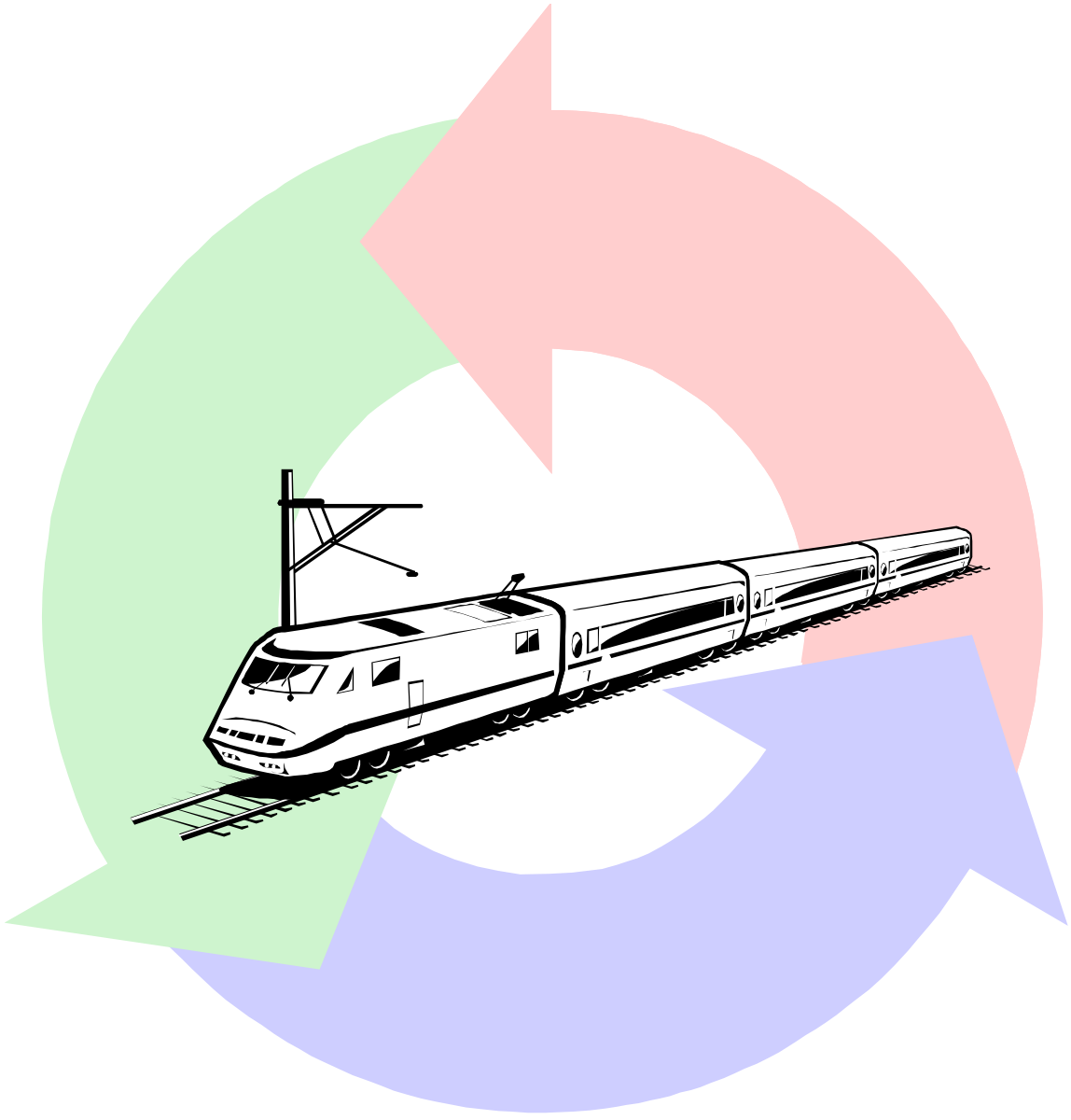
Nordic Environmental Manual



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Approval, application and distribution of this manual

Approval

This manual is approved by the Directors of the rolling stock Departments of the Community of Nordic Railways on November 10th 1999 in Stockholm.

Application

This manual shall be used as a reference to any specification on the environmental impact of railway rolling stock acquisitions to the Nordic Railways: VR in Finland, NSB in Norway, SJ in Sweden, and DSB in Denmark. It is implented by each company as described in section 5.3.

