	wrong tread profile	unsafe without warning	0	moderate high		low: relative few failures		160
3121 Solid wheel	derailment	deformed wheel	mechanical deformation	overloading of the wagon	unsafe without warning	0	low		low: relative few failures		240
3121 Solid wheel	derailment	deformed wheel	mechanical deformation	previous unknown derailments	unsafe without warning	0	moderate high		moderate: sometimes there are failures		240
3121 Solid wheel	derailment	deformed wheel	thermomechnical deformation	exceeding brake energy input (e.g. misuse of park brake / brake incidente)	unsafe without warning	0	moderate high		moderate: sometimes there are failures		240
3121 Solid wheel	derailment	flat wheel, tread damage	exceeding brake energy input (e.g. misuse of park brake / brake incidente)	malfunction of the brake (e.g. blocking wheel)	unsafe without warning	0	moderate high		moderate: sometimes there are failures		240
3121 Solid wheel	derailment	increase dynamic forces	wrong tread profile	tread profile damage	unsafe without warning	0	low		moderate: sometimes there are failures		360
3121 Solid wheel	derailment	increase dynamic forces	wrong tread profile	wheel out of round	unsafe without warning	0	low		moderate: sometimes there are failures		360

Component level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
3121 Solid wheel	derailment	loose wheel	loose wheel	too little pressfit	unsafe without warning	0	low		low: relative few failures		240
3121 Solid wheel	derailment	non conform wheel tread profile	extraordinary profil wear	prospective wear by normal operation	unsafe without warning	0	moderate high		low: relative few failures		160
3121 Solid wheel	derailment	non conform wheel tread profile	normal profil wear	prospective wear by normal operation	unsafe without warning	0	moderate high		moderate: sometimes there are failures		240
3121 Solid wheel	derailment	wheel crack	broken solid wheel	corroded wheel (or surface roughness)	unsafe without warning	0	moderate high		low: relative few failures		160
3121 Solid wheel	derailment	wheel crack	broken solid wheel	mechanical damage	unsafe without warning	0	moderate high		low: relative few failures		160
3121 Solid wheel	derailment	wheel crack	broken solid wheel	overloading by dynamic effects	unsafe without warning	0	low		low: relative few failures		240
3121 Solid wheel	derailment	wheel crack	broken solid wheel	overloading of the wagon	unsafe without warning	0	low		low: relative few failures		240
3121 Solid wheel	derailment	wheel crack	broken solid wheel	quality of production - material	unsafe without warning	0	moderate high		little: failure is probable		40
3121 Solid wheel	derailment	wheel crack	broken solid wheel	quality of production - process (e.g. geometrical reason)	unsafe without warning	0	low		low: relative few failures		240
3121 Solid wheel	derailment	wheel crack	broken wheel center	corroded wheel (or surface roughness)	unsafe without warning	0	moderate high		low: relative few failures		160
3121 Solid wheel	derailment	wheel crack	broken wheel center	mechanical damage	unsafe without warning	0	low		low:relative few failures		240

Component level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
3121 Solid wheel	derailment	wheel crack	broken wheel center	overloading by dynamic effects	unsafe without warning	0	low		low: relative few failures		240
3121 Solid wheel	derailment	wheel crack	broken wheel center	overloading of the wagon	unsafe without warning	0	little		moderate: sometimes there are failures		480
3121 Solid wheel	derailment	wheel crack	broken wheel center	quality of production - geometrical	unsafe without warning	0	moderate high		little: failure is probable		40
3121 Solid wheel	derailment	wheel crack	broken wheel center	quality of production - material	unsafe without warning	0	moderate high		little: failure is probable		40
3121 Solid wheel	derailment	wheel crack	loose wheel	loose wheel or loose wheel centre	unsafe without warning	0	low		low: relative few failures		240
3121 Solid wheel	derailment	wheel crack	thermomechnical crack	exceeding brake energy input (e.g. misuse of park brake / brake incidente)	unsafe without warning	0	moderate high		moderate: sometimes there are failures		240
3121 Solid wheel	derailment	wheel crack	thermomechnical crack	flanging brake blocks	unsafe without warning	0	moderate high		low: relative few failures		160
3121 Solid wheel	derailment	wheel crack	wrong tread profile	tread profile damage	unsafe without warning	0	low		low: relative few failures		240
3121 Solid wheel	increase dynamic forces	wrong tread profile	flat wheel	breaking incident	very low		low		moderate: sometimes there are failures		144
3121 Solid wheel	increase dynamic forces	wrong tread profile	tread profile damage	overloading by dynamic effects	very low		low		moderate: sometimes there are failures		144

Com-ponent level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity	Detectability	Frequency	Risk priority number
3121 Solid wheel	increase dy-namic forces	wrong tread profile	tread profile damage	overloading of the wagon	very low	low	low: relative few failures	96
3121 Solid wheel	increase dy-namic forces	wrong tread profile	tread profile damage	quality of produc-tion - geometrical	very low	moderate high	little: failure is probab-le	16
3121 Solid wheel	increase dy-namic forces	wrong tread profile	tread profile damage	quality of produc-tion - material	very low	moderate high	little: failure is probab-le	16
3121 Solid wheel	increase dy-namic forces	wrong tread profile	tread profile damage	wear	very low	moderate high	moderate: sometimes there are failures	96
3121 Solid wheel	increase dy-namic forces	wrong tread profile	wheel out of round	overloading by dy-namic effects	very low	low	moderate: sometimes there are failures	144
3121 Solid wheel	increase dy-namic forces	wrong tread profile	wheel out of round	quality of produc-tion - geometrical	very low	moderate high	low: relative few failures	64
3121 Solid wheel	increase dy-namic forces	wrong tread profile	wheel out of round	quality of produc-tion - material	very low	moderate high	little: failure is probab-le	16
3121 Solid wheel	wheel crack	axle shaft and / or bearing damage	loose wheel	exceeding loading conditions / excessive transverse load	moderate	low	little: failure is probab-le	36
3121 Solid wheel	wheel crack	axle shaft and / or bearing damage	loose wheel	quality of produc-tion - process (e.g. geo-metrical reason / wrong mounting)	moderate	low	low: relative few failures	144
3121 Solid wheel	wheel crack	bearing dam-age, damage of other components	dynammic overloading	flat wheel, tread damage	moderate	moderate high	moderate: sometimes there are failures	144

Com-ponent level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
3121 Solid wheel	wheel crack	bearing damage, damage of other components	flat wheel, tread damage	exceeding brake energy input (e.g. misuse of park brake / brake incidente)	moderate		moderate high		moderate: sometimes there are failures		144
3121 Solid wheel	wheel crack	bearing damage, damage of other components	flat wheel, tread damage	overloading by dynamic effects	moderate		low		moderate: sometimes there are failures		216
3121 Solid wheel	wheel crack	bearing damage, damage of other components	flat wheel, tread damage	quality of production - material	moderate		low		little: failure is probable		36
3121 Solid wheel	wheel crack	bearing damage, damage of other components	wheel out of round	malfunction of the brake (e.g. blocking wheel)	moderate		moderate high		moderate: sometimes there are failures		144
3121 Solid wheel	shock	bearing damage	flat wheel, tread damage		moderate		low		moderate: sometimes there are failures		216
3122 Tyred wheel	Note: For Tyred wheels only the failures typical for tyred whhels are listed. Failures which are identical to solid wheels are assessed already under "3121 Solid wheel".										
3122 Tyred wheel	derailment	broken tyre	fatique crack	mechanical damage	unsafe without warning	0	low		moderate: sometimes there are failures		360
3122 Tyred wheel	derailment	broken tyre	fatique crack	overloading by dynamic effects	unsafe without warning	0	low		moderate: sometimes there are failures		360
3122 Tyred wheel	derailment	broken tyre	fatique crack	quality of production (e.g. material, mounting)	unsafe without warning	0	low		low: relative few failures		240
3122 Tyred wheel	derailment	broken tyre	overloading by dynamic effects	wrong tread profile	unsafe without warning	0	low		low:relative few failures		240

Com-ponent level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
3122 Tyred wheel	derailment	broken tyre	overloading by dynamic effects	other effects of dy-namic overloading	unsafe wit-hout warning	0	low		moderate: sometimes there are failures		360
3122 Tyred wheel	derailment	broken tyre	thermomechni-cal crack	exceeding brake en-ergy input (e.g. misuse of park brake / brake inci-dente)	unsafe wit-hout warning	0	low		moderate: sometimes there are failures		360
3122 Tyred wheel	derailment	loose tyre	loose tyre	exceeding brake en-ergy input (e.g. misuse of park brake / brake inci-dente)	unsafe wit-hout warning	0	low		moderate: sometimes there are failures		360
3122 Tyred wheel	derailment	loose tyre	loose tyre	Tyre thickness is too low / excessive wear	unsafe wit-hout warning	0	moderate high		low: relative few failures		160
3122 Tyred wheel	derailment	loose tyre	loose tyre	wrong mounting / too little pressfit	unsafe wit-hout warning	0	low		low: relative few failures		240
3122 Tyred wheel	derailment	loose wheel	loose tyre	loose of the spring clip	unsafe wit-hout warning	0	low		low: relative few failures		240
3122 Tyred wheel	derailment	wheel failed	broken tyre	corrosion in the in-ner diameter of the bore	unsafe wit-hout warning	0	low		low: relative few failures		240
3122 Tyred wheel	derailment	wheel failed	broken tyre	excessive thermal input	unsafe wit-hout warning	0	little		low: relative few failures		320
3122 Tyred wheel	derailment	wheel failed	broken tyre	mechanical damage	unsafe wit-hout warning	0	low		low: relative few failures		240
3122 Tyred wheel	derailment	wheel failed	broken tyre	overloading of the wagon	unsafe wit-hout warning	0	low		low: relative few failures		240

Com-ponent level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
3122 Tyred wheel	derailment	wheel failed	broken tyre	overloading by dy-namic effects	unsafe wit-hout warning	0	low		moderate: sometimes there are failures		360
3122 Tyred wheel	derailment	wheel failed	broken tyre	quality of produc-tion - material	unsafe wit-hout warning	0	moderate high		little: failure is probab-le		40
3122 Tyred wheel	derailment	wheel failed	broken tyre	quality of produc-tion - geometrical	unsafe wit-hout warning	0	moderate high		low: relative few failures		160
3122 Tyred wheel	derailment	wheel failed	broken tyre	excessive wear (tyre thickness too thin)	unsafe wit-hout warning	0	moderate high		low: relative few failures		160
322 housing (including rear and frontcover)	derailment	broken housing	forced damage	damaged by trans-port / collision	unsafe wit-hout warning	0	nearly certain		low: relative few failures		40
322 housing (including rear and frontcover)	derailment	broken housing	forced damage	not reported de-railment in the past	unsafe wit-hout warning	0	low		low: relative few failures		240
322 housing (including rear and frontcover)	derailment	broken housing	forced damage	quality of produc-tion (e.g. wrong mount-ing)	unsafe wit-hout warning	0	moderate high		little: failure is probab-le		40
322 housing (including rear and frontcover)	derailment	broken housing	overloading by dynamic effects		unsafe wit-hout warning	0	moderate high		low: relative few failures		160

Com-ponent level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
322 housing (including rear and frontcover)	derailment	broken housing	overloading of the wagon		unsafe without warning	0	low		low: relative few failures		240
322 housing (including rear and frontcover)	derailment	broken housing	quality of production - material		unsafe without warning	0	low		little: failure is probable		60
325 bearing	broken axle (journal / abutment)	bearing damage	broken cage	geometrical failure	unsafe without warning	0	little		little: failure is probable		80
325 bearing	broken axle (journal / abutment)	bearing damage	broken cage	loose pins	unsafe without warning	0	little		low: relative few failures		320
325 bearing	broken axle (journal / abutment)	bearing damage	broken cage	overloading by dynamic effects	unsafe without warning	0	little		low: relative few failures		320
325 bearing	broken axle (journal / abutment)	bearing damage	broken cage	quality of production (e.g. material)	unsafe without warning	0	little		little: failure is probable		80
325 bearing	broken axle (journal / abutment)	bearing damage	broken inner ring	overloading by dynamic effects	unsafe without warning	0	little		low: relative few failures		320
325 bearing	broken axle (journal / abutment)	bearing damage	broken inner ring	quality of production (e.g. material)	unsafe without warning	0	little		little: failure is probable		80
325 bearing	broken axle (journal / abutment)	bearing damage	broken inner ring	utilisation	unsafe without warning	0	little		low: relative few failures		320
325 bearing	broken axle (journal / abutment)	bearing damage	corrosion inner ring	high electric current passing bearing	unsafe without warning	0	little		little:failure is probable		80

Com-ponent level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
325 bearing	broken axle (journal / abut-ment)	bearing damage	fractured inner ring	wrong mounting	unsafe wit-hout warning	0	little		little: failure is probab-le		80
325 bearing	broken axle (journal / abut-ment)	bearing damage	spalling bearing	overloading by dy-namic effects	unsafe wit-hout warning	0	little		moderate: sometimes there are failures		480
325 bearing	broken axle (journal / abut-ment)	bearing damage	spalling inner ring/ roller/ outer ring	quality of produc-tion (e.g. material)	unsafe wit-hout warning	0	little		little: failure is probab-le		80
325 bearing	broken axle (journal / abut-ment)	bearing damage	wear inner ring/ outer ring/ roller/ cage/ internal and external spacer/ abutment ring	quality of produc-tion (e.g. material)	unsafe wit-hout warning	0	little		little: failure is probab-le		80
325 bearing	broken axle (journal / abut-ment)	hot axle box	corrosion of bearing	lack of sealing	unsafe wit-hout warning	0	low		low: relative few failures		240
325 bearing	broken axle (journal / abut-ment)	hot axle box	corrosion of bearing	wheelset is out of service for too long time	unsafe wit-hout warning	0	low		low: relative few failures		240
325 bearing	broken axle (journal / abut-ment)	hot axle box	loose inner ring	change in the mate-rial due to wrong mount-ing temperature	unsafe wit-hout warning	0	little		little: failure is probab-le		80
325 bearing	broken axle (journal / abut-ment)	hot axle box	loose inner ring	too little pressfit	unsafe wit-hout warning	0	little		low: relative few failures		320
325 bearing	broken axle (journal / abut-ment)	hot axle box	spalling bearing	Aging grease	unsafe wit-hout warning	0	little		little: failure is probab-le		80
325 bearing	broken axle (journal / abut-ment)	hot axle box	spalling bearing	Current leakage	unsafe wit-hout warning	0	low		little: failure is probab-le		60

Com-ponent level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
325 bearing	broken axle (journal / abut-ment)	hot axle box	spalling bearing	Fatigue	unsafe wit-hout warning	0	low		low: relative few failures		240
325 bearing	broken axle (journal / abut-ment)	hot axle box	spalling bearing	Incorrect handling	unsafe wit-hout warning	0	little		low: relative few failures		320
325 bearing	broken axle (journal / abut-ment)	hot axle box	spalling bearing	loss of grease	unsafe wit-hout warning	0	low		low: relative few failures		240
325 bearing	broken axle (journal / abut-ment)	hot axle box	spalling bearing	mechanical shock	unsafe wit-hout warning	0	little		low: relative few failures		320
325 bearing	broken axle (journal / abut-ment)	hot axle box	spalling bearing	Mounting procedure	unsafe wit-hout warning	0	little		low: relative few failures		320
325 bearing	broken axle (journal / abut-ment)	hot axle box	spalling bearing	Suppling process	unsafe wit-hout warning	0	low		low: relative few failures		240
325 bearing	broken axle (journal / abut-ment)	hot axle box	spalling bearing	wrong amount of grease while mounting	unsafe wit-hout warning	0	low		low: relative few failures		240
325 bearing	broken axle (journal / abut-ment)	hot axle box	spalling bearing	wrong type / quality of grease	unsafe wit-hout warning	0	low		low: relative few failures		240
325 bearing	broken axle (journal / abut-ment)	hot axle box	wrong axle box assembly	unscrewed cover	unsafe wit-hout warning	0	moderate high		low: relative few failures		160
325 bearing	broken axle (journal / abut-ment)	hot axle box	wrong axle box assembly	wrong dimensioning chain	unsafe wit-hout warning	0	low		low: relative few failures		240
325 bearing	broken axle (journal / abut-ment)	hot axle box	wrong bearing assembly	unscrewed end cap	unsafe wit-hout warning	0	low		low: relative few failures		240

Com-ponent level IV	Final failure: effect on the wheelset	Failure mode resulting next	Failure mode	Root cause	Severity		Detectability		Frequency		Risk priority number
325 bearing	broken axle (journal / abut-ment)	hot axle box	wrong bearing assembly	wrong dimensioning chain	unsafe wit-hout warning	0	low		little: failure is probab-le		60
325 bearing	broken axle (journal / abut-ment)	spalling bearing	loss of grease	lack of sealing	unsafe wit-hout warning	0	nearly certain		very high: Failures are nearly not avoid-able	0	100
325 bearing	broken axle (journal / abut-ment)	spalling bearing	loss of grease	other reasons	unsafe wit-hout warning	0	low		low: relative few failures		240

European Visual Inspection Programme for freight wagon axles (EVIC inspections)

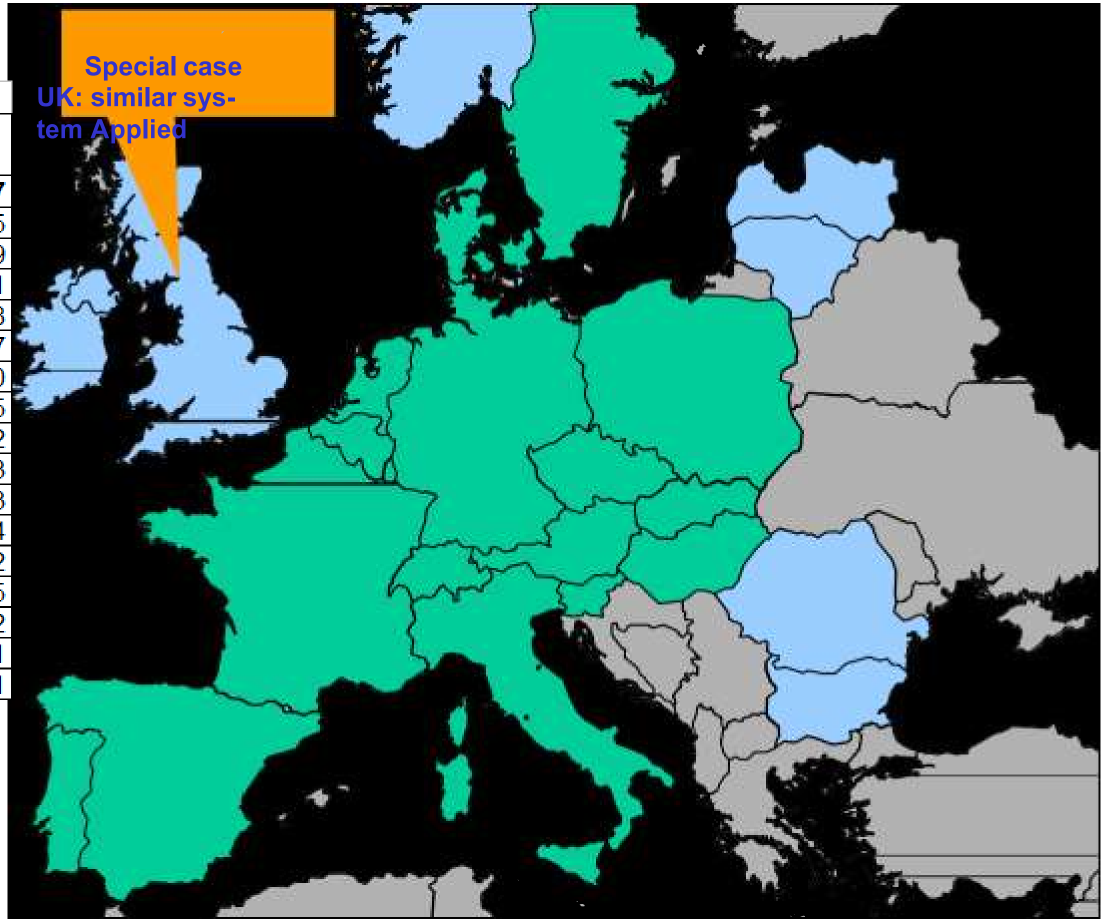
European tracing report April 2010 - April 2012

Joint Sector Group for ERA Task Force on wagon/axle maintenance

Status of the EVIC Visual Inspections: Total as per April 2012

Total April 2010 - April 2012

	Wagons checked	Other	EVIC ok	EVIC X	EVIC C	Total axle	No. Keepers
total	**377.056**	**114.353**	**854.496**	**29.793**	**459.238**	**1.451.715**	**167**
D	245.413	77.444	503.912	22.629	355.410	959.395	35
AT	21.221	16.262	53.326	1.698	9.070	80.356	19
F	25.108	8.956	73.018	672	8.960	91.606	31
H	7.421	77	25.071	22	3.871	29.041	8
IT	9.158	1.183	15.182	497	15.142	30.563	7
BE	6.941	0	25.350	182	370	21.249	10
CH	19.160	8.193	41.789	996	21.573	72.551	15
ES	2.801	24	5.867	1.783	3.089	10.763	2
CZ	397	56	1.497	4	29	1.586	3
PL	24.097	347	83.453	507	11.003	95.310	13
SK	8.924	23	14.660	7	19.347	34.037	4
SI	532	479	899	29	810	2.217	12
PT	992	897	544	569	1.585	3.595	5
LU	3.237	24	4.543	16	7.203	11.786	2
SE	1.511	388	4.955	182	1.622	7.147	1
NL	143	0	430	0	154	513	1



*** 16 countries, 164 wagon keepers**

(Feb 2012: 350 T wagons, 1.346 T axles)

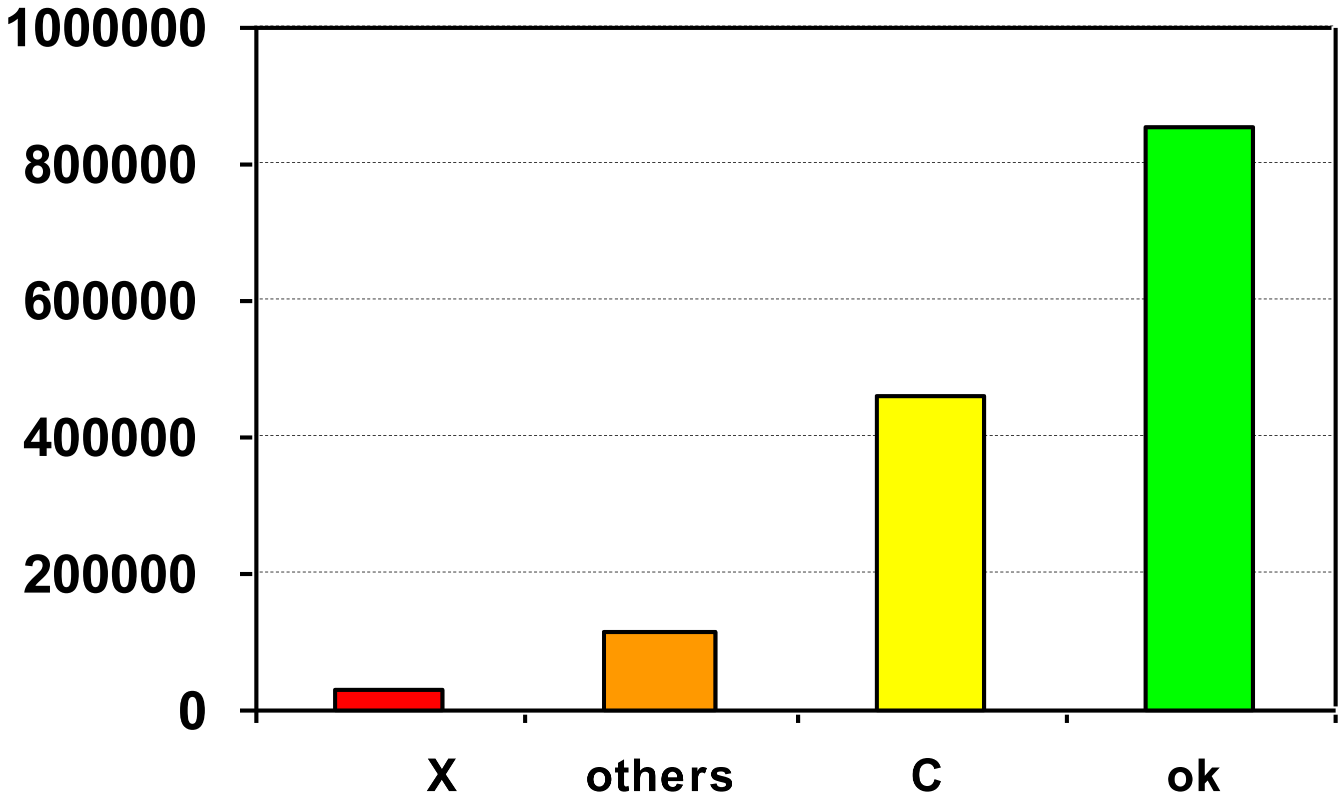
X: Remove from service without delay

others: sorted out for other reasons, e.g. reprofiling

C: Leave in service until the next EVIC check

ok: no defects, leave in service

Status of the EVIC Visual Inspections: EU total per April 2012

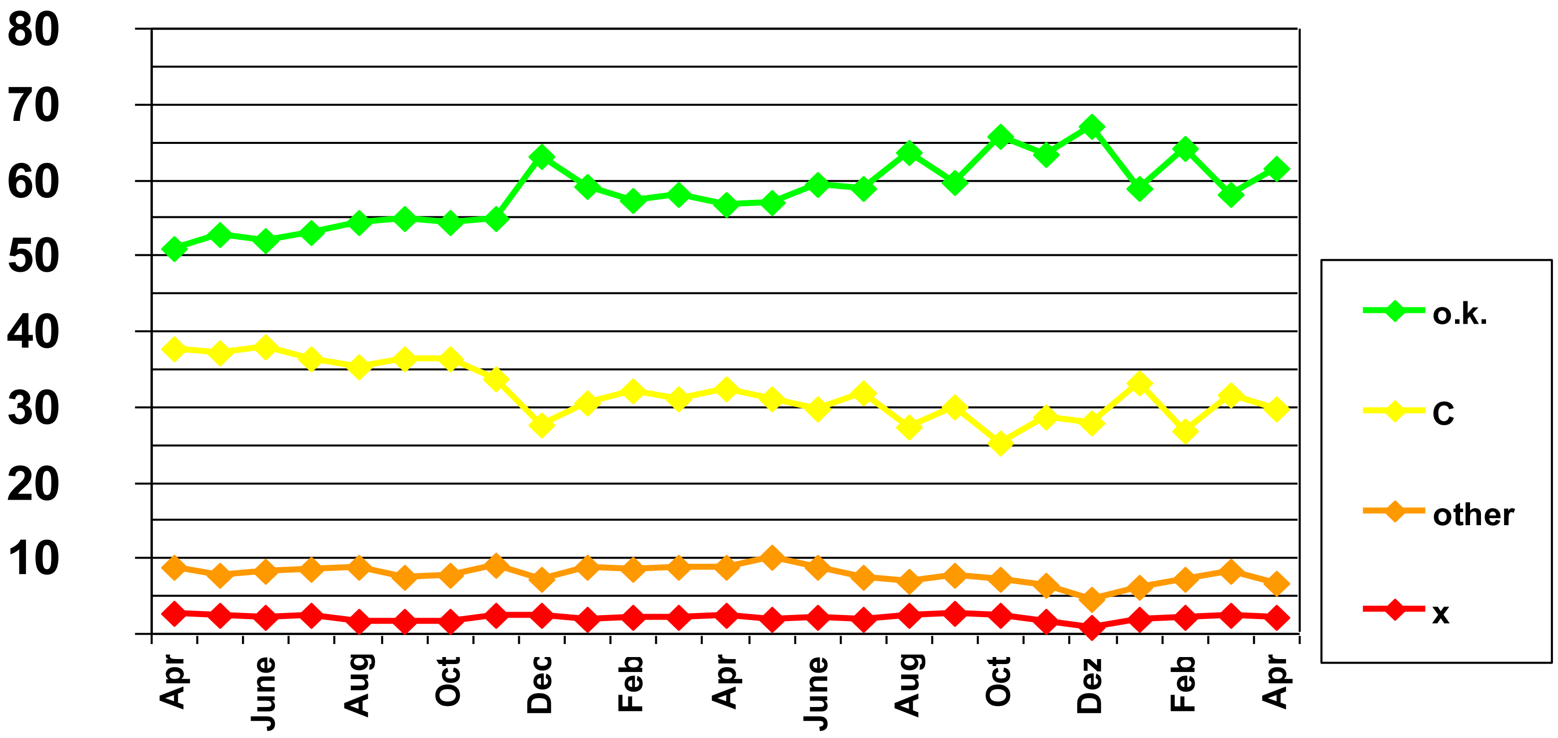


X: Remove from service without delay
C: Leave in service until the next EVIC check

others: sorted out for other reasons, e.g. reprofiling
ok: no defects, leave in service

Keeper's total EVIC checks (all countries) reported in keeper's registration country

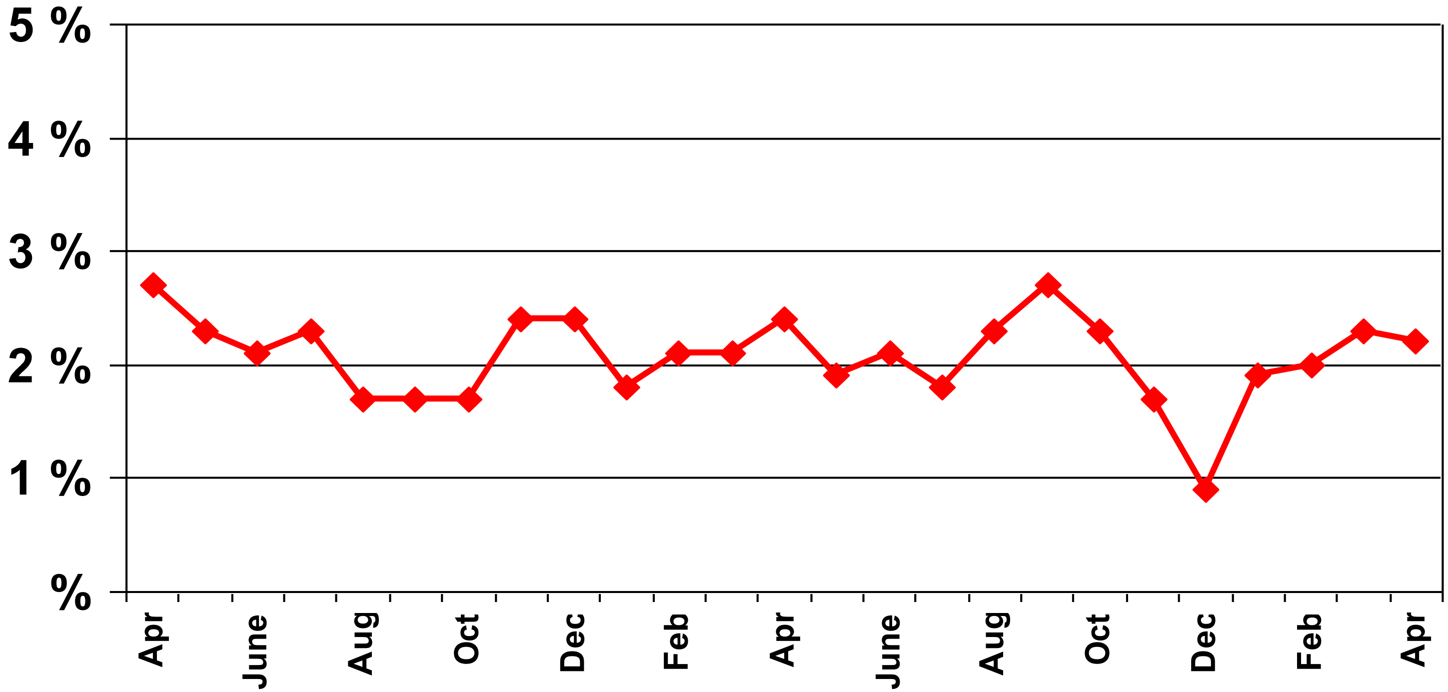
Evolution of the EVIC categories findings over 2 years (EU total, per month)



X: Remove from service without delay **others:** sorted out for other reasons, e.g. reprofiling

C: Leave in service until the next EVIC check **ok:** no defects, leave in service

Evolution of the EVIC categories findings over time (EU total, per month, only X)



X: Remove from service without delay **others:** sorted out for other reasons, e.g. reprofiling
C: Leave in service until the next EVIC check **ok:** no defects, leave in service

EUROPEAN VISUAL INSPECTION CATALOGUE (EVIC) FOR FREIGHT WAGON AXLES

to be applied in light maintenance of freight wagons in workshops

Joint Sector Group for ERA Task Force on wagon/axle maintenance

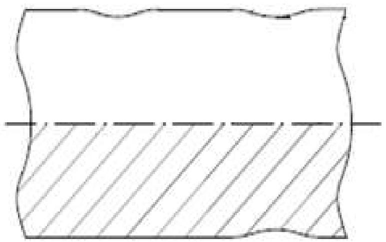
DAMAGE CATEGORY

	Painted axles	
30	No defects	OK
31	Mechanical damage sharp edged circumferential fluting	X (not ok)
32	Mechanical damage smooth edged circumferential groove	X (not ok)
33	Mechanical damage sharp edged notching	X (not ok)
34	Mechanical damage cracks	X (not ok)
35	Surface damage large and heavily corroded areas	X (not ok)
36	Surface damage single, deeply pitted corrosion scars	X (not ok)
37	Coating damage with or without corrosion	C
	Unpainted axles	
40	No defects	OK
41	Mechanical damage sharp edged circumferential fluting	X (not ok)
42	Mechanical damage smooth edged circumferential groove	X (not ok)
43	Mechanical damage sharp edged notching	X (not ok)
44	Mechanical damage cracks	X (not ok)
45	Surface damage very heavy, deep and large corrosion	X (not ok)
46	Surface damage single, deeply pitted corrosion scars	X (not ok)
	All axles	
50	Abutment area	X (not ok)

CRITERIA FOR PAINTED AXLES

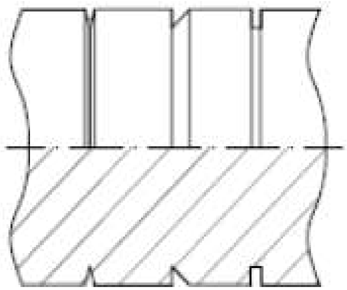
30 No or admissible defects found on the axle surface - smooth pitting		**Painted axles**
Salient information:		
	Pitting may occur either round the entire perimeter or intermittently and is characterised by smoothly rounded contours with no sharp transitions. This type of pitting may arise in the course of maintenance work. The anti-corrosion coating is undamaged.	
Decision:		
	Pitted axles whose coating is nevertheless undamaged may remain on the vehicle	
	Mark 1 at "ok" column in EVIC logging.	**O**

Pictorial representation:



31 Mechanical damage – sharp edged circumferential fluting		**Painted axles**
Salient information:		
	Flutes are characterised by sharp edged circumferential sharp-edged transitions.	
	Mechanical damage to the base material in the form of fluting is inadmissible.	
Decision:		
	Check on the wagon why this damage could have occurred and repair accordingly	
	Remove from service according	**Case A**
	Mark 1 at "X" column in EVIC logging	**X**

Pictorial representation:



32 Mechanical damage – smooth edged circumferential grooves		Painted axles
Salient information:		
	Characterised by smooth transitions in the edges (GCU Annex 9, 1.6.1). Pitting that arises during operation (caused e.g. by brake lever connectors dragging) involves damaged anti-corrosion	
Decision:		
	Check on the wagon why this damage could have occurred and repair accordingly	
	Remove from service	Case B
	if there is damage to the base material > 1mm: (acc. GCU)	Case A
	mark 1 at "X" column in EVIC logging	X

Pictorial representation:




33 Mechanical damage – sharp edged notching		**Painted axles**
Salient information:		
	Sharp edged notches occur locally and are characterised by sharp-edged transitions.	
	Mechanical damage to the base material in the form of notching is inadmissible.	
Decision:		
	Remove from service (according to GCU criteria)	**Case A**
	mark 1 at “X” column in EVIC logging	**X**

Pictorial representation:

34 Mechanical damage – cracks			Painted axles
Salient information:			
	Cracks occur locally on the shaft material (not on the painting) and are characterised and visible by fine lines.		
	Mechanical damage to the base material in the form of cracks is inadmissible.		
Decision:			
	Remove from service	**Case A**	
	mark 1 at "X" column in EVIC logging	**X**	

Pictorial representation:			
			

35 Surface damage – large and heavily corroded areas		Painted axles
Salient information:		
	Surface damage to base material in form of large and heavily corroded areas (old corrosion protection) is inadmissible.	
Decision:		
	Remove from service	**Case B**
	mark 1 at "X" column in EVIC logging	**X**

Pictorial representation:

36 Surface damage – single, deeply pitted corrosion scars			Painted axles
Salient information:			
	Surface damage to the base material in the form of marked, local corrosion scars (resulting e.g. from chemical effects) is inadmissible.		
Decision:			
	Remove from service	Case B	
	mark 1 at "X" column in EVIC logging	X	

Pictorial representation:			
			

37 Coating damage – with or without corrosion		Painted axles
Salient information:		
	Minor lack of an anti-corrosion coating, whether corrosion is involved or not.	
Decision:		
	Leave in service acc. case C and/or repair the damage in situ on the wheelset	Case C
	mark 1 at “C” column in EVIC logging	C

Pictorial representation:			
			
			

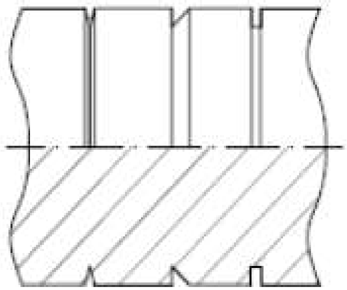
CRITERIA FOR UNPAINTED AXLES

40 No defect - admissible surface appearance		**Unpainted axles**
Salient information:		
	There exist maintenance rules that do not require any anti-corrosion protection. Axles and wheels stay unpainted in such cases and show a thin and uniform layer of rust on their surfaces in service.	
	SNCB return on experience proves that application of such an axle maintenance system does not lead to any fatigue caused ruptures during service of an axle.	
Decision:		
	Deep corrosion is not accepted.	
	Leave in service wheelset "as new", "very good", "good" and "acceptable"	
	mark 1 at "ok" column in EVIC logging	**O**

Pictorial representation:			
As new	**Very good**	**Good**	**Acceptable**
			

41 Mechanical damage – sharp edged circumferential fluting		Unpainted axles
Salient information:		
	Flutes are characterised by sharp edged circumferential sharp-edged transitions.	
	Mechanical damage to the base material in the form of fluting is inadmissible.	
Decision:		
	Check on the wagon why this damage could have occurred and repair accordingly	
	Remove from service according	Case A
	mark 1 at “X” column in EVIC logging	X

Pictorial representation:



42 Mechanical damage – smooth edged circumferential grooves		Unpainted axles
Salient information:		
	Characterised by smooth transitions in the egdes (GCU Annex 9, 1.6.2). Pitting that arises during operation (caused e.g. by brake lever connectors dragging) involves damaged anti-corrosion	
Decision:		
	Check on the wagon why this damage could have occurred and repair accordingly	
	Remove from service	Case B
	if there is damage to the base material > 1mm: (acc. GCU)	Case A
	mark 1 at "X" column in EVIC logging	X

Pictorial representation:




43 Mechanical damage – sharp edged notching			Unpainted axles
Salient information:			
	Sharp edged notches occur locally and are characterised by sharp-edged transitions.		
	Mechanical damage to the base material in the form of notching is inadmissible.		
Decision:			
	Remove from service (according to GCU criteria)		Case A
	mark 1 at "X" column in EVIC logging		X

Pictorial representation:

44 Mechanical damage – cracks		**Unpainted axles**
Salient information:		
	Cracks occur locally and are characterised and visible by fine lines.	
	Mechanical damage to the base material in the form of cracks is inadmissible.	
Decision:		
	Remove from service	**Case A**
	mark 1 at "X" column in EVIC logging	**X**

Pictorial representation:			
			

45 Surface damage – large and heavily corroded areas	Unpainted axles

Salient information:	
	Surface damage to base material in form of large and heavily corroded areas (old corrosion protection) is inadmissible.

Decision:		
	Remove from service	Case B
	mark 1 at “X” column in EVIC logging	X

Pictorial representation:

46 Surface damage – single, deeply pitted corrosion scars	Unpainted axles

Salient information:

	Surface damage to the base material in the form of marked, local corrosion scars (resulting e.g. from chemical effects) is inadmissible.

Decision:

	Remove from service	Case B
	mark 1 at "X" column in EVIC logging	X

Pictorial representation:

ABUTMENT AREA

50 Abutment area		**All axles**
Situation:		
	Normally, the abutment area cannot be inspected sufficiently for wheelsets mounted in the wagon	
Recommendation:		
Only if there is a clear indication on mechanical or corrosion damages		
	Take wheelset out	**Case A**
	Mark 1 at "X" column in EVIC logging	**X**
If not judgeable		
	Leave wheelset in service	
	Mark 1 at "OK" column in EVIC logging	**O**

Pictorial representation:			
Not acceptable		**Not jugeable**	
			

IMPLEMENTATION UIDE FOR THE EUROPEAN VISUAL INSPECTION CATALOGUE (EVIC) FOR FREIGHT WAGON AXLES

Joint Sector Group for ERA Task Force on wagon/axle maintenance

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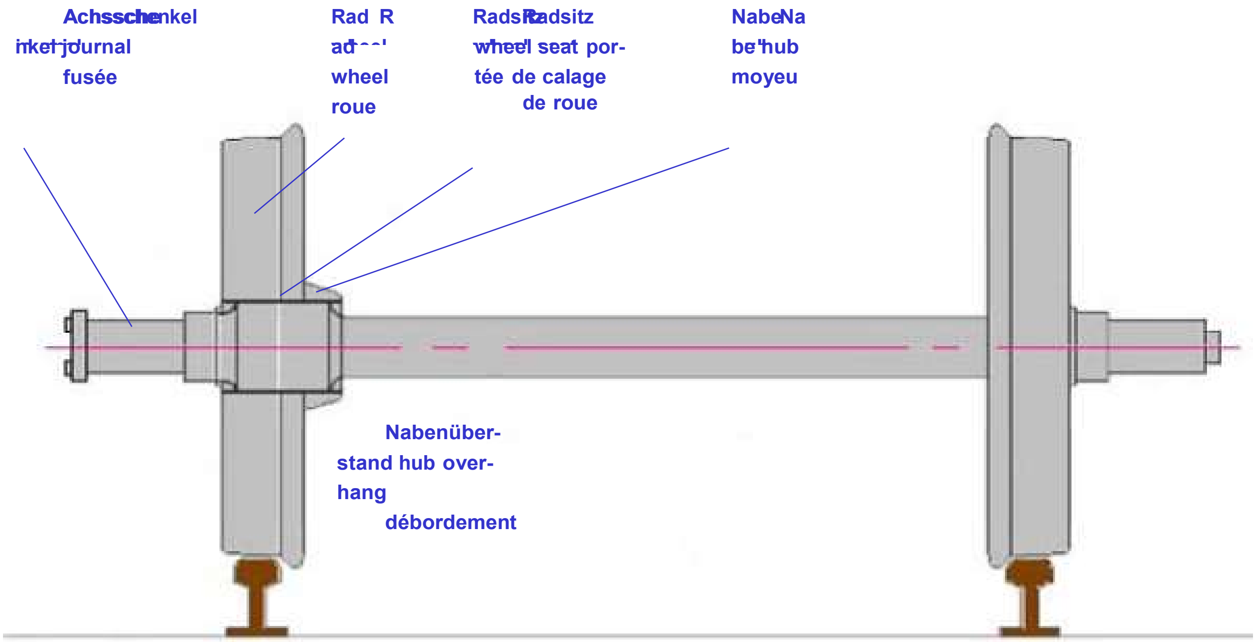
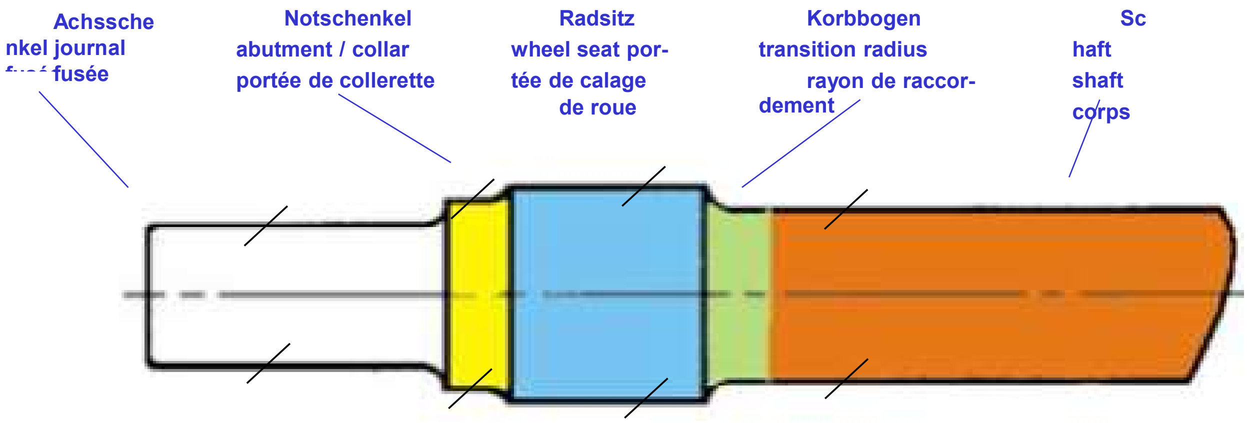
This version replaces all previous versions of the EVIC Implementation Guide

Brussels, 10.03.2010

1. Definitions



Radsatz
Wheelset Essieu monté



Radsatzwelle
Axle
Essieu-axe

In the EVIC procedure instructions, the meaning of several expressions is as follows:

Replace = take the wheelset out of the wagon (and repair it in a suitably competent workshop, if possible)

Repair = repair the damage in situ (wheelset mounted) according to the relevant rules

Remove from service = replace or repair (in situ if possible) according to the criteria

2. Basics and preparing inspections

2.1 Reasons for the EVIC program

European wagons keepers have developed since many decades a maintenance system assuring a safety which allowed to become the safest land freight transport.

However, after the tragic accident in Viareggio,
- the European Railway Agency
- the European NSAs and
- the Joint Rail Freight Sector (CER, ERFA, UIP, UIRR, UNIFE)

agreed to investigate in the frame of the ERA Task Force the possibilities for a European approach for harmonised criteria and immediate and mid-term measures ascertaining an even enhanced railway safety in an appropriate way.

The Joint Sector Program worked out in the ERA Task Force was fully adopted in Viareggio in december 2009. The European Action Program consists of a:

- **Visual Inspection of the European wheelset/axle population (according to EVIC)**
- more in-depth investigation of samples of wheelsets from defined operating areas
- European-wide implementation of systematic traceability of wheelset maintenance (for the EVIC campaign and for general wheelset maintenance)

The Joint Sector program was approved by all EU authorities and NSAs. It is up to the Sector to implement now what has been decided. The implementation of the program (especially EVIC) is done as a self-commitment in the Sector Association's companies in fulfillment of the Sector's Safety responsibility. There is no legal obligation but a clear commitment of the Sector to the European and National Authorities to implement the Action program. On the Sector level, the EVIC program is currently being integrated in the GCU.