Distribution

This report version 1.0 is free for distribution and use to any party on request, on condition that the four Nordic railway operators are clearly referred to as authors. Any comments, ideas, and questions to this Manual should be reported to any of the working group members (5.1 Organization).

1. Introduction

1.1 Scope

The Nordic railway operators are all in a position, where the society requires more efficient transportation with less cost. This has to be performed in an extremely competitive environment on the passenger side as well as in the freight business. The competitors are private cars, air traffic, buses, truck transport and transport by sea. The IT companies also claim that they can substitute a lot of the travelling with IT-technology, telephone calls, video conferences etc.

In the Nordic countries there is a wide understanding of a main advantage of public rail transportation: The environmental performance is in general the far best. Other important aspects include a low rate of accidents, fast and efficient travelling time etc. The passengers' and freight customers' environmental requirements are increasing, which together with directives from authorities will be a major market driving force for the railway companies.

By setting new environmental standards for rolling stock, the Nordic railways will not only face the other transportation competitors but also take a responsibility in society.

In order to keep up the high level of environmental performance, the Nordic railways have decided – as part of their environmental policies – to make a joint guideline regarding environmental requirements for rolling stock. The scope of this standard for specifications has three targets:

1. To fulfil the national laws and regulations of the Nordic countries concerning the protection of the environment, as well as the EU Directives and other international conventions on the matters concerned

2. To set new environmental standards for rolling stock

3. To get into a dialogue with suppliers

This manual is considered one of the practical tools in the Nordic contributions towards "Sustainable Mobility" in the railway sector.

1.2 Target group

This manual is aimed at the user groups within the railways, as these most often are the way to gather all internal forces involved in the purchasing of new rolling stock in a company. The user groups specify the performance requirements before the invitation to tender. The actual purchasers of refurbishment or new rolling stock have different requirements for each invitation to tender – depending on requirements regarding function, train types, sections, passengers etc.

This manual helps these user groups to choose the level of environmental performance of the future train, and it should be an instrument to:

- Comply with environmental requirements from the railway administrators

- Guide the relevant departments towards more environmentally adapted specifications

- Help the boards of the companies to strengthen their environmental profile

- Enable suppliers to foresee upcoming environmental requirements.

The recommendations in the manual are meant to be applicable regardless of the type of ownership (leasing etc.). They should also enable comparing the environmental performance of using existing (e.g. hired) or new rolling stock. This, however, is generally not easy, and may not produce conclusive results, see below.

1.3 Manual outline

1.3.1 Definitions used in the manual

Rolling stock: Common description for all types of rail vehicles for passengers, freight or assistance, incl. shunting locomotives etc.

Train: A complete set of vehicles coupled together, either a train set (motor coaches) or a loco-hauled mix of wagons for passengers and/or freight.

LCA: Life Cycle Assessment with regards to environmental impacts.

1.3.2 Environmental Key areas

This manual states the environmental requirements and recommendations, which have been divided into five different key areas, one general and four specific:

- General requirements, see section 3. This includes environmental policy, LCA methods etc.
- Energy consumption, see section 4.1, including exhaust emissions and energy sources.
- Noise, vibrations and electromagnetic fields, see section 4.2.
- Restricted materials, see section 4.3. Materials with restrictions in application are listed here.
- Resource management, see section 4.4, covering production, maintenance, recycling and waste.

These areas concern all parts of the rolling stock (train sets, locomotives, passenger and freight wagons) described in table A. The purpose of this matrix is to show, that some environmental developments are not without consequences in other aspects. Often an optimum compromise has to be found between contradicting requirement and wishes, e.g. between energy consumption in traffic and the use of recyclable (heavier) materials. The matrix provides:

1: An overview of the most important sources of environmental impact (the black spots), where they come from and which problems they cause.

2: A rough guideline on how some sources of environmental impact interact. If a “black spot” is analyzed (for potential improvements), other “high” or “medium” spots on the same line should be taken into consideration, since their contribution may be influenced.

It should be noted that the impact stated in the matrix to some extent depends on the train type and system solutions, so it should not be seen as “absolute”. The impact stated is mainly based on the general experience gathered in the involved companies, not on measurable parameters.

Analyzing and comparing different environmental impacts in figures is often not possible. However, some assistance may be found in LCA computer software on the market, if it is correctly adapted to the actual situation. The quality of such software is varying, and the uncertainty in the calculations has to be compared with the resulting figures.