The European NSAs are invited to audit the execution of the decided measures.

2.2 Objectives of the EVIC program

In execution of the first element of the European Action program, the **Visual Inspection of the European wheelset/axle population**, the European freight wagon fleet will be subject to a Visual Inspection of the axle status with the objectives

- to judge the axle status according the criteria in the European Visual Inspection Catalogue (EVIC)
- to remove from service axles in a not admissible state (immediately / after unloading)
- to record a set of minimum data for the inspected axles
- to hand over removed axles to heavy maintenance with appropriate treatment and NDT

2.3 Timeframes for the EVIC inspection

The EVIC program starts in Europe **from 01.04.2010 onwards**. From then on,

- **all wagons**

- for dangerous goods (only RID tank wagons) and
- operating under corrosive conditions

will be checked under EVIC conditions to **100% in a 4 years period**

- **all standard wagons** will be checked under EVIC conditions to **100% in a 6 years period**

In case of removal of the wheelset, the wheelset must be handed over by the keeper to regular heavy maintenance with NDT in accordance to the relevant maintenance systems.

After having checked the fleet to 100%, the EVIC will be applied continuously and/or amended depending on the return of experience (to be discussed in the Task Force).

Recommended priorities for standard wagons are:
- high loading factor (e. g. 50%, F-, T-wagons)
- impact due to drop loading (e. g. some E-types)

2.4 The tasks of the Joint EVIC body per country

The Joint EVIC body consists of members nominated by the Railway Associations UIP, CER and ERFA per European country (see table) and is responsible for the EVIC implementation in its respective Member State (plus Switzerland).

The Joint EVIC body will:

- organize the translation in the national language and the issueing of the EVIC
- organize joint central training session(s) per country for all associations, all keepers, all related workshops (and Railway Undertakings for information)
- manage all information of all concerned parties (workshops, keepers,…)
- collect the traceability of EVIC from the keepers
- condense the collected data from the keepers (per country) for the Joint Sector Group
- monitor the implementation of EVIC in the respective companies (e.g. by a checklist)

The collected results will be exploited and monitored by the Joint Sector Group for survey of the implementation process and for report in the ERA Task Force.

Country	LANG.	UIP / Rivière	CER / Müller	ERFA / Heiming
France	FR	David Tillier dtillier@ermewa.fr	Lafaix SNCF	
Switzerland	DE, FR, IT	Olga Wisniewska tech@cargorail.ch	Bernet SBB	Nicolin AAE johannes.nicolin@aae.ch
Germany	DE	Albert Hartmann VPI hartmann@vpihamburg.de	Manfred Bergmann DB manfred.bergmann@	Mallikat VDV mallikat@vdv.de
Italy	IT	Mauro Pacella ASSOFERR Mauro.pacella@assoferr.it	Paolo Fusarpoli TI	
Netherlands	NL	Don van Riel NVPG@trimodal-europe.nl	(Jaspers DB SR NL)	
Poland	POL		Krzysztof Buszka PKP k.buszka@pkp-cargo.pl Miroslaw Szczelina Rail-Polska miroslaw.szczelina @railpolska.pl	Dr. Ireneusz Gójski IGTL igojski@aster.pl 0048.601.387.516
Austria	DE	Günter Heindl VPI office@vpirail.at	Andreas Schachner ÖBB	
Belgium	FR, NL	Vincent Bourgois vin-cent.bourgois@trw.be	Maenhout SNCB	Monika Heiming moni-ka.heiming@erfa.be
Hungary	HON	Győző Cztó nagyd@pultrans.hu	Miklos Kremer MAV kremerm@mav.hu Mihály Drotos MAV Cargo	
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Ireland	EN		Damien Lambert IrishRail damien.lambert@irishrail.ie	Lord Tony Berkeley tony@rfg.org.uk
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Slovenia	SLO		Viktor Sinkovec viktor.sinkovec	
Portugal	POR		Joaquim José Martins Guerra	
Greece	GR			
Luxembourg	FR, DE		Gaston Zens gaston.zens@cflcargo.lu	
Estonia	E			

as per begin march 2010

2.5 Preparing the working documents

The conditions for the EVIC program are laid down in this **EVIC Implementation Guide 2.2**. The criteria for inspections, illustrations and required actions are laid down in the **EVIC 2.11 document**

The reference is the English language version. All documents (english and translated) will also be published officially on **xxx website** (to be defined by the Joint Sector Group)

The Joint EVIC body per country delivers the EVIC documents in the national language

The Joint EVIC body per country issues the EVIC documents to the countrie's keepers (and, for information, to the RUs)

The keepers (ordering the Visual Inspection from the workshops) hand over the documents to the executing workshops.

The executing workshop adds the required national and local working rules as well as all supporting further instructions on/for application on the workshop level.

2.6 Mandating and invoicing the EVIC inspection

The implementation of the EVIC in the GCU (including traceability) has already started (annex 10, new appendix 3)

The EVIC execution must be mandated to the contracted workshops by the keepers (in the meantime until the full EVIC implementation in GCU)

The keeper must take over the costs for executing the EVIC program (inspection and tracing) and potentially for a required change of the wheelset (future amendment in GCU annex 12)

In a first step, the workshops must not execute the EVIC inspections in a wagon GCU repair if not specifically ordered by the keeper (implementation in GCU is in progress). **This point is under urgent clarification in the GCU technical committees.**

The workshops must give the results of the EVIC tracing to the **keeper**
- with the corresponding invoice (maximum after one month)or
- separately with the monthly separate summary sending

The workshops must register the wheelset IDs/number(s) **of the new mounted wheelset(s)** (replacement for "EVIC failed" wheelset) **in the invoices/reporting document to the keeper** (normally already done in the maintenance documentation)

2.7 Staff qualifications

The inspections have to be conducted by staff qualified in application of this Visual Inspection Catalogue.

It is not necessary for the operatives conducting such visual inspections to be qualified as NDT visual inspectors pursuant to EN 473.

The staff involved in this inspection **should be trained one day** for the correct use of this procedure.

It is under the responsibility of the workshop to update a list of trained workers for the use of the present procedure.

3. Conducting the Visual Inspections

3.1 Execution of the Visual Inspections

The Visual Inspection of the freight wagon's axle shafts for damage to material and coating
(if existing) is mandatory

- during light maintenance
- each time the wagon is in a workshop (not mobile team)

and if one of the following conditions is fulfilled:
- the wagon is on a pit or
- the wagon is lifted

In case of non judgeable defects (not sufficiently detailed by the descriptions in the EVIC), the executor of the EVIC inspection must contact the keeper for further instructions.

A replacing wheelset for a sorted out axle must be in an "EVIC ok" status.

The EVIC doesn't replace existing maintenance rules. First, existing maintenance rules must be applied, then the EVIC check. If an axle is sorted out with current maintenance rules, it is not necessary to apply the EVIC

(Remark: the visual axle inspection is also mandatory in case of wagon heavy maintenance events)

The visual inspection **covers the complete area of the axle-shaft surface between the wheels.** See special instructions for the **abutment area** in the EVIC 2.11.

The inspection area is to be examined for
- **mechanical damage** (fluting, pitting and notching, cracks)
- **surface damage** (areas eaten away, corrosion scars)
- **coating damage** (with and without corrosion) *if coating system existing*

Reference images in EVIC 2.11 (typical damage features) are used for identifying inadmissible forms of damage.

It is not foreseen to clean the axle. In case of doubt, clean axle (locally) to allow examination

If natural light intensity is too poor, a supplementary white light source must be used in order to obtain an adequate visibility on the axle.

Axle shafts with inadmissible forms of damage are to be repaired according to the prescriptions, if possible. Otherwise, the axles must be replaced.

An example for an adequate position for the staff conducting the visual inspection is given in the figure below.

If the wheelset cannot rotate (if the wagon is not lifted up), the visibility of the full surface of the axle must be assured in a different way.

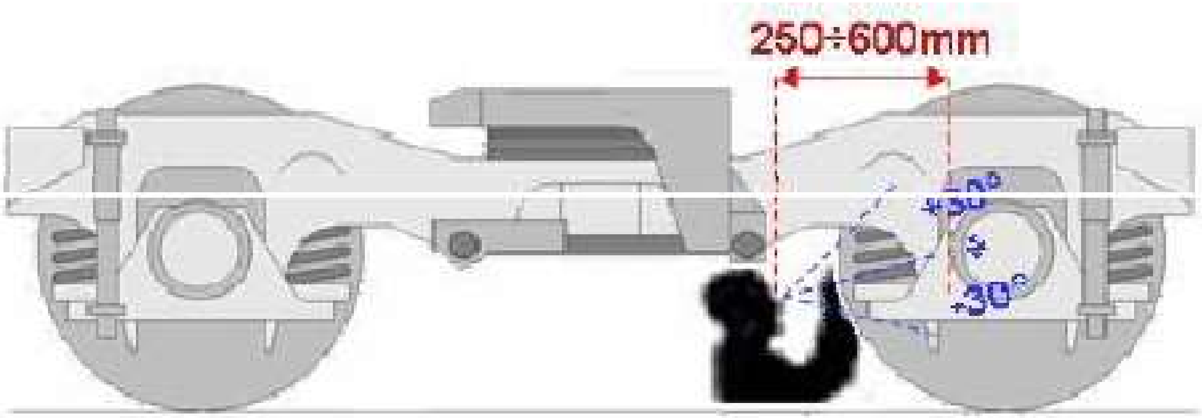


Figure 2 – Inspection angle and distance

3.2 Actions to be taken after inspection (cases)

The following **cases** describe the actions to be taken after a Visual Inspection of the axle:

A Remove the wheelset from service without delay

B Remove the wheelset from service after unloading the wagon
and/or sending back to home workshop

C Leave wheelset in service until the next revision/overhaul of the wagon
or repair the damage in situ on the wheelset.
In the next revision/overhaul, the remove from service is mandatory

Remove from service = replace or repair (in situ if possible) according to the criteria

For wheelsets operated in wagons under heavy corrosive conditions, only the categories A and B are allowed.

4. Recording the Visual Inspections

The results of the Visual Inspection program must be recorded / traced after the inspection in the workshop.

4.1 Overwiev on EVIC categories and logging

Painted and unpainted axles			Category for EVIC logging	
30	No defects		o	
40	No defects		o	
Painted axles				
31	Mechanical damage	sharp edged circumferential fluting	**X**	**(not ok)**
32	Mechanical damage	smooth edged circumferential groove	**X**	**(not ok)**
33	Mechanical damage	sharp edged notching	**X**	**(not ok)**
34	Mechanical damage	Cracks	**X**	**(not ok)**
35	Surface damage	large and heavily corroded areas	**X**	**(not ok)**
36	Surface damage	single, deeply pitted corrosion scars	**X**	**(not ok)**
37	Coating damage	with or without corrosion	**C**	
Unpainted axles				
41	Mechanical damage	sharp edged circumferential fluting	**X**	**(not ok)**
42	Mechanical damage	smooth edged circumferential groove	**X**	**(not ok)**
43	Mechanical damage	sharp edged notching	**X**	**(not ok)**
44	Mechanical damage	Cracks	**X**	**(not ok)**
45	Surface damage	very heavy, deep and large corrosion	**X**	**(not ok)**
46	Surface damage	single, deeply pitted corrosion scars	**X**	**(not ok)**
47	---			
All axles				
50	Abutment area		**X**	**(not ok)**

The roles and TO DOs of the several parties involved are as follows:

4.2 Workshops tasks

The workshops must

- record the results of the Visual Inspection
- **for each keeper**

- **in paper or**
- **in electronic file format**

according to the **"EVIC keeper traceability 2.2"** format (xls file):

DATA ARE ONLY EXAMPLES:

Workshop	TERGNIER	Year	2010
Country of the workshop	France	Month	5
Keeper	ERMEWA (as written on the wagon)		

		- as far as identifiable - enter NI if not identifiable		enter only 1 result per wheel- **Other check result** e. g. GCU check enter 1 where ap-	**EVIC check result** enter 1 where appropriate		
wagon number (set wagon number only once for all axles)	**Date**	**wheelset N**	**wheelset type**		**"ok"**	**"C"**	**"X"**
338712345689	02.0	12	9		1		
		12	9		1		
		345621	9			1	
		41	9				1
338700000002	12.0	1	9		1		
		2	9		1		
		N	N	1			
		2	9		1		
338700000123	12.0	13213213	9			1	
		123213141	N	1			
338701231123	13.0	34562133	9				1
		34562132	9				1

“EVIC keeper traceability 2.2”

4.3 Keepers tasks

The keepers must

- collect the monthly results from the contracted workshop (per country)
  1st week of next month
- keep the records

- condense the received monthly results from all workshops (per country) in electronic file format according to the **“EVIC monthly keeper report 2.2”** format,

  Nota: the name of the keeper has to be set according to VKM or registration in NVR.

- report monthly electronically the condensed “EVIC monthly keeper report”
  to the Joint EVIC bodies (details to be defined by the Joint EVIC bodies themselves):

  (Example Germany: **evic.germany@vpihamburg.de**)

DATA ARE ONLY EXAMPLES:

Country FRANCE

ID of the keeper to be formatted according to VKM or NVR registration

keeper	Month	Year	No of wagons checked	No of axles sorted out for other rea-sons	No of EVIC axles ”	No of EVIC axles „X“	No of EVIC axles ” C“
X	5	201	4	100	1000	8	120

“EVIC monthly keeper report 2.2”

4.4 Joint EVIC bodies tasks

The Joint EVIC bodies must

- collect the "EVIC monthly keeper reports" from the different keepers

- summarize electronically the monthly results of all keepers per country according to the
  "EVIC monthly country report 2.2" format
  2nd week of next month

- send this report monthly electronically to the JSG: **evic.europe@deutschebahn.com**

DATA ARE ONLY EXAMPLES:

Country FRANCE

ID of the keeper to be formatted according to VKM or NVR registration

keeper	Month	Year	No of wagons checked	No of axles sorted out for other reasons	No of EVIC axles ."	No of EVIC axles X""	No of EVIC axles C""
U	5	201					
X	5	201					
S			7	9	180	1	2

Only summarized data are reported in the ERA Task Force

"EVIC monthly country report 2.2"

ANNEX 3.2.2.A: EVIC Sampling procedure

1 – Introduction

After the tragic accident in Viareggio, the European Railway Agency, the European NSAs and the Joint Rail Freight Sector agreed to investigate in the frame of the ERA Task Force the possibilities for a European approach for harmonised criteria and immediate and mid-term measures ascertaining an even enhanced railway safety in an appropriate way, taking into account the expressed several requests for amendment.

The sector proposes a European programme for Visual Inspections (EVIC) of the axles related to the risk domain operated in. Axles sorted out are brought to heavy maintenance including non destructive tests (NDT).
Inspections are prioritized according to identified potential risk domains.

A sampling programme with more in-depth NDT investigation of axles taken from the risk domains will be performed in parallel to prove the EVIC approach and to clarify the assumption of the defined risk domains.

2 – Aim of the sampling

The EVIC can be considered as a reference manual for RUs and keepers providing the criteria to freight wagon maintenance staff to visually identify damages, during light maintenance in workshops. A wheel-set/axle which doesn't meet the EVIC-criteria will be discarded from service and undergo the heavy maintenance with non-destructive tests (NDTs).
Additionally, a sample of axles which fulfil the EVIC and a sample of them which do not fulfil the EVIC criteria will be inspected in a special monitored maintenance programme with NDT ("the sampling programme").
Comparisons of the NDT results of "EVIC failed" and "EVIC passed" axles will be performed. The results will be compared also to the results from heavy maintenance currently undertaken. According to the return of experience, the sector will propose appropriate measures to deal with identified risk areas.

3 – Description of the sampling methods

3.1 Generality

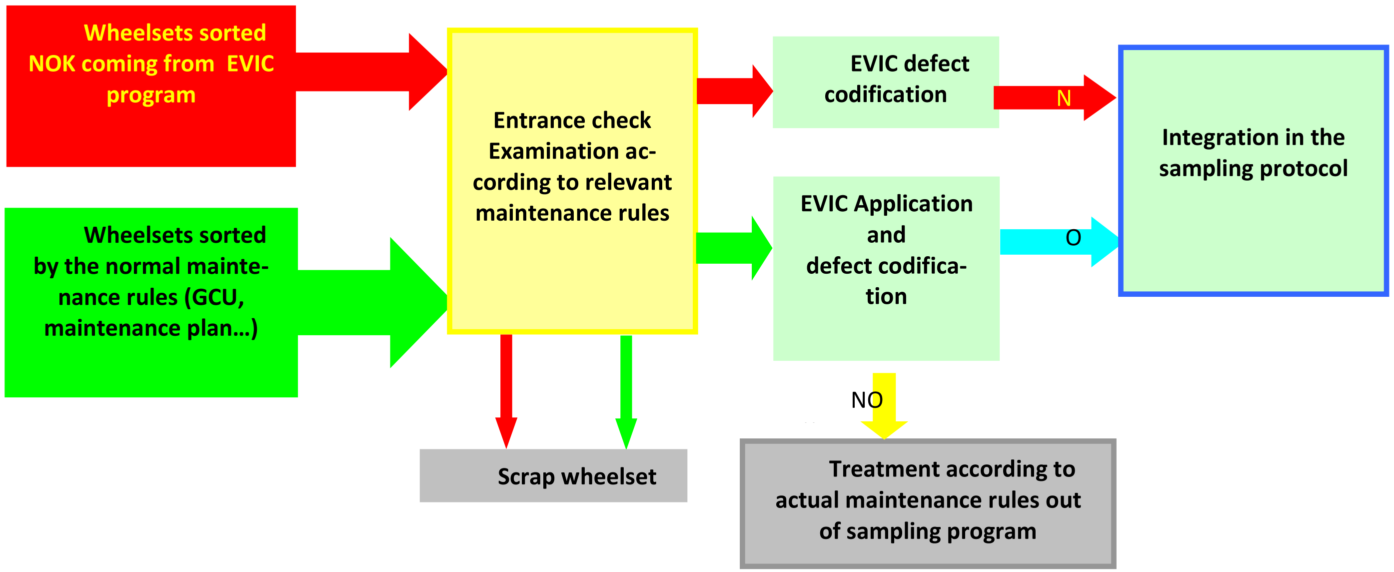
According to the risk assessment, the sector identifies 4 different risks domains:
corrosive conditions, vehicles transporting salt, potash, fertilizers ;
high loading factor, wagon with 50% full loaded in service;
impact due to drop loading, typical examples: scrap, clay, wood, coils, etc.;
dangerous goods (RID).

Samples of axles from both states (1000 EVIC passed/ 1000 EVIC failed) taken from those 4 special traffics will be subject to each NDT system: manual UT, auto UT and MT as shown in the table below.

NDT system	Sampling theoretical	COR		High Loading		Drop Loading		RID	
		EVIC+	EVIC-	EVIC+	EVIC-	EVIC+	EVIC-	EVIC+	EVIC-
UT MAN	8000	1000	1000	1000	1000	1000	1000	1000	1000
UT auto	8000	1000	1000	1000	1000	1000	1000	1000	1000
MT	8000	1000	1000	1000	1000	1000	1000	1000	1000
Total	**24 000**	**6000**		**6000**		**6000**		**6000**	

3.2 Selection of the axles for the sampling programme

A possible way to select axles for the sampling programme (referred to activities in heavy maintenance) is described below.



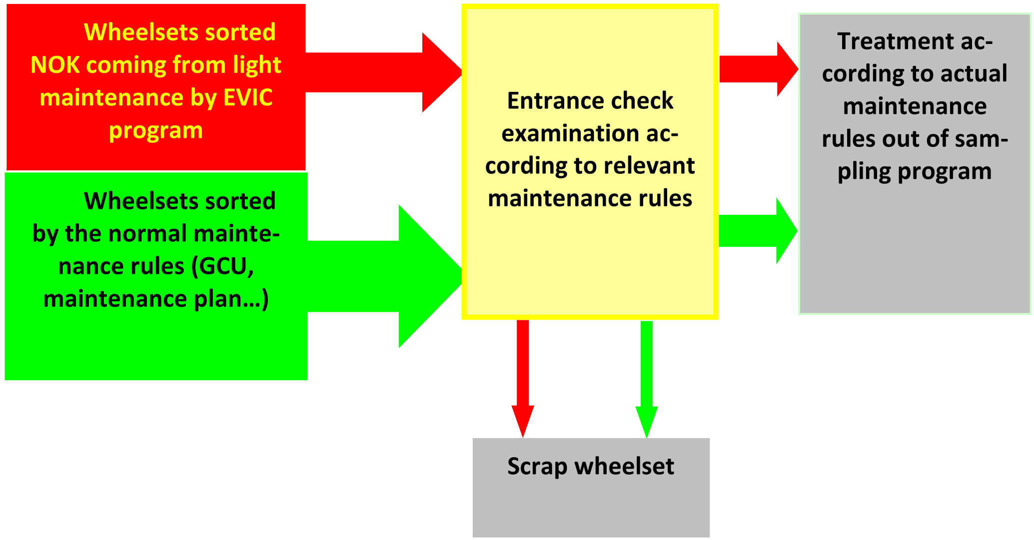
In light maintenance, only EVIC failed wheelset (red one) are removing from service, and then this is favourable for the sampling because these axles are sorted earlier than with the existing maintenance rules. EVIC passed wheelset stay under the vehicle; we cannot use them for the sampling. We can use if we accept to remove them from service but this will be increase the cost.

In the wheelset entering in heavy maintenance (green one), we can, by EVIC application, marked the EVIC OK wheelset (blue one). This is also favourable because these wheelset will be deposed by normal existing maintenance rules (the previous heavy maintenance is old or the mileage is important) and they are still in a good state.

The expertise according to the maintenance scheme allows eliminating non reparable wheelset (i.e. distort axles, wheel seat at the wear limit...) or to adapt the consistency of the repair (i.e. a wheelset come in for reprofiling but the size of the defect is too big so the wheel shall be replace).

This selection must be applied as far as the number of sampled axles is not equal to the target.

Once the number of sampled axles is equal to the target, the selection of the axles becomes:



3.3 Description of the sampling protocol

3.3.1. The different states of the sampling programme are described below

General information to be documented

The following information must be documented:
- workshop;
- wheelset type;
- wheelset number;
- risk domain: DG, HL, DL, COR;
- date, workshop and type of the last NDT.

For the following steps, the side of the axle must be clearly identified and remain the same during the whole process.

EVIC (cf. EVIC implementation guide)

The following information must be documented:

- EVIC result (category);
- Precise region where the EVIC defects occurred for later comparison to the NDT results (9 sections according to the picture showed in §7);
- Procedure for removing the coating (if needed).

NDT before treatment

The tests are realised according to the standard maintenance regime of the RU/Keepers, particularly the acceptance/failure criteria.

Tests are done with wheels mounted:
- MT on free surface, UT in wheel seat;
- Auto UT on the entire surface;
- Man UT; on the entire surface;

or with wheels dismounted (in MT system).

100% of the axle surface is checked.

The following information must be documented:
- NDT system apply at each section (Cf. § 3.3.2.);
- NDT detected failures section where failure occurred (9 sections according to the picture showed in §7);
- graphic detailing of the defect and the length as shown in §7;
- in case on automatic documentation of the NDT, the protocol must be kept.

Treatment
The following information must be documented: which procedure for surface correction (grinding, turning, depth, diameter, etc.).

NDT after treatment
The following information must be documented: type of NDT and NDT results after treatment (axle scraped or not).

3.3.2. NDT system parameters to be documented for the workshop concerning by the sampling programme (Cf. §9)

3.3.2.1 General
- Quality certification of the workshop
- Worker certification level
- Rejection criteria (length or depth and direction)
- NDT production average p/year
- Date of implementation of the process in the workshop

3.3.2.2 MT

- Surface preparation
- Magnetization technique, including (as appropriate) indicated current values, tangential field strengths, waveform, contact or pole, spacing, coil dimensions, etc.
- Detection media used, and contrast aid paint if used
- Application of detection media
- Viewing conditions
- Sensitivity

3.3.2.3 UT

- Surface preparation
- Technique:
Transmission
Pulse echo
- Probe
Single
Double (twin)
Separate (transmitter and receiver)

- Vibration mode
Longitudinal wave
Transverse wave
Lamb wave
Rayleigh wave

- Transducer
Frequency
Dimensions
Focusing probe

- Coupling media
Water
Contact paste

Oil
Grease
Cellulose paste

- Calibration blocks
- Reference blocks
- Sensitivity

3.4 Responsibilities of the person in charge of the sampling programme

The person in charge of the sampling programme per member will:

• organize the translation in the national language and the issuing of Sampling Programme Implementation Guide;
• manage all information of all concerned parties (workshops, etc.);
• collect the data for traceability and condense the collected information for the Joint Sector Group (see § 6).

4 – Programme

This is the decided programme for the beginning of the sampling

Member	Number of axles (total)	% of total	sampling theoretical	samplingdecided	NDT System	COR	RID	High load	Drop load
PKP	*280'000*	*17%*	*4'065*	*4'000*	*UT man*	2000	0	1000	1000
SBB	*30'000*	*2%*	*436*	*600*	*UT man*	0	0	350	250
AAE	*40'000*	*2%*	*581*	*750*	*UT man*			50	700
SNCB	*60'000*	*4%*	*871*	*800*	*UT man*	0		400	400
HUPAC	*16'000*	*1%*	*232*	*300*	*UT man*		0	150	150
Total	**426'000**	**0**	**6'185**	**6'450**		**2'000**	**-**	**1'950**	**2'500**
DB SR D	*370'000*	*22%*	*5'372*	*5'000*	*UT auto*	3300	0	500	1200
TI	*115'000*	*7%*	*1'670*	*1'300*	*UT auto*	200		1100	
ÖBB	*60'000*	*4%*	*871*	*700*	*UT auto*			400	300
AAE	80'000	*5%*	*1'162*	*1'000*	*UT auto*			200	800
Total	**625'000**		**9'074**	**8'000**		**3'500**	**-**	**2'200**	**2'300**
UIP	*300'000*	*18%*	*4'356*	*6'000*	*MT*		6000		
SNCF	*291'000*	*18%*	*4'225*	*3'550*	*MT, UT man*	500		1850	1200
SLO	*11'000*	*1%*	*160*	*-*	*MT/ UT man*				
Total	**602'000**		**8'740**	**9'550**		**500**	**6'000**	**1'850**	**1'200**
Total	**1'653'000**		**24'000**	**24'000**		**6'000**	**6'000**	**6'000**	**6'000**

5 - Planning

The sampling will take place over a 12 month period after which an evaluation of the results and of the effectiveness of the campaign will be carried out to decide on the way forward. A preliminary evaluation of the results should be done after 6 months from the start of the campaign.

The campaign will start together with the EVIC programme (April 2010).
The status of the implementation will be reported in Task Force meeting.

6 – Recording the sampling programme

The results of the sampling programme must be recorded / traced.

The roles and TO DOs of the several parties involved are as follows:

6.1 - Workshops tasks

The workshops concerned by the sampling programme must:

- recorded the results of the sampling, in paper and/or in electronic file format, according to Traceability sheet shown §7;

- condense the results in electronic file according to the dedicated data sheet shown §8.1;

- send this file monthly to the person in charge of the sampling programme.

6.2 - Person in charge of the sampling programme tasks

The person in charge of the sampling programme must:

- collect the sampling monthly file from the workshops;

- summarize electronically the monthly results from all workshops according to the dedicated data sheet shown in §8.1;

- send this report monthly to the JSG.

6.3 - JSG tasks

- collect and summarize all the monthly report of the person in charge of the sampling programme;

- condense the results according to the presentation shown in §8.2.

7 – Traceability

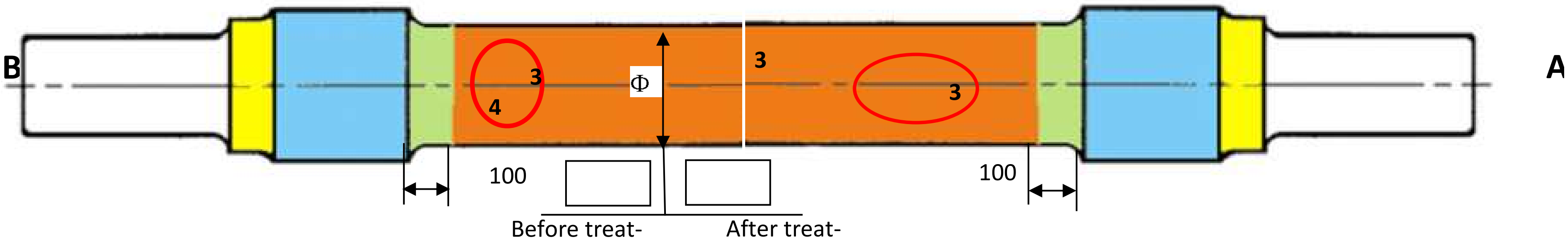
Workshop	Risk Domain	Wheelset type	Wheelset number	Date	Wheel dismounted	Bearing ring dismounted
TERGNIER	DG	9052	12345	24 / 02 / 2010	Yes / No	Yes / No

Previous axle maintenance with NDT

Date	Level	NDT System	Workshop				
15 /01/ 2001	COP	MT	Rennes				

EVIC APPLICATION

Zone	B journal	B abut-ment	B wheel seat	B transition radius (100 mm)	Shaft	A transition radius (100 mm)	A wheel seat	A abut-ment	A journal
EVIC defect category					33,34				
Roughness or UIC surface categories									



NDT before treatment

Zone / NDT System	B journal	B abut-ment	B wheel seat	B transition radius (100 mm length)	Shaft	A transition radius (100 mm length)	A wheel seat	A abut-ment	A journal
MT	**No**	**No**	**No**	**No**	**Yes**	**No**	**No**	**No**	**No**
Man UT									
Auto UT									
Eddy Current									
Defect in EVIC zone		**Yes / No**		**Yes / No**	**Yes / No**	**Yes / No**		**Yes / No**	

Treatment

Grinding the shaft central part 0,5 mm depth.

NDT after treatment

MT man ☐	**UT auto** ☐

Axle scraped for NDT reason	**Yes / No**
Axle scraped for other reason	**Reason: …………………….**

User Manual for the completion of the data sheet

EVIC APPLICATION

Indicate for each zone the defect category number according to EVIC catalogue and if necessary marked on the axle drawing

NDT before treatment

Marked for each zone and in the relevant NDT system line if you have found a defect or not and marked the defect (form, direction and dimensions) on the axle drawing. (see example on drawing)

Treatment

Indicate which treatment has be done ie turning the shaft, or grinding locally or polishing locally

NDT after treatment

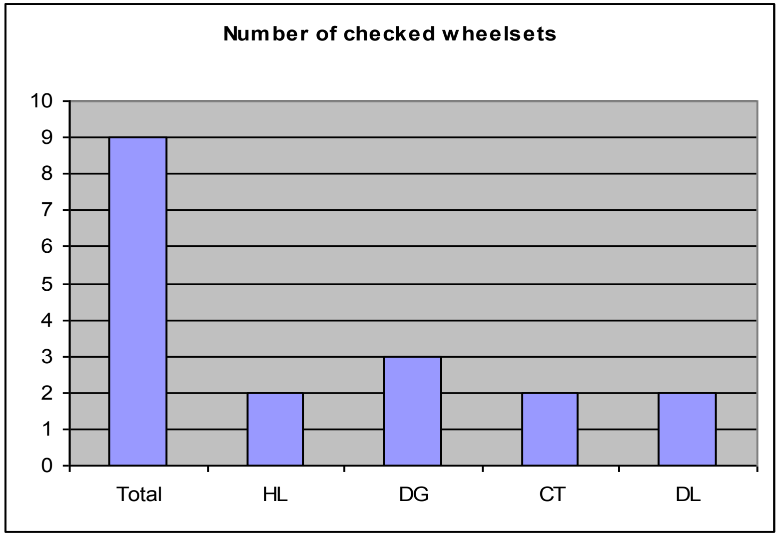
Marked a cross the used NDT system and if the axle is scraped or not.

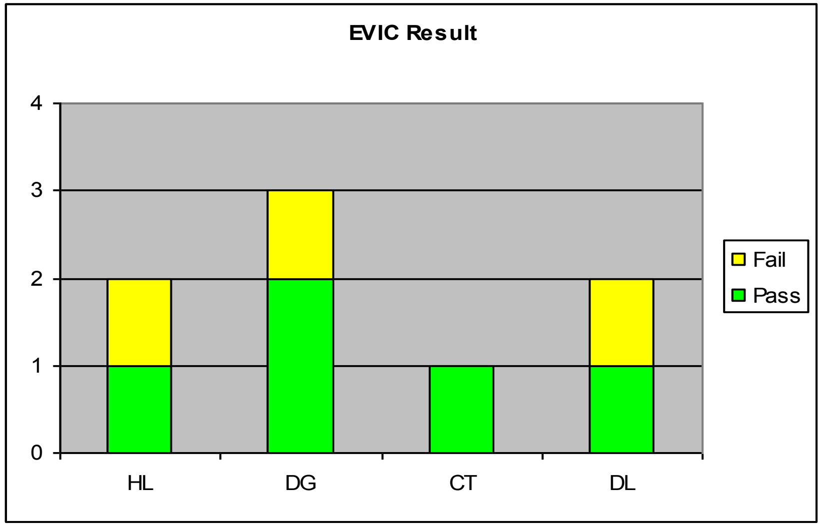
8 – Presentation of the results

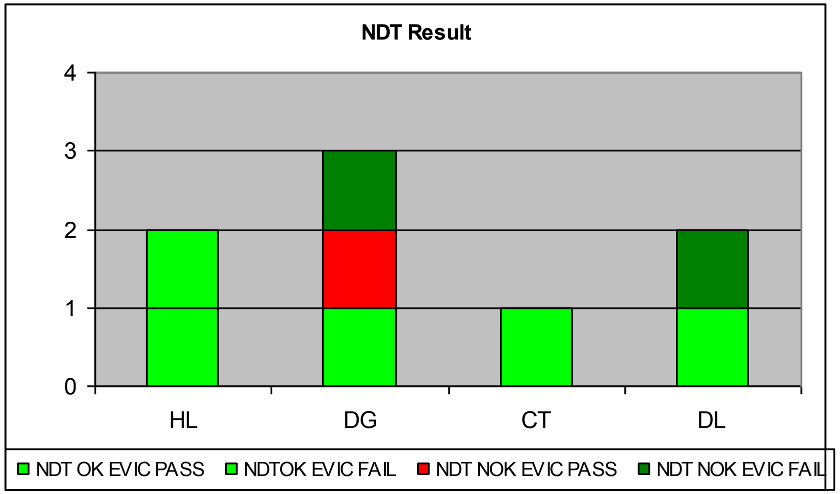
8.1 – Dedicated data sheet

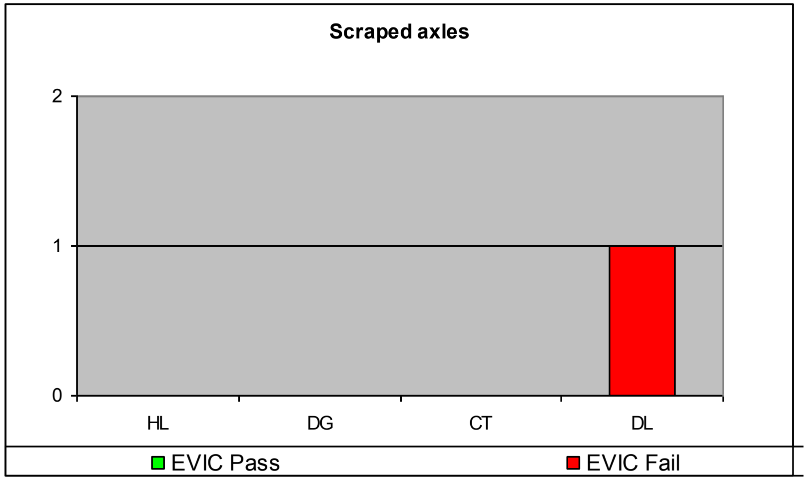
Original Wagon number if possible	Risk category	Wheel set number	Wheelset type	UIC Type	Axle judgement according normal maintenance rules	EVIC Result	NDT after EVIC and before treatment	NDT Defect in the EVIC zone	NDT after treatment
123456789012	High loading	1234	9052	AIII(2)	OK	OK	OK	No	OK
338089765432	Dangerous good	1235	9052	AIII(2)	OK	OK	NOK	No	OK
338089765433	Dangerous good	123	9052	AIII(2)	OK	NOK	NOK	No	OK
338089765434	Drop loading	12345	002	B	OK	OK	OK	Yes	OK
338089765435	High loading	865	9052	AIII(2)	OK	NOK	OK	Yes	OK
338089765436	Corrosive traffic	876	9056	No	OK	OK	OK	No	OK
338089765437	Drop loading	43	9052	AIII(2)	OK	NOK	NOK	No	NOK
338089765438	Corrosive traffic	12	9056	No	OK	C	NOK	No	NOK
338089765439	Dangerous good	456	9052	AIII(2)	OK	OK	OK	No	OK

8.2 – Example of presentation of the results









9 – Practical information

List of concerned wagons classes for the 4 risk domains, workshop(s) concerned by the sampling programme & Person in charge of the sampling programme

Members	Person in charge of the sampling programme	Workshop(s) concerned by the sampling	Wagon classes				
			Corrosive traffic	DG	High loading	Drop loading	Normal operation
PKP / IGTL	Ireneusz Gojski (IGTL)						
DB SR D	Michael Gerstner Michael.Gerstner@deutschebahn.com	Paderborn Eberswal born Eberswalde	Tamns x 886.0, Tamns x 893.1 Taoosy 894.0 Tanoos 896.0 Tanoos 896.1 Uaoos y 948.0 Tads 957.0 Tads y 957.1 Tads 958.0 Tads y 958.1 Talns x 968.1 Talns x 968.2 Talns x 968.6 Tds 930.0 Tds 932.0 Tds 934.0 Tds 937.0 Tds 938.0 Tds 940.0 Tds 941.0 Tds 942.0		Falns 121 Faals 151 Falrrs 152, 153 Fal(n)s 164, 165, 180, 182, 183	Falns 121, Faals 151Falrrs 152, 153 Fal(n)s 164, 165, 180, 182, 183 Fals 124, 128 Eaos 051, Eanos 052, Ealos 053, Eas 066, Eaos 075	
SNCB	Etienne Maenhout Etienne.maenhout@b-rail.be	AC Gentbrugge			Tads 1004 D1	Shimms	
ÖBB	Andreas Schachner Andreas.Schachner@oebb.at	TS Werk Knittelfeld			Falns	Shimmns	

SBB	Thomas Bernet bernet.thomas@sbbcargo.com	SBB / FFS, IW Bellinzona			Fans-u, Shimmns, Shimms, (Snps), (Sps), Tagnpps, (Tgpps), Uacs, Ucs	Eanos, Eaos	
SNCF	Bernard Lafaix bernard.lafaix@sncf.fr	TC de Tergnier			S5*, T80, TADS	tombereau (E71, E79, E80) et grumier (R54, R55)	
UIP	Charles-Antoine Rivière	FERIFOS (ERME-WA) Brühl (VTG) ZntkOstroda (GATX)					
AAE	Johannes Nicolin Johannes.nicolin@aae.ch	TS Werk Knittel-feld for UT auto … for UT man					
HUPAC	Olga Wisniewska tech@cargorail.ch						
TI	Alessandro Corbizi A.corbizi@trenitalia.it	Osmannoro (FI)	Tadns		Falrrs(28) Sgns(34) Rhlmms		

NDT system parameters to be documented for the workshop concerning by the sampling programme

	SNCF	DB	SNCB	OBB	SBB	VPI	TI	PKP	AAE	HUPAC
General										
Quality certification of the workshop	ISO 9000 ISO 14000	ISO 9001/9002 ISO 14001	ISO 9001:2000	ISO9001	ISO 9000 ISO 14000 OHSAS 18001	ISO 9000 ISO 14000	ISO 9001			
Worker certification level	EN 473 N1 & N2	EN 473, DIN 27201-7 Level 1 a. 2	Internal training (similar to EN 473 N1 level)	EN 473 Level1 & 2	EN 473 MT 1 / 2	EN 473 MT 1 / 2 Prüfaufsicht level 2 / 3	EN 473 Lev.1, 2, 3			
Rejection criteria (length or depth and direction)	No indication (MT)	MT: length 2mm, transverse and diagonal, UT: depth 2mm, transverse	No crack allowed (MT)	2mm UT 3mm MT	2 mm cross direction	no linear indication	No indication (MT)			
NDT production average p/year	<TBD>	ca. 45000	10.000	~13500 UT ~13500 MT	~ 7000		UT _ 4000 MT _ 600			
Date of implementation of the process in the workshop	1970's	2001/2007	1970's	1996 MT 2005 UT	2005	2000	MT_1985 UT_(sixties)			

	SNCF	DB	SNCB	OBB	SBB	VPI	TI	PKP	AAE	HUPAC
MT										
Surface preparation	Blasting	blasting	Cleaning, brush	Brushing or turning	Blasting	Blasting	Grinding			
Magnetization technique	Rigid coil	rigid coil, current flow	Rigid coil	Coil	Rigid coil	Rigid coil	Rigid Coil			
Detection media	Fluorescent	fluorescent	fluorescent	Fluorescent	Fluorescent	Fluorescent	Fluorescent			
Application of detection media	Flow onto surface	spraying	spraying	Sprinkle on surface	Flow onto surface	Spray on surface, flow on surface (not often)	Flow onto surface			
Viewing conditions	EN ISO 9934	EN ISO 9934	EN ISO 9934		EN ISO 9934	EN ISO 9934	EN ISO 9934			
Sensitivity	0.1mm to 2mm depending on surface roughness	0,1mm	Depth ≥ 0.1 mm	<1mm	1mm to 1.5 mm depending on surface roughness	0.1mm possible, depending on surface	0.1mm to 2mm depending on surface			
UT										
Surface preparation	blasting	blasting	Cleaning, brush	Brushing or turning	Blasting Grinding	Blasting Grinding (if surface must be improved)	cleaning on journal end surface			
Technique	Pulse echo	Pulse echo	Echo impulsion	Pulse echo	Impulse echo	Pulse with 2 -4 MHz	Pulse echo			

Probe	Double	Fased array	Single crystal, emitter and receiver	30 pcs.	single	single	Rotating			
Vibration mode	Longitudinal wave from the end and transverse wave from surface	Transverse wave	Longitudinal and transversal waves	Longidudinal and transversal wave	Transverse wave from surface and Longitudinal wave if required	Longitudinal wave from the end and transverse wave from surface	Longitudinal wave from the journal end			
Transducer	<TBD>	<TBD>	Straight and angular / 2 to 4 MHz	2 MHz and 4 MHz	WB 45 – 2 WB 60 – 2 B 4 S or equal	must fulfil the requirements (e.g. WB 45-2, B 4 S)	3 transd. with ≠ angles			
Coupling media	Grease	Water	Mineral oil	Water	Ultragel II or equal	gel, grease	Oil			
Calibration blocks	Axle, bloc	Bloc (K1)	V1 block / ref. axle in AC-Salzinnes	Calibration bloc K1, K2	Axle, bloc	K1 (EN 12223)	Axle bloc			
Reference blocks	Bloc AFNOR B type	Axle	V1 block	Reference axle	K 1, K 2	VPIL 04, Annex 27	/			
Sensitivity	< 2 mm	2mm	2 mm	<2mm	< 1 mm	< 2 mm (roughly, depending on surface)	< 3 mm			

ANNEX 3.2.2.B: EVIC Sampling: statictical procedure and relevance

1. Goal

The EVIC Sampling program was introduced to measure the efficiency of the EVIC program. It served the purpose to

- Prove that the EVIC catalogue is a valuable tool to identify and sort out axles that have potential NDT indications
- Prove that the EVIC program enhances the level of safety in freight operation

2. Sampling

In order to achieve this goal, it was initially intended to sample 24,000 axles from the EVIC program. The sampling procedure for each axle consisted of the following steps:

1. the axle was subjected to the EVIC procedure and evaluated either “Ok”, “C”, or “NOk” (Not Ok)
2. the axle underwent a first NDT (Non Destructive Testing) in order to see if there was an indication
3. the axle was treated according to the usual maintenance rules. This treatment was independent from the outcome of step 2
4. the axle underwent a second NDT procedure

The EVIC result for each axle was then compared to the NDT result before and after treatment. Since the goal of the EVIC program was to sort out axles with potentially critical NDT indication, the attributes to be compared were the EVIC result and the NDT result after treatment. Sampled axles with a positive EVIC result (“Ok” or “C”) and a negative NDT result after treatment were considered critical since they would remain in service even after an EVIC inspection. All other combinations were considered either good (EVIC positive, NDT positive) or uncritical (EVIC “NOk”, meaning that the axle would have been taken out of service no matter the NDT result). The goal was to show via statistical analysis of the sampling that EVIC systematically sorts out critical axles and thus enhances safety by removing critical components from the system.

3. Sample size

Initially it was planned to sample: 12,000 EVIC “NOk” axles and 12,000 EVIC “Ok” or EVIC “C” axles. By October 2012, a total of about 13,000 axles had been sampled and the distribution of the EVIC results can be viewed in the following table:

EVIC result	Number sampled
Ok	5933
C	4423
NOk	2835
Total	*13191*

In the process it showed that this overall sample size was big enough to achieve the above mentioned goals of the sampling program. Compared to the numbers shown in chapter 3.2, the difference (325) in the size of the sampled axles is linked to the scrapping or sorting out of axles before treatment in accordance with normal maintenance rules (for example: geometrical reasons, diameter of the seats, etc.)

4. Method

The method of statistical analysis of the sample data consisted of calculating estimators for the contingent of axles with NDT after treatment indication (“NDT-positive” axles) within the EVIC categories as well as the determination of confidence intervals in order to make sure that the nature of the results of the sampling was systematic.

5. Estimators

The estimators were simply the ratio of NDT-positive in the different EVIC categories. These are shown in the following table:

EVIC category	**Number of axles in Sample**	**Number of axles with NDT after treatment not OK**	**Contingent estimator**
“Ok”	5933	1	0,017%
“C”	4423	3	0,068 %
“Ok” or “C”	10356	4	0,039 %
“Not Ok”	2835	15	0,529 %
Total	13191	19	0,144 %

Table 1: EVIC sampling numbers by October 2012. The fourth column gives the estimators for the contingents of NDT-positive axles within the EVIC categories

6. Confidence intervals

Since the sampling procedure by itself can only give an estimation of the true contingents of NDT-positive axles within the entire EVIC program (i.e. all axles in European freight traffic), it is crucial to obtain additional information of the quality of the estimators, i.e. in what range the true values lie. It is assumed that the true probability of finding a NDT-positive axle in an EVIC-category has the value ***P***, e.g. for the probability of finding an NDT-positive axle in the set of all “EVIC Ok”-axles is $P_{Ok,NDT-NOk}$. In the sample the estimator for $P_{Ok,NDT-NOk}$ is found to be 0 (**Fehler! Verweisquelle konnte nicht gefunden werden.**, 4th column, first entry), since zero NDT-positive axles have been found in the sample. This does not mean that the true value is zero since it is possible that zero NDT-positive axles have been found purely by chance. For any true value of $P_{Ok,NDT-NOk}$ the chance of finding any number of NDT-positive axles in a sample of size 5933 can be calculated.