Table A, Matrix of Environmental Key Areas

Rolling stock code system: (based on CEN structure)	Energy consumption incl. emissions during operation chapter 4.1	Noise, vibrations and electromagnetic fields chapter 4.2	Restricted materials chapter 4.3	Resource Management chapter 4.4
Carbody and frame, incl. exterior doors, gangways and body additions				
Bogies and other running gear, incl. wheels, suspension, traction link				
Power supply, incl. engine and fuel systems, alternator, high voltage eq.				
Propulsion system, incl. power conditioning and conversion, drive system				
Auxiliary systems, incl. air supply, hydraulics, battery system				
Brakes, incl. parking-, service- and emergency brake systems				
Interior, incl. air-conditioning, interior doors, toilets, catering, info-systems				
Control and communication, incl. train radio, vehicle control, data comm.				
Special equipment, incl. tilt systems				

Classification of specific requirements		Low impact
		Medium impact
		High impact

2. Selection criteria

This chapter gives an introduction to the manual, describing the composition of the requirements in the next chapters. It also sets up preferences for the selection of environmental performance to be made by the user groups.

2.1 Selection of optional or minimum requirements

This manual consists of two main parts: The general and the specific requirements.

Chapter 3 - the general part - consists of topics related to the suppliers' own production and the future rolling stock in general.

Chapter 4 deals with the specific requirements related to parts and subsystems within the rolling stock. Each topic is described with plain text followed by a table divided into two types of requirements:

- Minimum requirements covering the level that the railways have agreed upon as the basic standard. These requirements are made in such a way that national exceptions should not be necessary. Also the level is chosen to make possible long-term decisions regarding environmental matters, without getting caught by near future regulations.

- Optional requirements covering a higher level of environmental performance than above. These requirements are made in order to set a better environmental standard for rolling stock and to point out which direction the companies will follow in the future.

2.2 Preferences

An invitation to tender should comply with the minimum requirements. The user groups are encouraged to make them selves acquainted with this manual and to decide whether optional or minimum requirements should be used. The actual choices depend on several issues (non-prioritized):

- Environmental policy

- Design policy

- Customer expectations

- Economy

- National policy (energy sources, restrictions etc.)

The decisions should be based also on a "holistic" approach, where no issues are "left out by accident", but weighted in accordance with the latest specialist knowledge and experience. Environmental specialists from a relevant company should be contacted if any question occurs on topics not dealt with in the manual, or not understood.

2.3 The process

It is important to stress that environmental requirements for an invitation to tender is only one step in a long process, which includes:

- Adjusting general environmental requirements to a specific invitation to tender
- Environmental evaluation of the tenders
- Co-operation with the chosen supplier(s)
- Co-operation between technical and environmental specialists and the user group(s)
- Evaluation of environmental performance - also after delivery of the rolling stock

The best way to secure a major environmental influence on the decisions regarding the new rolling stock is for the environmental managers to be a part of the steering committee and/or for the environmental specialists to be a part of matching user- or working groups. The process must be organized individually according to the company's organization and the tender. It is also important to have a long-term strategy for environmental education of employees working in user groups.

3. General requirements

3.1 Environmental Policy and Management System

As a minimum, the supplier shall fulfil legal requirements, have a board approved environmental policy, and work seriously with environmental topics within the firm.

Optionally, the supplier should have an Environmental Management System (EMS) e.g. ISO 14001, EMAS or an equivalent system to show a systematic effort to reduce the environmental impacts from the production.

3.2 LCA of the rolling stock

The purpose of applying the Life Cycle Assessment method is to enable all the important aspects to be evaluated. When focusing on the total environmental load from the train e.g. maintenance and energy consumption during operation are of major importance. The LCA method basically means “Assessment from cradle to grave”.

The supplier should deliver an LCA on the environmental load of the rolling stock for which a tender has been submitted. The LCA must be as accurate as possible at the time of the tender and in accordance with ISO 14040. The evaluation criteria are not fully developed yet, and may to some extent depend on national differences, for instance regarding production of electricity.

The supplier shall at least submit data for a preliminary LCA when appropriate. This should be in accordance with ISO 14040 and as specified in each invitation to tender.

3.3 Life cycle responsibility

The supplier shall specify procedures for appropriate environmental adapted reuse and scrapping after the operation phase. This means e.g. submitting a reuse- and scrap manual together with the train. The reuse- and scrap procedures shall be an integrated part of the maintenance system, and shall state how to treat all parts in the train when the use of the train or the part is finished. The specific requirements for such a reuse- and scrap manual are mentioned in chapter 4.4 - Resource management.