Furthermore, the probability ***prob(n,M)*** of finding ***n*** NDT-positive axles in a sample sized ***M*** (0 ≥ M ≥ N), when the true contingent is ***P***, obeys a binomial distribution, i.e.

$$prob(n,M) = \binom{M}{n} P^n (1-P)^{M-n}.$$

The confidence interval for an estimator then describes the values of the true parameter ***P*** for which the outcome of the sample is plausible, i.e. the values of ***P*** for which it is sufficiently probable that the obtained sample comes out. The 95% confidence interval then basically means that it can be said that one is 95% sure that the real value of ***P*** lies in the attributed confidence-interval. The confidence-intervals for the contingent-estimators for the EVIC-sampling are given in

EVIC category	**Number of axles in Sample**	**Number of axles with NDT after treatment not OK**	**Contingent estimator**	**95% Confidence-interval**	**99% confidence interval**
“Ok”	5933	1	0,017%	0,0009-0,095 %	0,0002-0,143 %
“C”	4423	3	0,068 %	0,0234-0,199%	0,017-0,268 %

"Ok" or "C"	10356	4	0,039 %	0,015-0,099 %	0,011-0,13 %
"Not Ok"	2835	15	0,529 %	0,324-0,87 %	0,275-1,01 %
Total	**13191**	**19**	**0,144 %**	**0,092-0,224 %**	**0,08 – 0,258 %**

Table 2: Estimators and confidence intervals for the EVIC sampling up to October 2012.

7. Interpretation

The results for the contingent estimators and the appropriate confidence intervals show that
The EVIC program is ***systematic*** in the sense that the probability to find an NDT-positive axle in the "EVIC NOk" set is higher than the appropriate probability to find an NDT-positive axle that has not been sorted out by EVIC (i.e. "EVIC Ok" or "EVIC C")
The described positive effect of EVIC is **statistically significant to a confidence level of 99 %**, i.e. the 99 % confidence intervals do not overlap.

The analysis shows that EVIC is an efficient tool to sort out NDT-positive axles and thus enhances the safety of freight traffic in Europe.

ANNEX 3.2.3: Stress-concentration by centre punch mark

During the course of the EVIC investigation, it was found that a significant number of wheelset axles from different manufacturers have centre punch markings on the shaft.
Centre punch marks of this kind had been commonly used for marking the centre of the shaft, in order to be able to adjust as well as possible the wheels symmetries to the centre that are important when pressing on the wheels in new constructions and when replacing the wheels in the wheelset-maintenance. They had been applied to the axles of locomotive wheelsets, as well as to those of passenger train carriages and goods wagons.
A fracture of a wheelset axle as a result of these "punch notches" has never been observed or known.

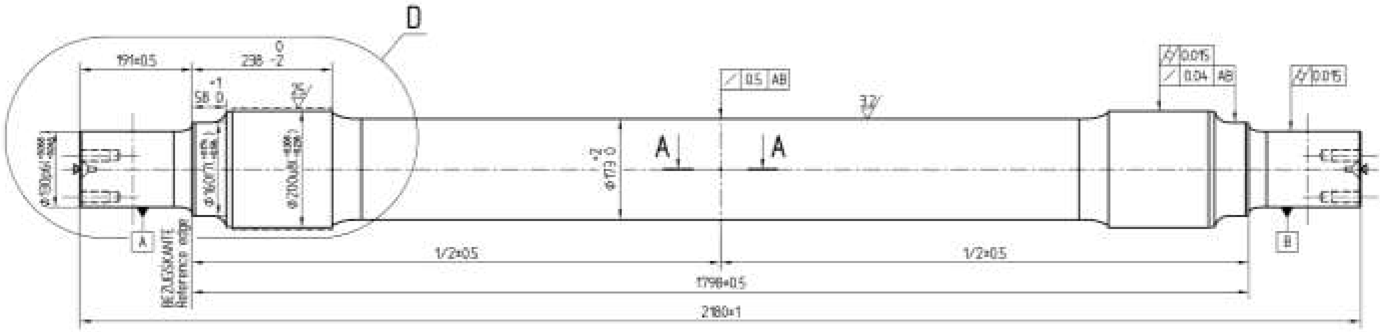
Within the context of the discussion of the impacts of surface effects / flaws / corrosion etc. on the fatigue strength of the wheelset shaft also the effect of this centre punch mark has been considered.

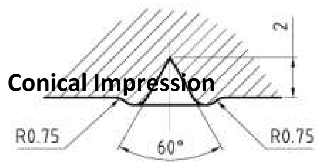
The following questions were thereby to be answered:

- *As a "surface defect", how does the centre punch mark act on the strength and/or the fatigue limit of the shaft at the location of the punch?*
- *Is there any risk to the fatigue strength of the wheelset axle as a result of the centre punch?*
- *What measures would be necessary or practical for the wheelset axles that are already in operation?*

In order to answer these questions an investigation of the strength of wheelset axles was carried out, as a comparison, with and without a centre punch mark, and was then assessed on the basis of the tensions in relation to the respective fatigue limit. The important aspects/results of these strength considerations will be presented in the following, and conclusions will be drawn from them regarding the answers to the above questions.

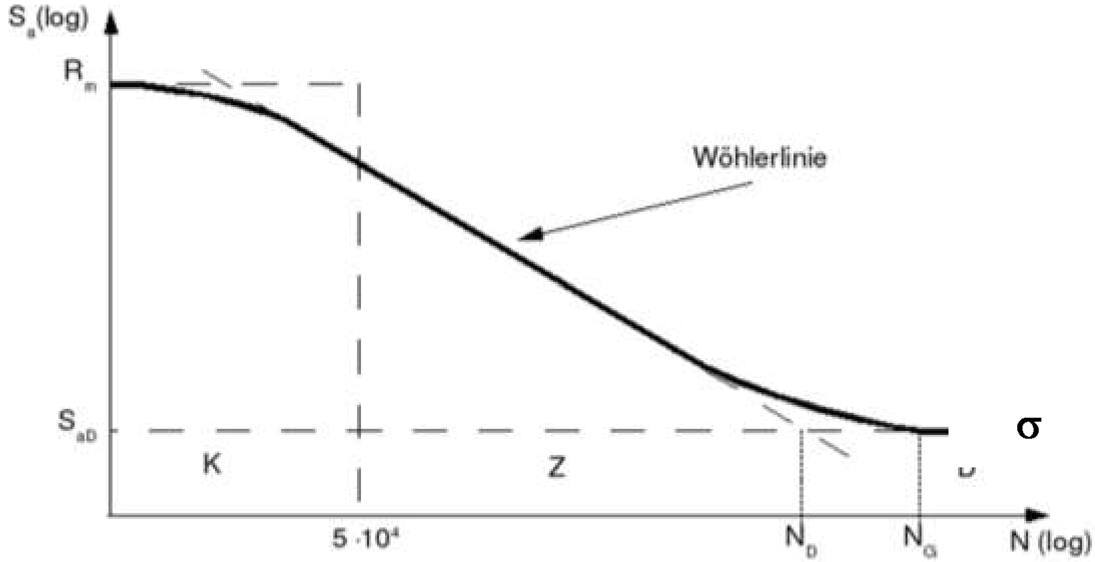
Strength calculation
(example of a shaft for 25 t wheelset load, steel **A1N**) - Estimation of the fatigue limits for bending stress





Centre Punch Marking of the shaft centre (Section A-A) by

In the case of a **smooth rod** (corresponding wheelset axle, shaft) made from steel **A1N,** the **fatigue limit** σ_C according to EN 13103 is as follows:



The following applies: σ_{Ct} = 0.48 x R_m = 0.48 x 600 MPa = 288 MPa
and the following fatigue limit for the smooth wheelset shaft thereby results for the smooth test rod – call the wheelset axle –

σ_C **= 200 MPa**
(with "zero-notch")

There are no standardised strength-reducing values for the determination and/or reduction of the respective **fatigue limit** depending on the type of impression for the case of the **"cone impression"** notch in the centre of the otherwise smooth shaft.

Starting from the fatigue limit for the smooth shaft σ_C = 200 MPa (see above), the impact of a known cross-hole is used as a first approximation of the centre punch mark.
With the known coefficients and influencing factors for cross-holes in shafts, the reduced fatigue limit of the shaft with a through cross-hole Ø 3 mm can be estimated according to Serensen and Lejkin, as well as Siebel and Stieler, with

Fatigue limit with cross-hole $\sigma_{Co\,I}^{*}$ **= 99 MPa**

The respective impact of the notch: cone impression in relation to the notch: cross-hole – with the otherwise identical shaft diameter and the same shaft bending stress– can be directly compared and assessed from the resulting stresses.

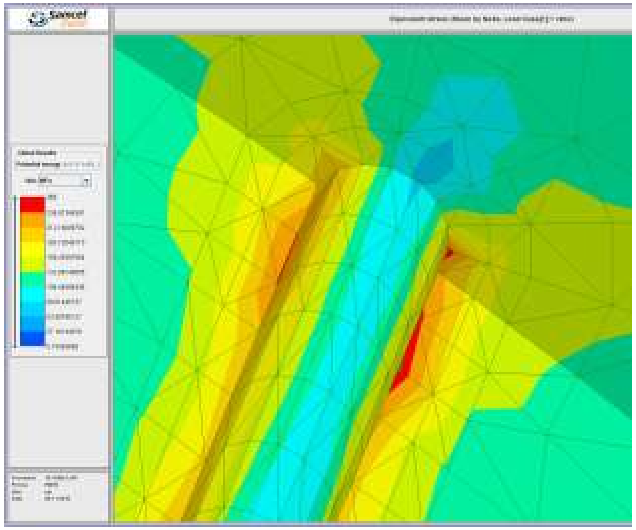
Notch I cross-hole
Notch II Centre punch mark, cone impression

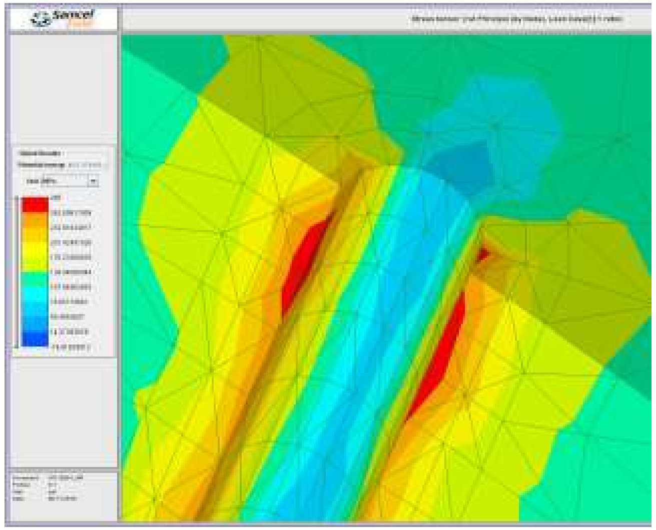
The resulting local stresses (maximum equivalent stress and maximum principal stress) of the associated **notches I, II** will be determined through the method of finite elements and will be set in relation to a shaft with "zero-notch".

Notch I (cross-hole)

Maximum equivalent stress $\sigma_{HMHmax\,I}$ **= 265 Mpa**

Maximum principle stress $\sigma_{1max\,I}$ **= 295 Mpa**





In this case of the Notch I “cross-hole”, the associated

fatigue limit σ_{CoI}^{*} **= 99 MPa**

has already been determined according to Serensen and Lejkin, and to Siebel and Stieler.

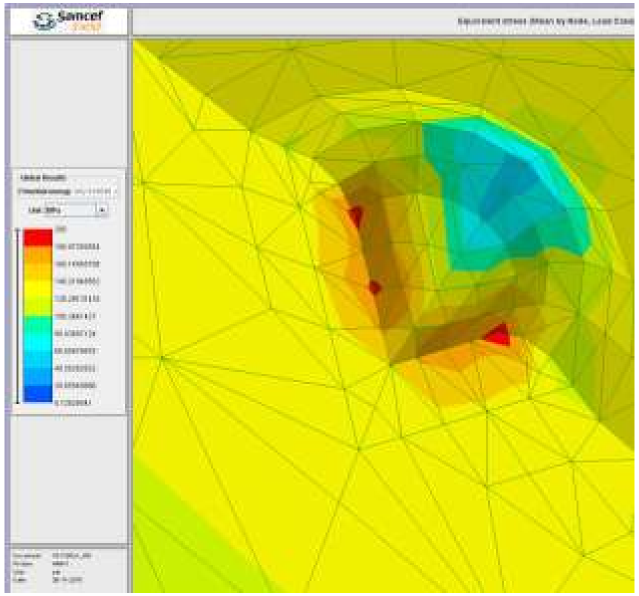
Notch II (centre punch mark, cone impression)

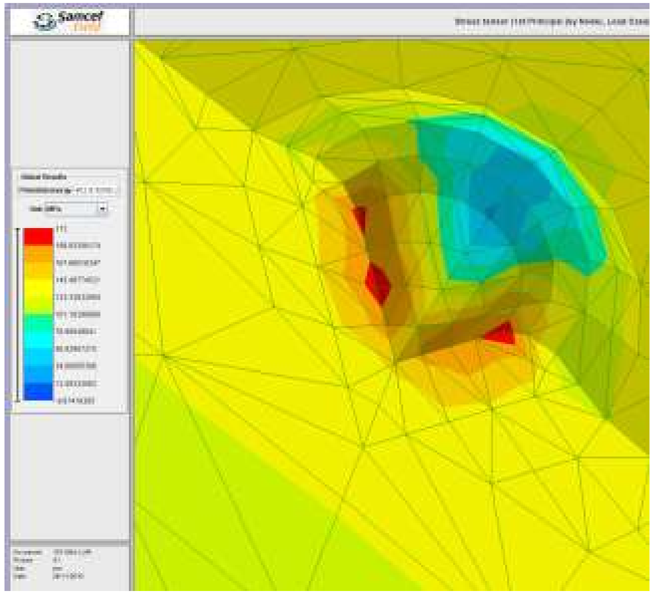
Maximum equivalent stress

$\sigma_{HMHmax\ II}$ **= 200 Mpa**

Maximum principal stress

$\sigma_{1max\ II}$ **= 212 Mpa**





By comparing the stresses of the standard notch cross-hole and the peak stresses of notch II (cone impression), the correction factor k_{kII} is determined for the fatigue limit of notch II (cone impression). The fatigue limit for the centre punch mark and/or notch II (cone impression) is derived from this with

$$k_{kII} = \sigma_{HMHmax\,I} \,/\, \sigma_{HMHmax\,II} = 265 / 200 = 1.32$$

or

$$k_{kII}' = \sigma_{1max\,I} \,/\, \sigma_{1max\,II} = 295 / 212 = 1.39$$

The following then applies for the fatigue limit $\sigma_{Co\,II}^*$ for the shaft with centre punch mark:

$$\sigma_{Co\,II}^* = k_{kII} \times \sigma_{Co}^* = 1.32 \times 99 \text{ MPa} = 130 \text{ MPa}$$

In this case of notch II (cone impression) the

fatigue limit $\sigma_{Co\,II}^*$ **= 130 MPa**

is estimated.

The following applies for the case of the **smooth undisturbed wheelset axle:**

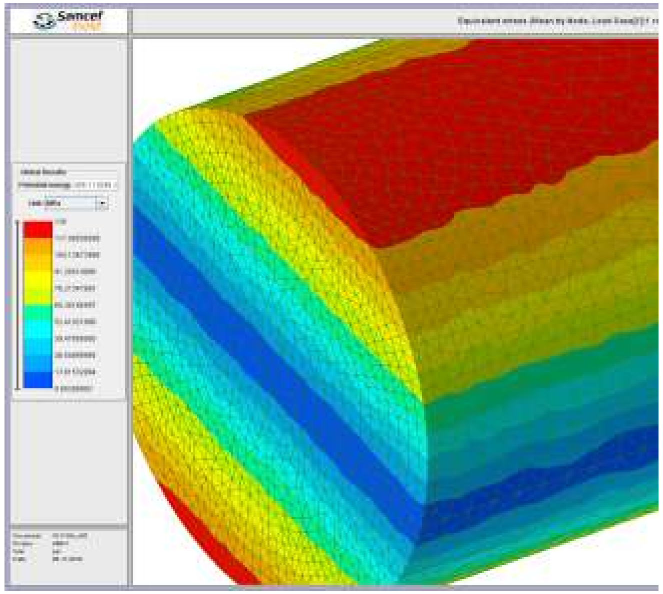
"Zero-notch"

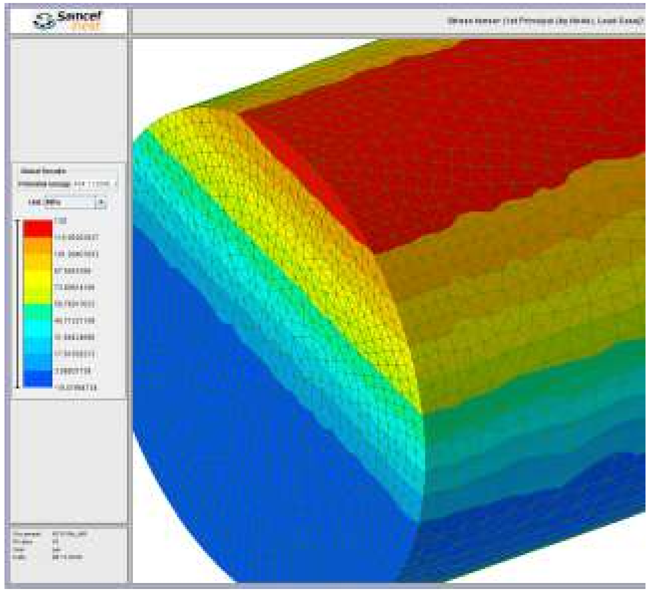
Maximum equivalent stress

$\sigma_{HMHmax\,"0"}$ = 130 Mpa

Maximum principal stress

$\sigma_{1max\,"0"}$ = 130 MPa





The fatigue limit for the smooth shaft, the "zero-notch" thereby results

$$k_{k"0"} = \sigma_{HMHmax\,I} / \sigma_{HMHmax\,"0"} = 265 / 130 = 2.03$$

or

$$k_{k"0"}' = \sigma_{1max\,I} / \sigma_{1max\,"0"} = 295 / 130 = 2.27$$

The following then applies for the fatigue limit $\sigma_{Co\,II}$ for the smooth shaft with "zero-notch":

$$= k_{k''0''} \times \sigma_{Co}^{*} = 2.03 \times 99 \text{ MPa} = 201 \text{ MPa} = \sigma_{C}$$

The
fatigue limit $\sigma_{Co''0''}^{*}$ = **201 MPa**

was estimated for this case of the "**zero-notch"** (estimated in a similar way to the cone impression). The fatigue limit $\sigma_{Co''0''}^{*}$ estimated in this manner corresponds to the fatigue limit σ_{C} **= 200 MPa** according to EN 13103, see above

In this way, the procedure selected here, starting from the EN 13103 for the smooth shaft and then determining the fatigue limit of the shaft with cross-hole, and then going back to the fatigue limit at Notch II, cone impression, at the known cross-hole through the comparison of the maximum equivalent stresses and/or the maximum principal stresses determined by the FEM calculation, is thereby confirmed.

Conclusions

- ***As a "surface defect", how does the centre punch mark act on the strength and/or the fatigue limit of the shaft at the location of the centre punch?***

The **fatigue limit** σ_{C} = 200 MPa according to EN 13103 for the smooth, undisturbed shaft will be reduced by the stamping as follows:

The fatigue limit $\sigma_{Co\,I}^{*}$ for the **cross-hole (notch I)** has been calculated as:
$\sigma_{Co\,I}^{*}$ = 99 MPa

The fatigue limit $\sigma_{Co\,II}^{*}$ for the **centre punch mark, cone impression (notch II)** has been calculated as:
$\sigma_{Co\,II}^{*}$ = 130 MPa

The fatigue limit $\sigma_{Co\,''0''}^{*}$ for the **smooth wheelset axle, "zero-notch"** has been calculated as:
$\sigma_{Co\,''0''}^{*}$ = 201 Mpa

or has been determined from EN 13103 as

σ_{C} = 200 MPa

- ***Is there any risk to the fatigue strength of the wheelset axle as a result of the centre punch?***

The strength analysis of the wheelset axle shaft, with Ø 173 mm and maximum, i.e. worst case stress of 25 t wheelset load, indicates a stress level in centre of the shaft of 129 MPa.
The cone-shaped centre punch mark (notch II) is thereby at the limits of the long-term strength, i.e. the fatigue limit, but can be tolerated.

- ***What measures would be necessary or practical for the wheelset axles that are already in operation?***

It is **recommended** to level out any local stamps / centre punch marks, **i.e. to grind them out,** in order to recreate a greater separation from the fatigue limit.
This recommendation is thereby conclusively proved / confirmed here by the impact on the fatigue limit at the location of the centre punch mark in the centre of the shaft.

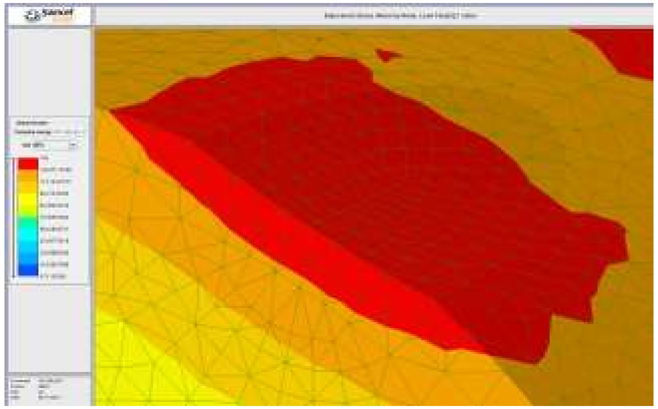
Strength calculation with levelled centre punch marks (and similar impressions)

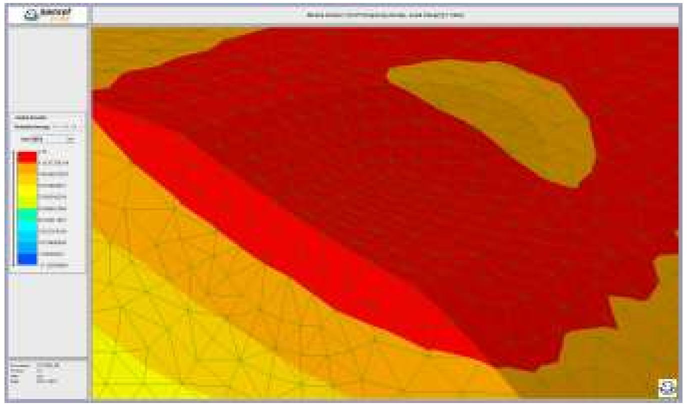
Using the FEM calculation, the

Maximum equivalent stress **Maximum principal stress**

at the leveled location is calculated as:

$\sigma_{HMHmax\ Mul}$ **= 140 Mpa** $\sigma_{1max\ Mul}$ **= 139 MPa**





The fatigue limit for the oval, grinded out area (depth = approx 2 mm and diameter d_x = 35 mm, d_y = 70 mm) thereby results as

$$k_{kMul} = \sigma_{HMHmax\ I} / \sigma_{HMHmax\ Mul} = 265 / 140 = 1.89$$

or

$$k_{kMul}' = \sigma_{1max\ I} / \sigma_{1max\ Mul} = 295 / 139 = 2.12$$

The following then applies for the fatigue limit $\sigma_{Co\ Mul}^{*}$ for the shaft with cavitation:

$$\sigma_{Co\ Mul}^{*} = k_{kMul} \cdot \sigma_{Co}^{*} = 1.89 \times 99 \text{ MPa} = 189 \text{ MPa}$$

The

fatigue limit $\sigma_{Co\ III}^{*}$ = **189 MPa**

is calculated for this case of the **levelled / grinded out area.**

The fatigue limit of the centre punch marks notches II and III of

130 and 135 MPa

are thereby increased at 189 MPa.

Levelling by grinding out is a recognised standard procedure in the maintenance of wheelset axles for the removal of local surface damages. The local grinding out of the centre punch impressions can be carried out within the context of the normal wheelset maintenance or within the framework of the EVIC initiative. As a result of the levelling, the fatigue limit is considerably improved compared to the presence of centre punch impressions.

As an alternative turning down the shaft with ΔD = 4 mm on a lathe is possible as a further measure for the removal of 2mm deep notches. The fatigue limit of the wheelset axle with a grinded out center punch mark and with Ø 173 mm “remaining diameter” is approx 7% higher than the turned shaft with Ø 169 mm remaining diameter, which benefits the complete shaft.

Local grinding out in order to remove local defects is preferable in every case against the turning down of the shaft with it’s higher reduction of diameter and the corresponding strength loss.

European Common Criteria for Maintenance (ECCM) "vertical version" of freight wagon axles

to be applied **in wheelset axle maintenance**

Joint Sector Group for ERA Task Force on wagon/axle maintenance
Lille, 22nd June 2010

ECCM results summary (1)

EU-wide harmonised requirements for…

Light Wagon Maintenance

- Visual checks of the axle surface (EU-harmonised) according EVIC catalogue
- Corrosive environments: EVIC „short“ (4y) and more severe EVIC criteria (only cases A, B)

Heavy Wagon Maintenance (revision, major overhaul)

- Remove all axles with EVIC defect cases A, B, handover to wheelset maintenance (medium or heavy)
- Remove all axles with EVIC defect cases C (replace or repair)

Higher axle maintenance levels (1)

- **Axle surface status**
  - Treatment of local and severe defects (according UIC category 4)
  - Treatment of large and heavily corroded areas, strongly and uniformly pitted surface
- **Non-Destructive Testing (NDT)**
  - Complete NDT on all axle sections in the „medium maintenance“ level (off-vehicle maintenance level w/o changing wheels). Required migration is ongoing
  - Complete MT on the total axle surface in the highest maintenance level

ECCM results summary (2)

EU-wide harmonised requirements for…

Higher axle maintenance levels (2)

- **Wear limits**
  - Min. wheel seat diameter (all UIC Type A axles) limited to 182 mm when operated at 20t

Operation

- Unified rules for high performance axle operation (all UIC axle types)
- Continued operation of painted and unpainted axles under today‘s existing service and appropriate maintenance conditions (including Task Force results)

Traceability

- European EVIC logging
- European Wheelset Traceability + measures resulting from lack of traceability

Continued high performance operation *(increased load limit)*

Limit for high performance operation	Limited mileage between medium or heavy maintenance (with and w/o changing wheels)	Corresponding maintenance Action
type A-I; A-II; A-III(1) 20 t	**> 20 t not permitted**	
Axle load exceeding design load <= 5% type A-III (2) > 20,6 t up to 21 t	- 400.000 km - ECM task is to define the equivalent time limit	**NDT with mounted wheels** - UT at wheel seat - UT or MT at transition radii
Parc SUR		
Axle load exceeding design load >5% ->10% type A-III (2) > 21 t up to 22 t	- 200.000 km - ECM task is to define the equivalent time limit	
For type A axles operated at 21t axle load in standard maintenance plan and re-classified back to 20t operation:	re-integrate axle in standard maintenance plan with UT of the wheel seat at the next reprofiling, medium or heavy maintenance level of the wheelset	
type B > 22,5 t up to 23,5 t	Inside design limits but use to be checked case by case in accordance with wagon parameters and permitted infrastructure axle load	no special
type B > 23,5 t	**not applied**	

Limits for axle maintenance

Service limit(s)

- shall only be based on condition (wear limits, **not age related**) because basic concept in dimensioning has always been the infinite life approach

- Age is not a clear indication for the status of an item (but the undergone load conditions)

- This is supported by the return of experience of the existing maintenance and monitoring systems (NDT, surface treatment,…). After maintenance/overhaul, the wheelset/axle is able to continue its operation in the foreseen maintenance plan.

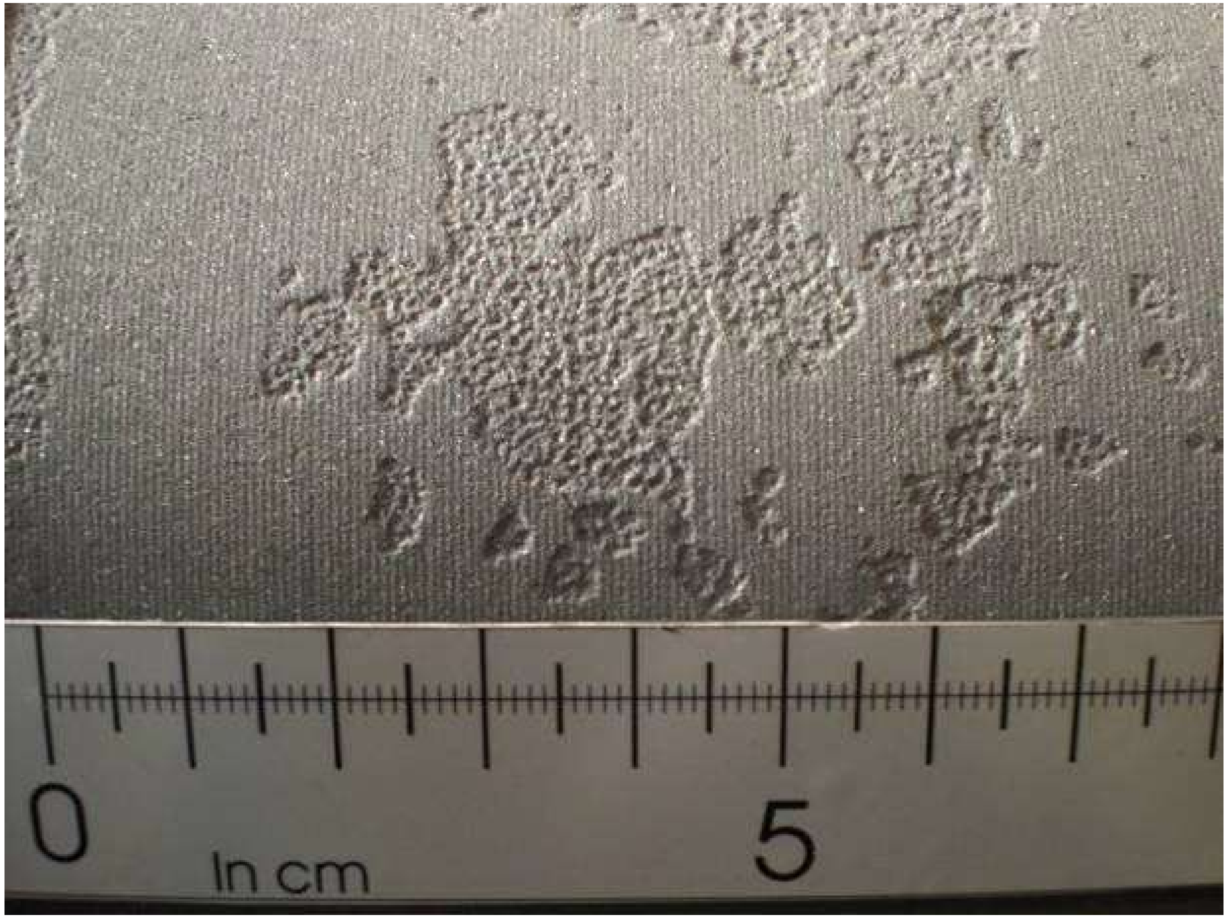
- This is supported further by the Visual Inspection program with following heavy maintenance now to apply sorting out even quicker axles from operation to appropriate treatment

Surface status to be treated in medium and heavy maintenance: references

1) Local and severe defects (according UIC category 4)

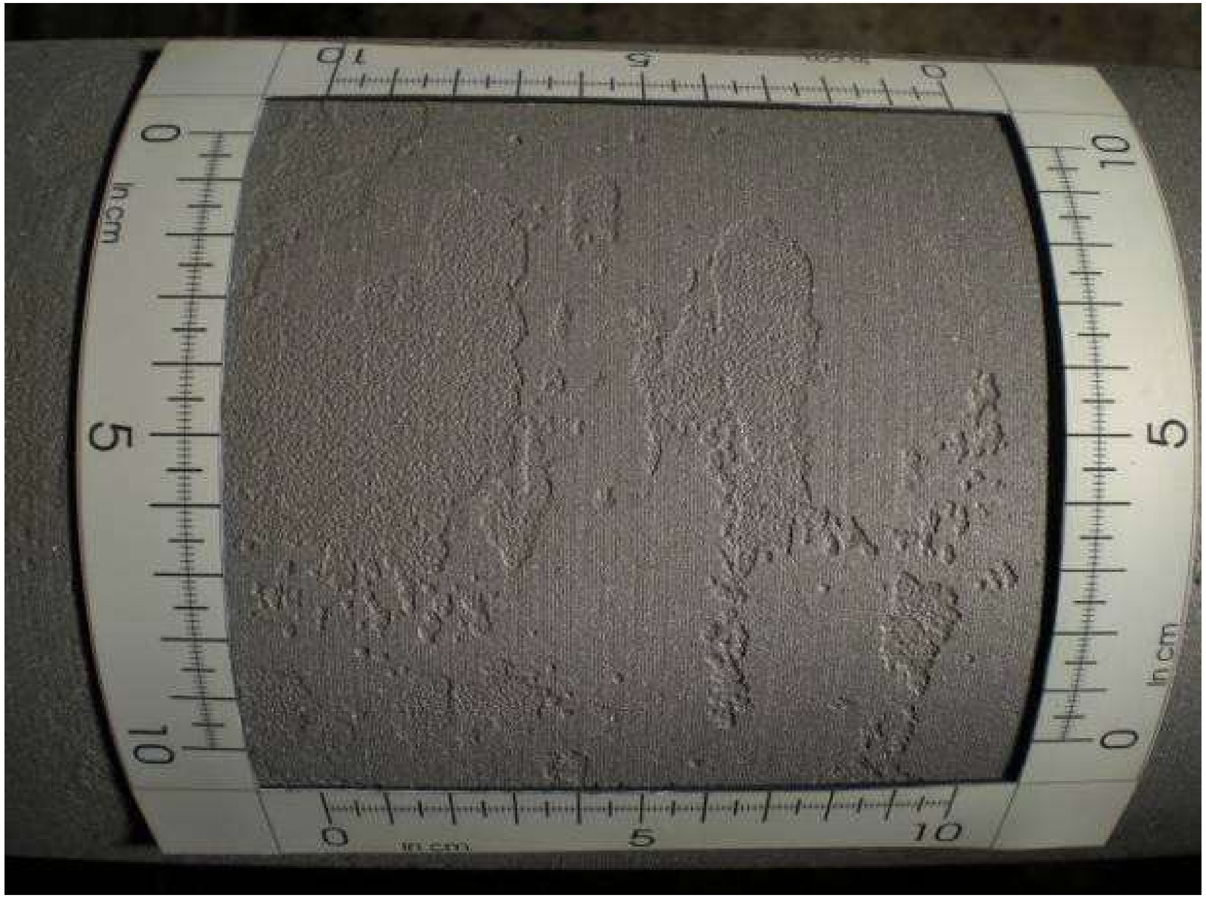
Surface status to be treated in medium and heavy maintenance: references

1) Local and severe defects (according UIC category 4)



Surface status to be treated in medium and heavy maintenance: references

1) Local and severe defects (according UIC category 4)



Surface status to be treated in medium and heavy maintenance: references

2) Large and heavily corroded areas, strongly and uniformly pitted surface

(link to prescriptions in EVIC:“to be treated in next heavy maintenance”)

Surface status to be treated in medium and heavy maintenance: references

2) Large and heavily corroded areas, strongly and uniformly pitted surface

Surface status to be treated in medium and heavy maintenance: references

2) Large and heavily corroded areas, strongly and uniformly pitted surface

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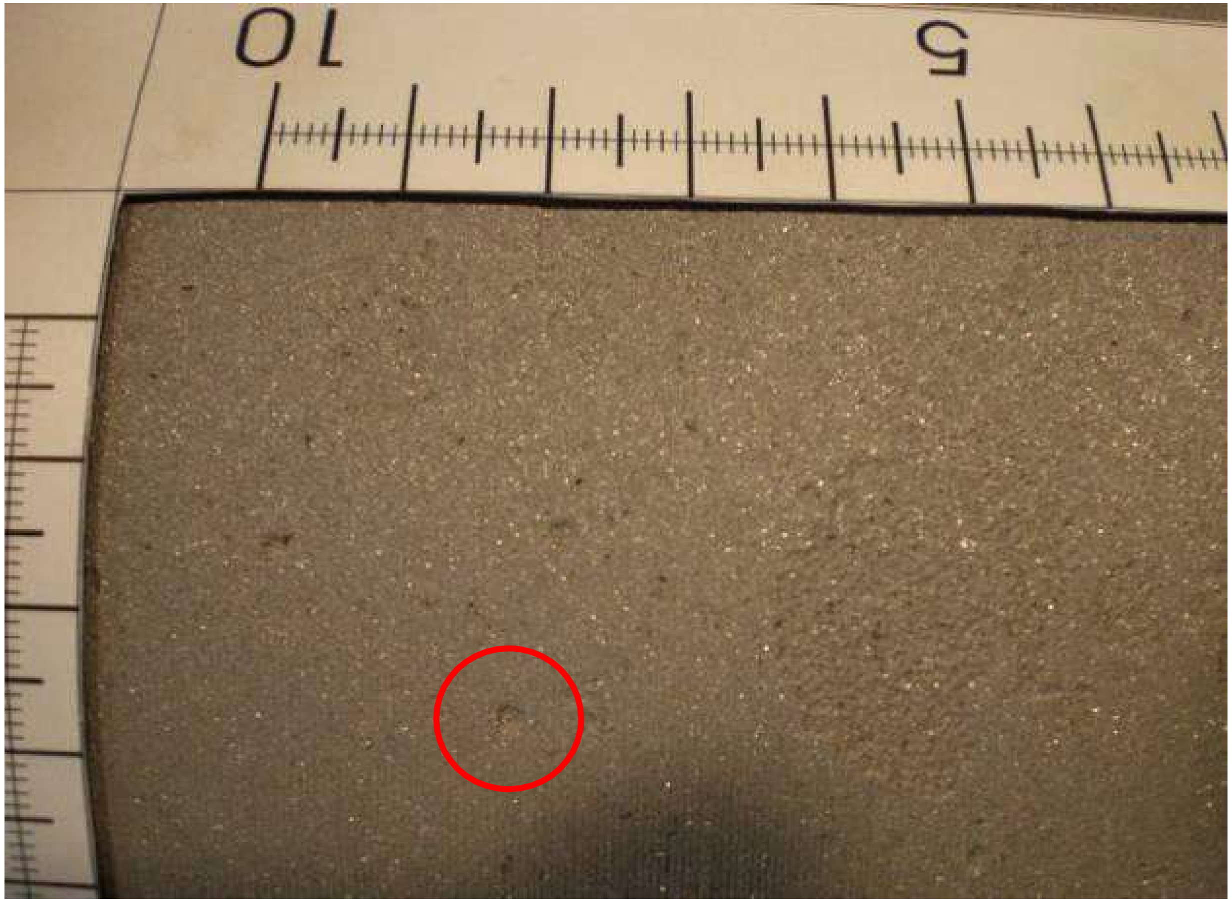

Surface status to be treated in medium and heavy maintenance: references

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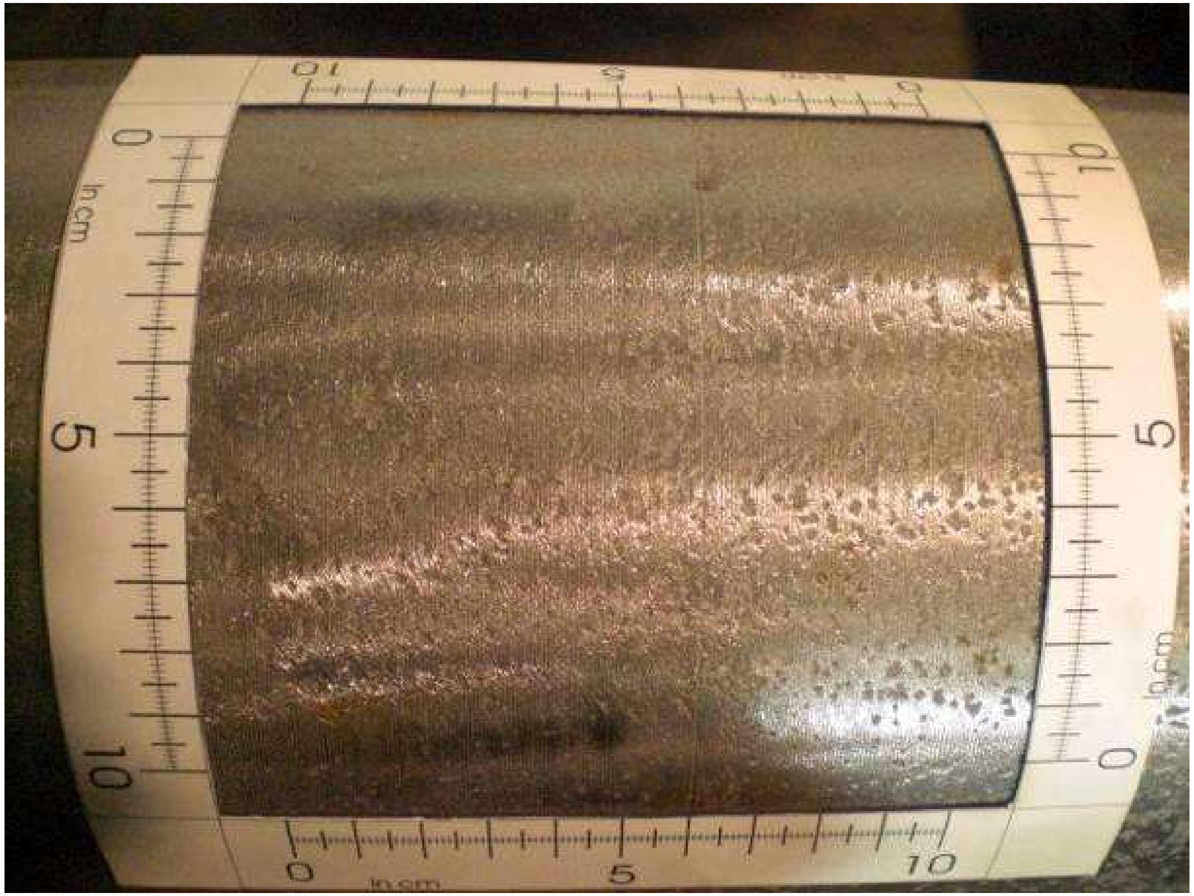
Surface status to be treated in medium and heavy maintenance: references

2) Large and heavily corroded areas, strongly and uniformly pitted surface



Surface status to be treated in medium and heavy maintenance: references

2) Status to be treated in transition radii and abutment area (examples)

abutment

abutment

Surface status to be treated in medium and heavy maintenance: procedure

For "medium maintenance" levels (without changing wheels, combined with bearing overhaul):

- If the surface status under coating of the axle is not clear: remove coating as far as necessary

- The surface status according to the given reference pictures must be treated or withdrawn in order to prevent potential cracks from propagation:

1) Local and severe defects (according UIC category 4)
2) Large and heavily corroded areas, strongly and uniformly pitted surface
- The treatment can be turning, grinding, blasting,… with subsequent NDT (according to ECCM)

The same criteria have to be applied also in the level with dismounted wheels

Measures resulting from lack of traceability

1. If in a wheelset maintenance level (with axle boxes opened) one or two of the following informations for an individual wheelset is/are missing:

- **manufacturer**
- **manufacturing date**
- **manufacturing standard**

the ECM has to decide according to its experience with its axle population about the measures to be applied. At minimum, the axle has to be subject to immediate NDT (only once).
(The timeframe is in accordance with the European Wheelset Traceability solution).

If no indication at all is given, the axle must be scrapped.

2. If the existence of the following data for an individual wheelset cannot be proven on paper, databases, data band,.. (detected during the acquisition according to the European Wheelset Traceability scheme or on special request):

- **Workshop of last maintenance activity**
- **date of last maintenance activity**
- **type of last maintenance activity**

then the axle has to be subject to immediate NDT (only once).

NDT for the axle must be performed in all cases 1. and 2. according to ECCM criteria.

3. The ECM/keeper has to decide according to its experience with the operational conditions of the axles if the non traceable axle has been used in accordance with its design or with high performance parameters.

If this is not identifiable, the most severe NDT conditions according to the "ECCM Continued High Performance Operation" rules must be applied in the future maintenance of the axle (see this document - *ECCM final, 5. special regimes*).

IMPLEMENTATION GUIDE

FOR THE

EUROPEAN WHEELSET TRACEABILITY (EWT) FOR FREIGHT WAGON AXLES

Joint Sector Group for ERA Task Force on wagon/axle maintenance

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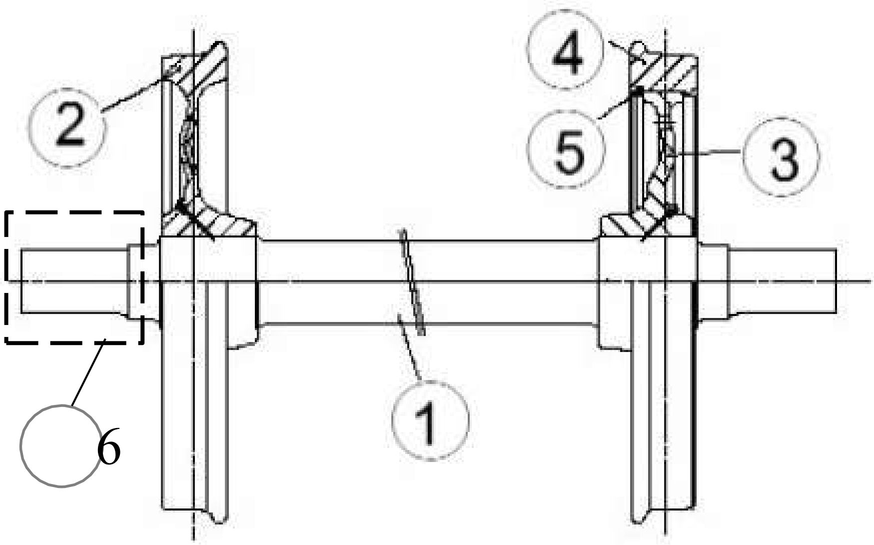
Brussels, 26.07.2010

1 Definitions



Key

1 axle
2 monobloc wheel
3 wheel centre
4 tyre (if)
5 retaining ring (if)
6 axle box with bearing

ECCM	European Common Criteria for Maintenance (of wheelset axles)
EWT	European Wheelset Traceability
ECM	Entity in Charge of Maintenance
GCU	General Contract of Use (CUU, AVV)
NDT	Non Destructive Testing
NSA	National Safety Authority

2 Reasons for the EWT

European wagons keepers have developed since many decades a maintenance system assuring a safety which allowed to become the safest land freight transport.

However, after the tragic accident in Viareggio,
- the European Railway Agency
- the European NSAs and
- the Joint Rail Freight Sector (CER, ERFA, UIP, UIRR, UNIFE)

agreed to investigate in the frame of the ERA Task Force the possibilities for a European approach for harmonised criteria and immediate and mid-term measures ascertaining an even enhanced railway safety in an appropriate way.

The Joint Sector Program worked out in the ERA Task Force was fully adopted in Viareggio in december 2009. The European Action Program consists of a:

- Visual Inspection of the European wheelset/axle population (according to EVIC)
- more in-depth investigation of samples of wheelsets from defined operating areas
- **European-wide implementation of systematic traceability of wheelset maintenance (EWT)**

The Joint Sector program was approved by all EU authorities and NSAs. It is up to the Sector to implement now what has been decided. The implementation of the program (here especially: EWT) is done as a self-commitment in the Sector Association's companies in fulfillment of the Sector's Safety responsibility. There is no legal obligation but a clear commitment of the Sector to the European and National Authorities to implement the Action program. The European Wheelset Traceability will be integrated in the updated version of EN 15313.

The European NSAs are invited to audit the execution of the decided measures.