3.4 Fire, safety and accidents conditions

Fire requirements are regulated in different international standards. The environmental impact related to fire and accidents may be severe but are very difficult to predict because of varying local conditions (oxygen content, nearby installations, leaking chemicals etc.). Fire prevention regarding the choice of materials is made according to relevant safety standards. The future European fire and safety standard will be EN 45545.

Also other types of accidents may have impact on the environment, and the supplier shall submit documentation for possible environmental consequences of normally occurring accidents, preferably in the form of a safety report. An example is a possible leakage of hazardous substances during shunting derailments.

3.5 Documentation and verification

Each type of environmental requirements in this manual shall be thoroughly documented and possible to verify. This means that the environmental data shall be supplied according to the documentation and verification standard for the actual invitation to tender.

The documentation and verification of environmental data shall cover the test methods, the material specifications (recyclability, origin, etc.), LCA data, disassembly and scrapping procedures, etc. The documentation could be an integrated part of the Environmental Management System. The documentation and verification shall include environmental milestones and parts hereof throughout the project phase (“order phase”).

4. Specific requirements

Traditionally the environmental effort is concentrated on three major topics: Energy consumption and emissions, noise, and materials with harmful side effects. This chapter deals more detailed and up-to-date with these issues, and is divided into four categories (4.1 - 4.4) as described in table A (chapter 1.3). All parts of the rolling stock shall be assessed from all these aspects.

4.1 Energy consumption

A fundamental goal is to minimize energy consumption and losses, to make practical use of the largest possible percentage of the consumed energy. Another goal is to minimize the environmental impact of the energy transformation.

Basically the train should be designed for top speeds that are actually usable, and the performance specifications should be analyzed from the expected driving pattern (timetable). In this way the energy consumption can be minimized for a given journey time.

Other important aspects dealt with below are: Weight of the train, recovering brake energy, aero-dynamics, optimizing capacity and insulation of coaches. Also included are exhaust emissions and energy sources.

Energy consumption in traffic:	*Requirements*	*References/comments*
Minimum	The tender shall include detailed specifications of the energy consumption in predefined traffic (simulation), in order to enable a realistic evaluation. It shall be possible to measure and verify the energy consumption between predefined points.	
Optional	The train should be supplied with a system for energy-optimized driving (acceleration, braking and - if possible - according to signalling).	

Consumption at longer standstills:	*Requirements*	*References/comments*
Minimum	The energy consumption at longer standstills shall be as low as possible, and shall be specified totally and for each auxiliary system.	
Optional	It should be possible to switch off the engine in order to heat the driver’s cabin and the motor etc. in other ways. It should be easy to put the train in a low power mode or possible to engage an automatic switch off/on after predefined times. Remote control should be considered.	

4.1.1 Exhaust gas emissions

The exhaust gas emissions should be as limited as possible. The requirements shall specify permitted emissions from diesel engines. Today the most applicable norm for emissions is the EURO norm tailored for engines in the lighter transport sector, and applied widely on trucks, buses etc.

These specifications do not automatically apply, as the engine ages. The most realistic way of checking the emissions over the years of operation will probably be to apply continuous measuring devices, which presently undergo a rapid development.

It should be noted that the EURO norm is continuously being "upgraded". At the moment (1999) the EURO II values apply. Implementation date for EURO III is October 2000. The relevant requirement for the EURO norm is the latest edition available at the delivery of the first train of the series. See also table T.3.

	Requirements	*References/comments*
Minimum	In general the diesel engine shall be tested according to ISO 8178, cycle F, but there is at the moment no emission limits appropriate for this cycle*. For train sets with mechanical traction the emissions shall not exceed the emission limits for cycle A of the existing EURO norm at the date of delivery. Exhaust gases shall be emitted from exhaust pipes at the top of the roof	*A working group under UIC is at the moment trying to find an appropriate test cycle and emission limits for train engines. The results from this work shall be taken into consideration. Low NO_x values can lead to higher fuel consumption.
Optional	Diesel engines should in general be tested according to ISO 8178, cycle F. Emissions should not exceed the emission limits in the latest EURO norm at the date of delivery. Catalytic converters (e.g. Re NO_x), particle filters, or similar after-treatment should be applied if appropriate. The train should be fitted with, or prepared for measuring devices for relevant exhaust emissions.	