3 Objectives of the EWT

To improve and to harmonize traceability further, and to reduce the time for analyzing in case of incidents, the sector will collect the data listed in this document.

The aim of the EWT is to:

√ trace wheelsets in case of incidents and to reduce the risk for further incidents due to similar reasons.
√ trace in case of incidents the service conditions of a wheelset in the past and also its core item, the axle.
√ trace the applied maintenance regime and which non destructive tests have been done on the wheelset.

In case wheelset defects will be detected, the keeper is able to select concerned wheelsets by the aid of EWT. This allows the keepers and NSA's to carry out appropriate measures.

4Timeframes

From August 2010 onwards, the sector will begin to collect the data listed below:

√ The data of the group “a” have to be collected at the first time the wheelset enters a suitable workshop (the ‘’suitable’’ workshop will be defined by the ECM) and at the latest at the next reprofiling maintenance level.

√ The data of the group “b” have to be collected at latest at the next maintenance of the wheelset with overhaul of the bearing.

√ The data of the group “c” have to be collected at latest at the next mounting and dismounting of the wheelset from the wagon.

√ For the data of the groups “a” and “b” which couldn't be determined, the notice “not available” has to be entered.
Measures to be taken in this case: according to the adopted ECCM
(see chapter 10; later according to EN 15313).

The collection of the data per wheelset has at latest to be completed within the next maintenance with overhaul of the bearing.

For new wheelsets, the collection of all data group a, b, c must start **from 08/2010 onwards**
and before the wheelset is in service.

The data must be recorded in a filterable electronic system at **latest from 01.01.2012 onwards.**

5 Boundary conditions

I. Collected maintenance dynamic data of category “I” of the wheelset must be stored as minimum until the next maintenance operation on the respective component (e. g. bearing overhaul to bearing overhaul).

II. Data of the category “II” have to be stored over the lifetime of the respective component. III. Data of the category “III” have to be stored over the lifetime of the wheelset.

The current keeper has the responsibility to obtain the data from the previous keeper or the manufacturer and store and update the data until the change of the keeper according to the categories.

The existing wheelset data have to be given to the new keeper in case of change of the keeper.

The EWT doesn't replace existing maintenance rules. The data listed in the EWT are the minimum of data to be recorded. It is up to the Entity in Charge of Maintenance (ECM) to decide if it is necessary to record additional data.

6 The tasks of the Joint EWT bodies

The Joint EWT body consists of members nominated by the Railway Associations UIP, CER and ERFA per European country (see table) and is responsible for the issues regarding the EWT in its respective EU Member State (plus Switzerland).

The Joint EWT body will:

- organize the translation of the EWT in the national language
- issue the translated EWT documents to the keepers
- manage all information of all concerned parties (workshops, keepers,…)

The Joint EWT bodies per country:

Coun-	**La**	**UIP / Rivière**	**CER / Schachner**	**ERFA / Heiming**
France	FR	David Tillier AFWP dtillier@ermewa.fr	Lafaix SNCF ber- nard.lafaix@sncf.fr **evic.france@sncf.fr**	
Switzerland	DE, FR, IT	Olga Wisniewska VAP tech@cargorai	Bernet SBB thomas.bernet@sbbcargo.com **evic.ch@sbb.ch**	Dr. Johannes Nicolin AAE
Germany	DE	Jürgen Tuscher VPI tu- scher@vpihamburg.de **evic.germany@vpihamburg.de**	Manfred Berg- mann DB manf- red.bergmann@	Mallikat VDV
Italy	IT	Mauro Pacella ASSO- FERR Mau- ro.pacella@assoferr.it	Paolo Fusar- poli TI p.fusarpoli@trenital	D.ssa Maria Fran- cesca Ricchiuto ric-
Netherlands	N	Don van Riel	Paul Clews DB SR NL	
Poland	POL		Krzysztof Buszka PKP k.buszka@pkp- cargo.pl Miroslaw Szczelina Rail-	Dr. Ireneusz Gójski IGTL i- gojski@aster.pl
Austria	DE	Günter Heindl VPI office@vpira	Andreas Schachner ÖBB andre-	
Belgium	FR, NL	Vincent Bourgois	Maenhout SNCB etienne.maenhout@b-	Monika Heiming

Hungary	HON	Györö Czitó nagyd@pultrans.hu **evic.ungary@pultrans**	Miklos Kremer MAV kre-merm@mav.hu	
Luxembourg	FR, DE		Gaston Zens gas-ton.zens@cflcargo.lu	
United Kingdom	EN	Geoffrey Pratt geof-frey.pratt@btconnect.com	Paul Antcliff paul.antcliff@dbschenker.com	Lord Tony Berkeley tony@rfg.org.uk
Ireland	EN		Damien Lambert IrishRail damien.lambert@irishrail.ie	Lord Tony Berkeley tony@rfg.org.uk
Czech Republic	CZ	Martin Vosta sekre-tariat@sdruzeni-spv.cz	Martin Vosta sekre-tariat@sdruzeni-spv.cz	
Slovak Republic		Jaroslav Miklanek zvkv@zelos.sk	Roman Sklenar	
Latvia	LAT		Dainis Zvaners LDz dainis.zvaners@ldz.lv	
Lithuania	LIT		Kęstutis Rakauskas k.rakauskas@ litrail.lt	Edita Gerasi-moviene e.gerasimoviene
Romania	ROM	Nucu Morar nmorar@ermewa.ro	Gheorghe Avram gheorghe.avram@irsgroup.eu	Gheorghe Av-ram
Spain	E	Alfonso Ynigo Al-	Javier Fernández-Pello jfpello@renfe.es Ignacio Hernández Vallhonrat	
Sweden	SWE	Staffan Rittgard		*(Stephan Aström Steph-an.astrom@*
Slovenia	SLO		Viktor Sin-kovec vik-tor.sinkovec	
Portugal	POR		Paulo Jorge de Oliveira pjoliveira@cpcarga.pt	
Denmark	DK		Benny Spangsborg Benny.Spangsborg @dbschenker.com	

The reference is the English language version. All documents (english and translated) will also be published officially on **xxx website** (to be defined by the Joint Sector Group)

The Joint EWT body per country delivers the EWT document in the national language

The Joint EWT body per country issues the EWT document to the countries' keepers (and, for information, to the RUs)

The keepers (ordering the EWT from the workshops) hand over the documents to the executing workshops.

The executing workshop adds required national and local working rules as well as all supporting further instructions to the EWT docs on/for application on the workshop lev-el.

7 The tasks of the keeper

The keeper is responsible to collect, update and keep the data from the workshops **from 08/2010 onwards.**

From 01.01.2012 onwards the keeper has to store the data in a filterable electronic system.

The execution of the EWT must be **mandated to the contracted workshops by the keepers.**

The keeper must take over the costs for executing the EWT.

In case of a replacement according to GCU, the executing workshop has to send the **"Form H_R"** according to the GCU with the information of the wagon number and the wheelset number of the wheelset to be replaced to the keeper.

8 The tasks of the workshop

The workshop has to collect the data.
The workshop has to submit the collected data to the keeper.

Any workshop (light or heavy maintenance) which executes a wheelset change must collect the data of the group "c" and submit them the keeper.

If the workshop is a heavy maintenance workshop which executes a major maintenance / overhaul level on a wheelset, additionally the data of the group "a" and group "b" have to be collected and submitted to the keeper.

9 Data to be collected

9.1 Wheelset in general

No	Time-	Designation	Remark	category
1	a	Wheelset number		I
2	a	Wheelset design type or alternative designation		III

3	a	Previous keeper(s) (ECM)	if applicable (if the keeper has changed) Data has to be stored from the last change of the keeper onwards. Remark: Current keeper of the wheelset is the keeper of the wagon (see number 38)	I II
4	a	Certificate number and notified body from EC-declaration of conformity (TSI compliant wheelsets) Homologation number and authorising or certifying body	if available if available	I II
5	a	Maximum authorised axle load		I II
6	a	assembler of wheels (manufacturer if first assembly)	• for existing wheelsets already in service: if available • for new wheelsets: manda-	I II
7	a	Date of first assembly of wheels (month/ year)	• for existing wheelsets already in service: if available • for new wheelsets: manda-	I II
8	a	Date when wheelset is taken out of keepers' fleet		I II

9.2 Wheelset axle

No	Time-	Designation	Remark	category
9	a	Wheelset axle serial number (of	if available	II
10	a	Wheelset axle design type or alternative designation		III
11	a	Certificate number and notified body from EC-declaration of conformity (TSI compliant axles) Homologation number and authorising or certifying body (other axles)	if available if available	II
12	b	Manufacturer	• for existing wheelsets already in service: if available • for new wheelsets: mandatory	II
13	b	Manufacturing date (month/ year)	• for existing wheelsets already in service: if available • for new wheelsets: mandatory	II
14	b	Number of cast iron	• for existing wheelsets already in service: if available • for new wheelsets: mandatory	II
15	b	grade of steel (state of heat treatment)	• for existing wheelsets already in service: if available • for new wheelsets: mandatory	II
16	a	Maximum permissible axle load		II
17	b	Manufacturing standard of the axle	• for existing wheelsets already in service: if available • for new wheelsets: mandatory The manufacturing standard is directly related to the manufacturing date; (UIC; EN)	II

9.3 Wheels

No	Time-fra	Designation	Remark	cate-gory
18	A	Design type or alternative designation		III
No	**Time-fra**	**Designation**	**Remark**	**cate-gory**
1	A	Tyred wheels	Yes/ No	I
20	A	Certificate number and notified body from EC-declaration of con-formity (TSI compliant wheels) Homologation number and authoris-ing or certifying body (other wheels)	if available if available	II
21	B	Manufacturer	• for existing wheelsets already in service: if available • for new wheelsets: mandatory	II
22	B	Manufacturing date (month/ year)	• for existing wheelsets already in service: if available • for new wheelsets: mandatory	II
23	B	grade of steel (state of heat treatment)	• for existing wheelsets already in service: if available • for new wheelsets: mandatory	II
24	B	Number of cast iron	• for existing wheelsets already in service: if available • for new wheelsets: mandatory	II
25	A	Maximum authorised axle load (regarding the wheel)		II

9.4 Bearings

No	Time-fra	Designation	Remark	cate-gory
26	a	Design type of axle box or alternative designation		II
27	b	Bearing geometrical type (e.g. cylinder roller bearing, ball joint bearing etc…)		II
28	b	Original manufacturer of the bearing (component contains outer ring, cage and rollers)		II

29	b	Converter of the bearing (e.g. on synthetic cage)	If applicable	I
30	b	Date of manufacture of the bearing in clear or coded form	• for existing wheelsets already in service: if available • for new wheelsets: mandatory	I
31	b	Cage design type (e.g. material polyamide, brass with steel rivet, steel)		I
3	b	Type of grease		I

9.5 Medium and Heavy Wheelset maintenance

N o	Tim e-	Designation	Remark	cate- gory
3	a	Date of maintenance		I
3 4	a	Applicable maintenance pro- gram		I I
3	a	Maintenance level		I
3	a	Maintenance workshop / site		I
3 7	b	Last maintainer of the bearing (if different from mainte-		I
3 8	a	Date of next planed overhaul of		I

9.6 Vehicle in which the wheelset is built in

Note: not applicable for bogies with variable gauge

N o	Ti me-	Designation	Remark	cate- gory
3	c	Keeper of the wagon		I
4	c	Vehicle number		I
4 1	c	Vehicle UIC letter code (e.g.Shimmns)		I II
4	c	Vehicle class (e.g. 708)	if available	I
4 3	c	Maximal authorised axle load (regarding the vehicle)		I II
4	c	Date of wheelset mounting		I
4	c	Date of wheelset dismounting		I
4 6	c	Mileage of the wheelset respective to the period of use per vehicle if available		I II

9.7 Irregularities

Note: since applying the traceability system

N o	Ti me-	Designation	Remark	cate- gory

47	a	Irregularities	Special examinations in case of remarkable damages (e.g. derailments, overload, short- circuits via the axle-bearing, high water, broken wheels, broken axle, wagon collisions) (description of the cause, execution workshop, date)	III

10 Measures resulting from lack of traceability

1. If in a wheelset maintenance level (with axle boxes opened) one or two of the following information for an individual wheelset is/are missing:

- **manufacturer**
- **manufacturing date**
- **manufacturing standard**

the ECM has to decide according to its experience with its axle population about the measures to be applied. At minimum, the axle has to be subject to immediate NDT (only once).

If no indication at all is given, the axle must be **scrapped.**

2. If the existence of the following data for an individual wheelset cannot be proven on paper, databases, data band... (detected during the acquisition according to the European Wheelset Traceability scheme or on special request):

- **workshop of last maintenance activity**
- **date of last maintenance activity**
- **type of last maintenance activity**

then the axle has to be **subject to immediate NDT (only once).**
NDT for the axle must be performed in all cases 1. and 2. according to the relevant existing rules and after publication (in 2010) acc. to the ECCM criteria (see below).

3. The ECM/keeper has to decide according to its experience with the operational conditions of the axles if the non traceable axle has been used in accordance with its design or with high performance parameters**.**

If this is not identifiable, the **most severe** NDT conditions according to the “ECCM Continued High Performance Operation” rules must be applied in the future maintenance of the axle (see below, ECCM clause *5. special regimes*).

The above mentioned measures are communicated in advance to their publication in the ECCM which are going to be introduced in short term (2010) in the European Sector. In the step after, the measures mentioned here (and the ECCM in a whole) will be integrated in the EN 15313.

European Wheelset Traceability for freight wagon axles (EWT)

Intermediate implementation status as per 08/2011

Joint Sector Group for ERA Task Force on wagon/axle maintenance

General:

First of all, the Sector would like to state clearly that the required information for all wheelsets in freight wagons is given and ensures full traceability of each wheelset. Traceability is available by physical signs on the wheelset and by the documentation of the production and the maintenance in case of necessity. At the moment, most of the keepers have no central electronic database for traceability.

To improve and to harmonize traceability further, and to reduce the time for analyzing in case of incidents, the sector will collect the data listed in this document.

The aim of the EWT is to:

- trace wheelsets in case of incidents and to reduce the risk for further incidents due to similar reasons.
- trace in case of incidents the service conditions of a wheelset in the past and also its core item, the axle.
- trace the applied maintenance regime and which non destructive tests have been done on the wheelset.

In case wheelset defects will be detected, the keeper is able to select concerned wheelsets by the aid of EWT. This allows the keepers and NSA's to carry out appropriate measures.

European Wheelset Traceability will be integrated in the updated version of EN 15313.

Questionnaire:

• To the EWT bodies:

- EWT Implementation guide translated
- EWT Implementation guide submitted to the respective keeper

- **To the Keeper (via the EWT bodies):**
  - **Regarding European Wheelset Traceability**
    - **Start of developing an electronic database (Done or estimated time)**
    - **Electronic database developed (Done or estimated date)**
    - **Start of data acquisition (Done or estimated time)**
  - **Regarding special wheelset data**
    - **Traceable wheelsets regarding wheelset data***
    - **Traceable wheelsets regarding wagon number**

- **To the Keeper (via the EWT bodies):**
  - **Regarding European Wheelset Traceability**
  - **Regarding special wheelset data**

*** wheelset data (on paper or by database):**
wheelset number (Data Nr. 1 in EWT)
wheelset type (Data Nr. 2 in EWT)
date of last maintenance (Data Nr. 33 in EWT)
date of next maintenance (Data Nr. 38 in EWT)
workshop of last maintenance (Data Nr. 36 in EWT)

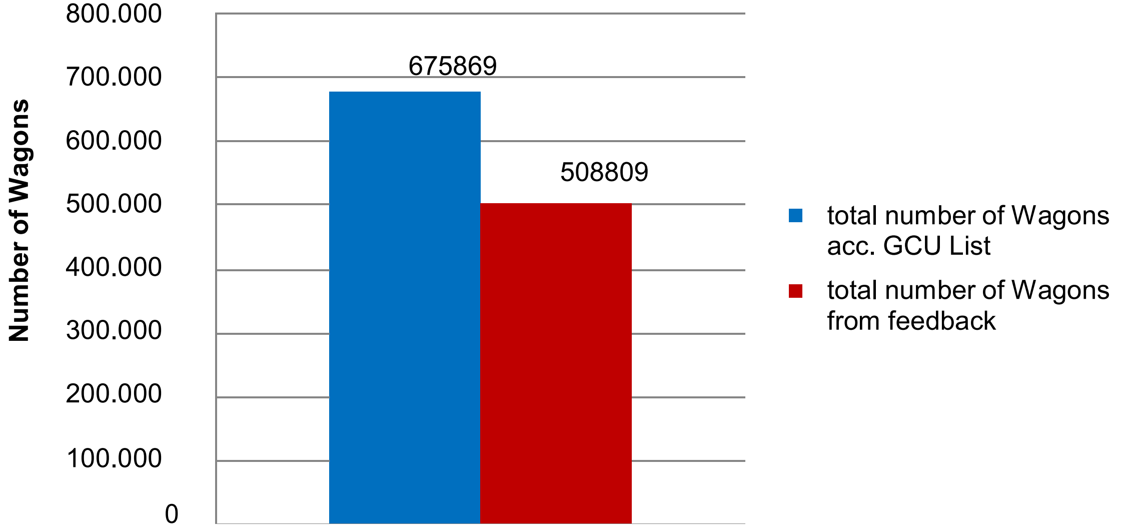
- **Questionnaire:**

Start of developing an electronic database	Electronic data-base developed	Start of data acqui-	Traceable wheel-sets reg. wheelset	Traceable wheel-sets reg. wagon

- **Feedback from the 2nd survey in total (from 105 Keeper – 66 Keeper 1st survey)**

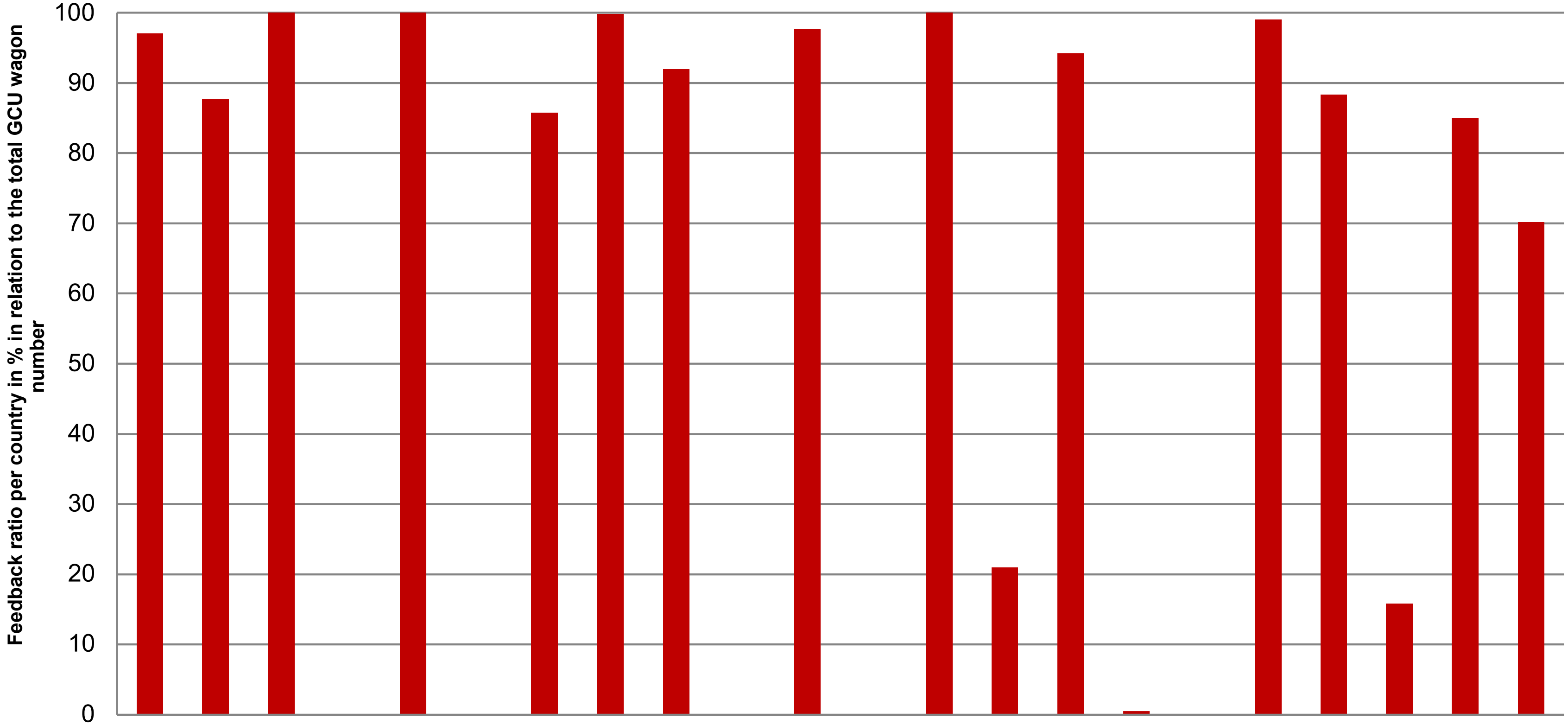
Feedback ratio in total

(Numbers based on GCU – List 01/02/2010)



* wheelset data (on paper or by data-base): wheelset number (Data Nr. 1 in EWT) wheelset type (Data Nr. 2 in EWT)
date of last maintenance (Data Nr. 33 in EWT) date of next maintenance (Data Nr. 38 in EWT) workshop of last maintenance (Data Nr. 36 in EWT)

Feedback from the 2nd survey per country in % in relation to the total GCU wagon number per country



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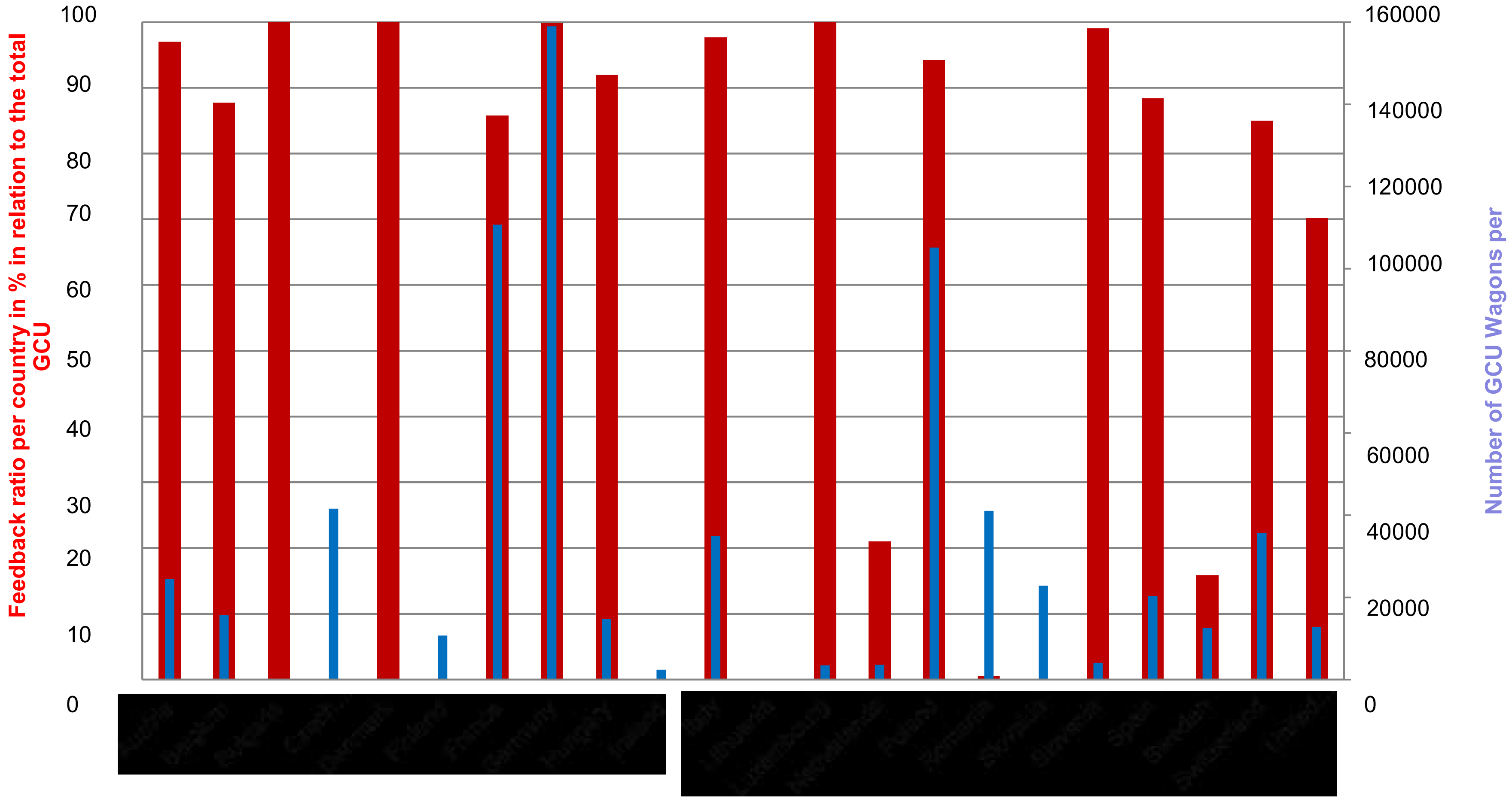
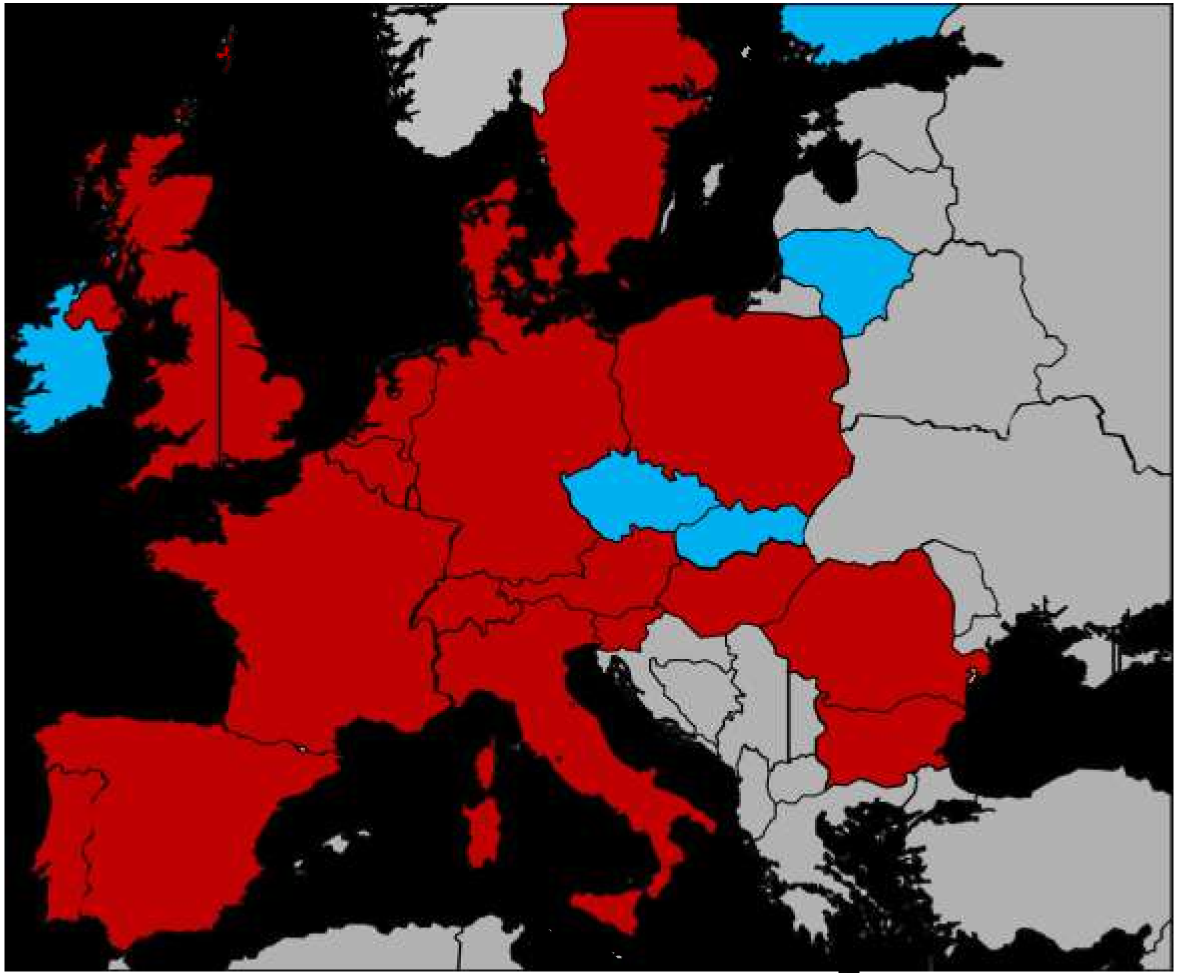
Feedback from the 2nd survey per country in % in relation to the total GCU wagon number per country and number of GCU Wagons per country

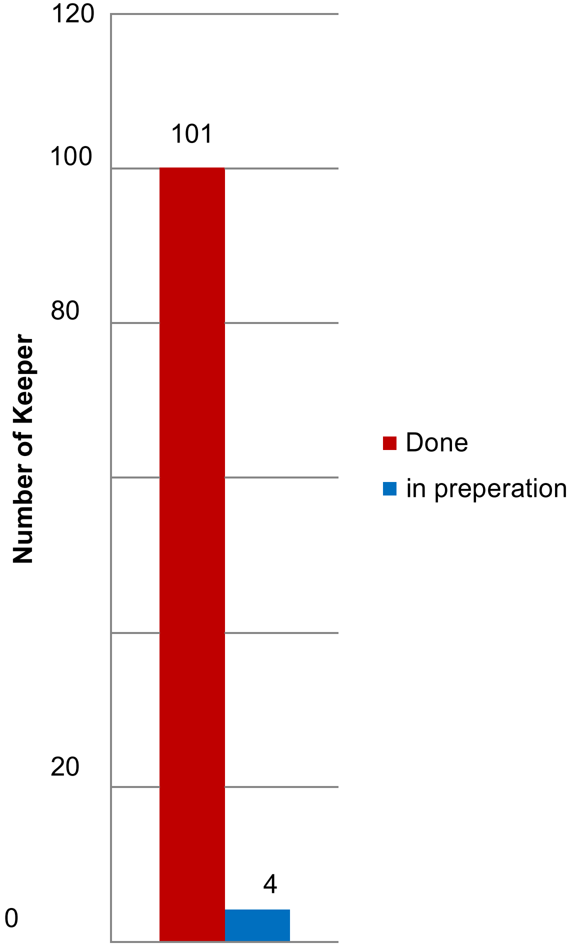


EWT participating countries (countries with feedback)

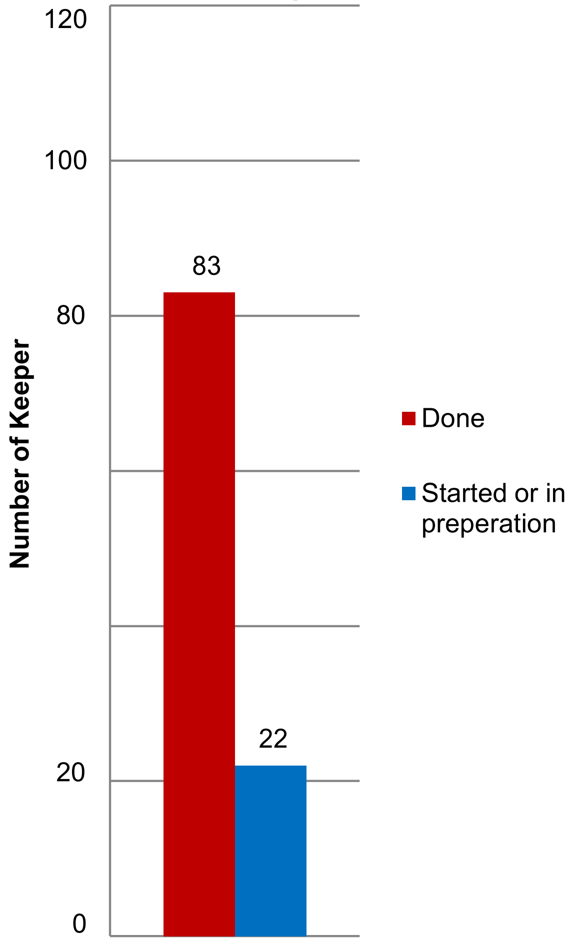
- Austria
- Belgium
- Bulgaria
- Denmark
- France
- Germany
- Hungary
- Italy
- Luxembourg
- Netherlands
- Poland
- Portugal
- Romania
- Slovenia
- Spain
- Sweden
- Switzerland
- United Kingdom



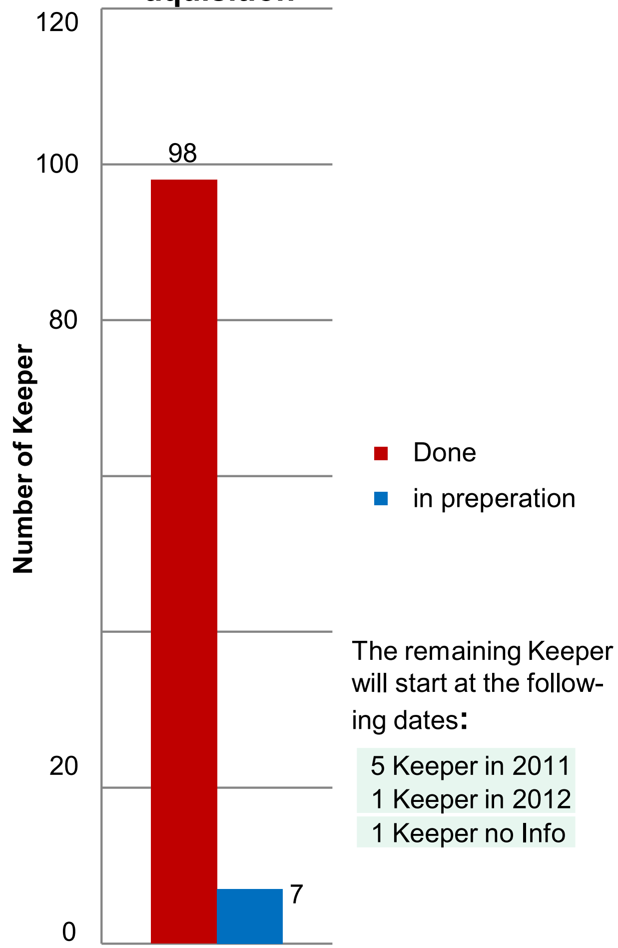
Start of developing an electronic data base



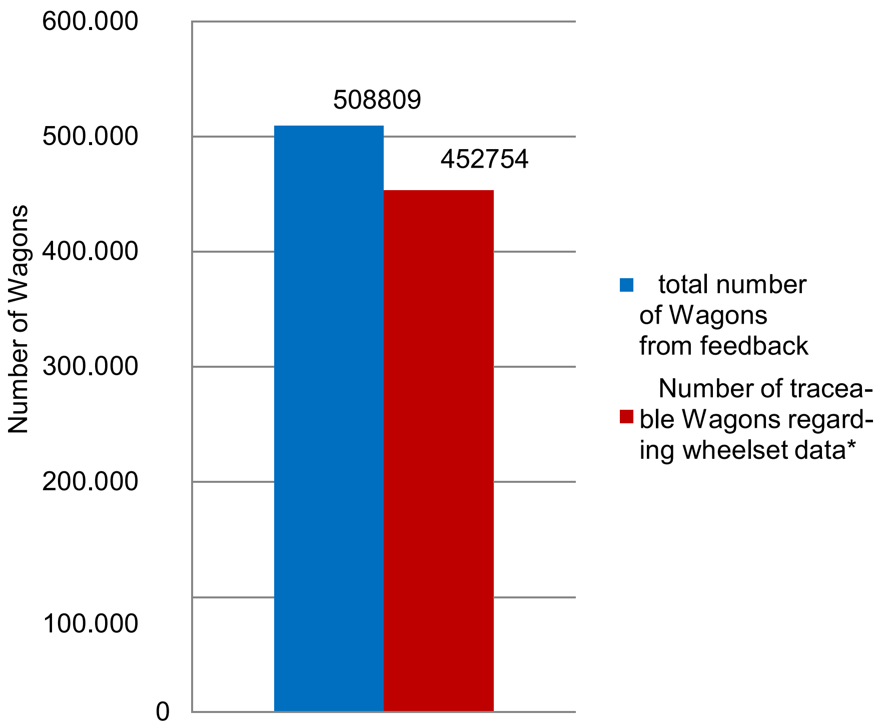
Electronic database developed



Start of data aquisition

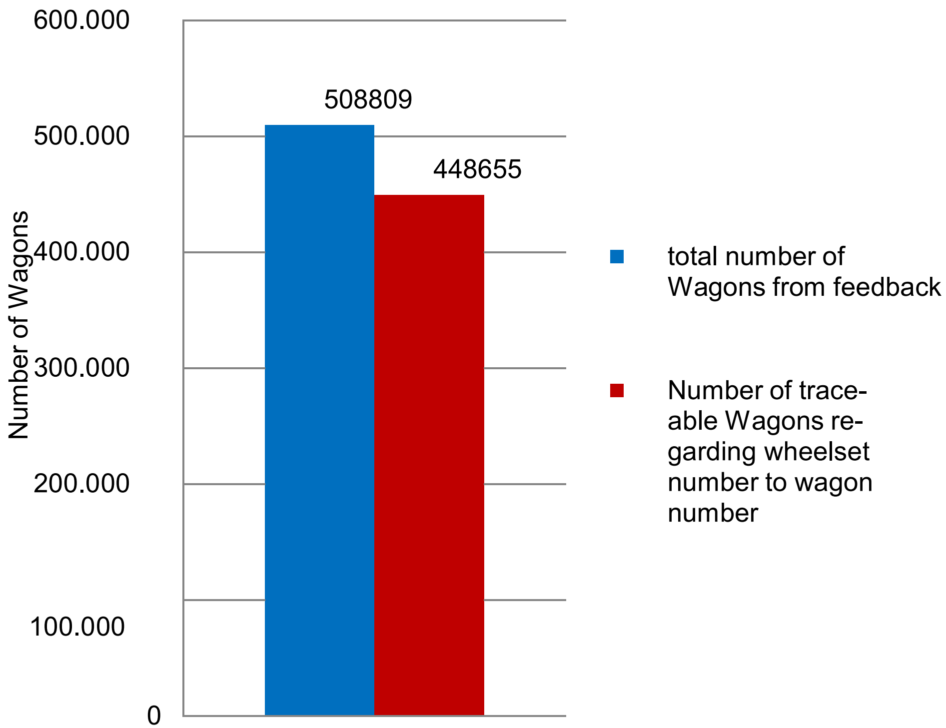


Traceable wheelsets regarding **special wheelset data***
(Numbers based on GCU – List 01/02/2010)



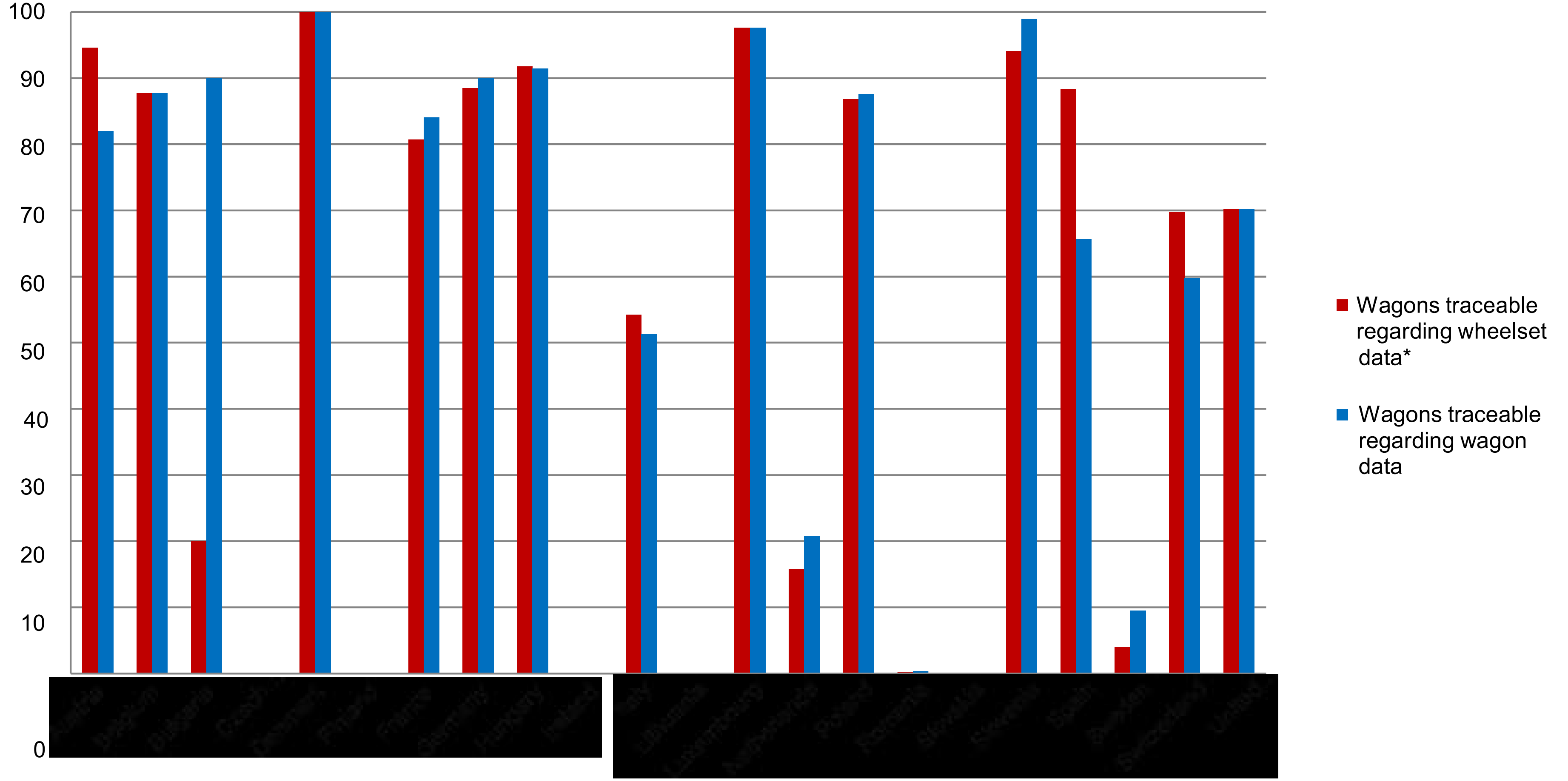
* wheelset data (on paper or by database): wheelset number (Data Nr. 1 in EWT) wheelset type (Data Nr. 2 in EWT)

Traceable wheelsets regarding **wheelset number and wagon number (Numbers based on GCU – List 01/02/2010)**

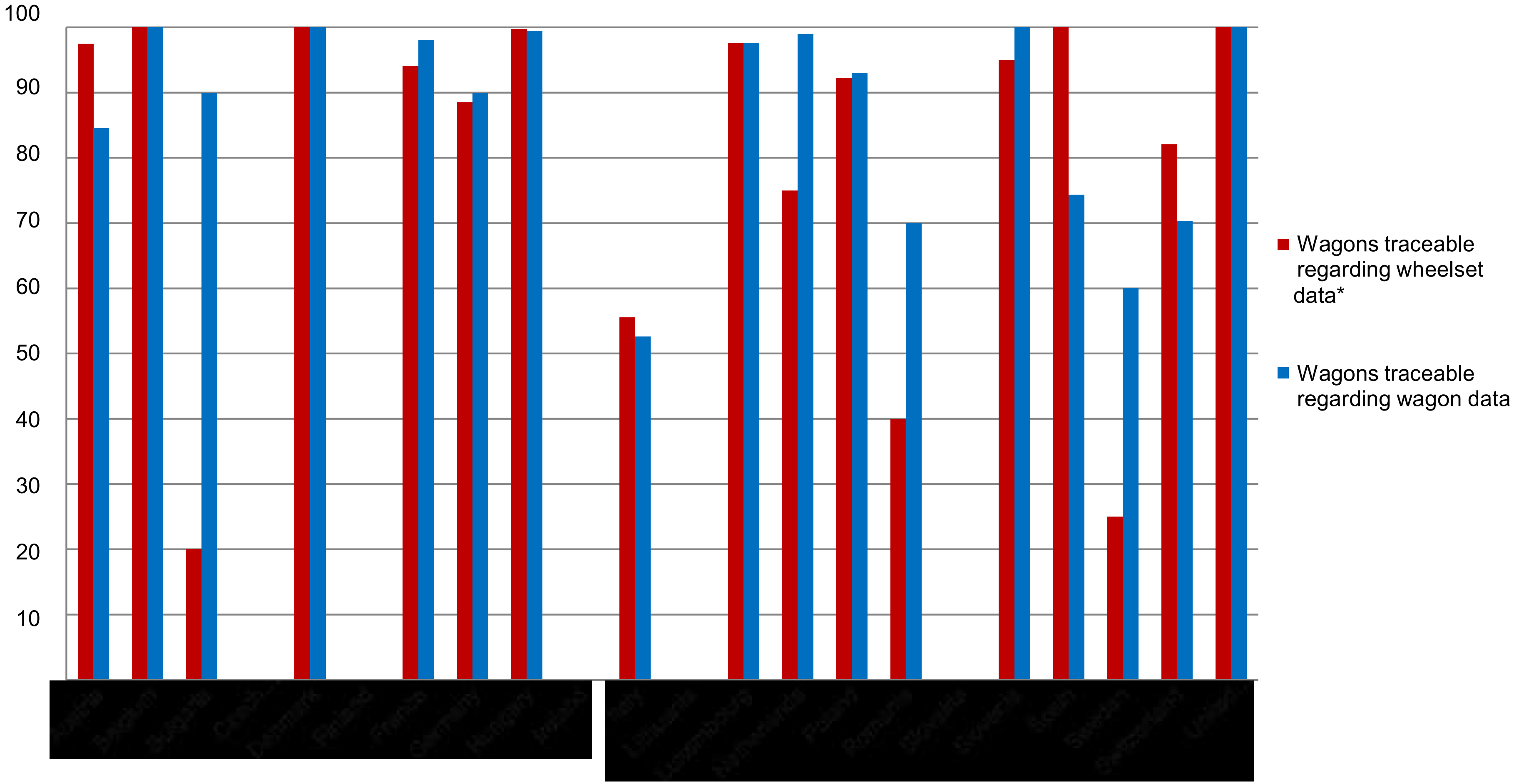


date of last maintenance (Data Nr. 33 in EWT) date of next maintenance (Data Nr. 38 in EWT) workshop of last mainte-nance (Data Nr. 36 in EWT)

Traceable Wagons reported in relation to the number of GCU wagons per country



Traceable Wagons reported in relation to the number of reported wagons per country



Conclusion:

Implementation of EWT:

– The 2nd survey on EWT Implementation status is representing approx. 75% (64% 1st survey) of GCU wagons.

– Received feedback from 105 Keeper (66 Keeper 1st survey)

– The prevailing part of this survey (96% - 89% 1st survey) has already started or finished the developing of an electronic database.

– 79% (2/3 1st survey) of the keeper of this survey has already finished the developing of an electronic database.

– 94% (94% 1st survey) of this survey have already started with the data acquisition.

Survey regarding special wheelset data:

– 89% (90% 1st survey) of the wheelsets in this survey are traceable regarding the inquired wheelset data

– 88% (88% 1st survey) of the wheelsets in this survey are traceable regarding the wagon number