4.1.2 Energy sources

The environmental impact from an electric train depends mainly on how the electricity is produced. When electricity is made using environmentally friendly energy sources, the electric train generally has a lower environmental impact.

In order for the railways to keep their environmental competitive advantage - and even increase it - they need to follow the development of engines and energy sources closely and encourage the producers of trains to do the same.

	Requirements	*References/comments*
Minimum	The diesel engine shall be able to use fuel with low content of sulphur (sulphur content < 0,005 %)	
Optional	Environmentally adapted energy sources should be considered for the driving energy and subsystems, e.g. fuel cells, biomass, calculated by LCA. The diesel engine shall be able to use fuel with very low content of sulphur (sulphur content < 0,001 %)	

4.1.3 Reduction of mass

For many types of trains, reduction in mass of the rolling stock is a major way of reducing energy consumption. For passenger trains in frequent stop/start traffic (urban and regional trains) the weight of the train is generally the most important parameter regarding energy consumption. For freight traffic the influence is much smaller.

When reducing mass, it is important not to compromise crash safety and stability. It is not only a question of reducing the mass in the car body - all items contributing with significant dead weight need to be optimized (weight/function/LCC), since this will lead to further weight savings on lighter power/propulsion systems and supporting structure. Therefore lighter interiors (wall panels, insulation, seats and toilet systems) are very important.

A reduction in mass also means less vibration to the environment.

	Requirements	*References/comments*
Minimum	Passenger trains shall be built as light as practically possible. Where appropriate, the supplier shall take into account the items shown in the table T.4. The supplier shall calculate and periodically revise a weight budget in the building phase in order to meet the contractual weight.	
Optional	The tender for passenger trains should describe optional measures to reduce weight, in order to enable further investigation.	

4.1.4 Aerodynamics

The importance of aerodynamics is highly dependent on the cruising speed. From approximately 100 km/h the influence is significant, while from approximately 200 km/h the aerodynamics become a critical factor. Therefore the design requirements shall reflect the actual top speed.

Aerodynamic drag and aerodynamic noise are closely related in high speed traffic, therefore actions made to reduce aerodynamic drag will most often decrease aerodynamic noise as well.

A figure for the drag coefficient can normally be estimated only roughly, and is largely dependent on the train length. Therefore the requirements are “qualitative”.

	Requirements	*References/comments*
Minimum	The vehicle shall be optimized for low aerodynamic resistance. The supplier shall take into account the items shown in the table T.5.	
Optional		

4.1.5 Capacity optimizing

In capacity optimizing there is another potential to lower the energy consumption per passenger or per ton. However, there is often a compromise between passenger comfort and capacity optimizing. Capacity optimizing can be divided into three parts:

- Obtaining the largest possible furnishable area of the vehicle’s total area. This can be achieved e.g. by the use of ”distributed power” train sets, double-deckers or wide trains.

- Using the furnishable area as optimally as possible e.g. by fitting as many comfortable seats as possible in a given area.

- Optimizing the train size to expected variations in traffic demand by using a flexible composition of trains, e.g. smaller units that can be coupled and uncoupled quickly.

Intelligent placing of technical equipment can leave more space for passengers. Building wider car bodies or double-deckers makes it possible to put in more seats per train length, generally reducing the total mass per seat and the corresponding energy consumption.

	Requirements	*References/comments*
Minimum	The capacity shall be optimized in passenger coaches and freight wagons.	Measured for passenger trains as seats per length of train. Measured for freight wagons by net weight / wagon weight.
Optional		

4.1.6 Recover braking energy

Regenerative brakes or electrical brakes save energy and produce less braking dust and noise than mechanical brakes. A regenerative brake is standard on most electric trains today, and is generally capable of handling most of the braking effort on passenger trains.

How much energy the train regenerates is highly dependent on type of train and voltage system, relative number of driven axles, type of traffic and topography. Electric train sets with distributed power (many driving axles) are generally best in this respect.

	Requirements	*References/comments*
Minimum	The electric train shall regenerate maximum energy under the actual circumstances (voltage, traffic etc.) The amount of regenerated energy for a given case shall be calculated together with the energy consumption during driving.	Different scenarios should be calculated in order to determine the relation between driving pattern and energy consumption.
Optional	Regenerative possibilities should be considered for diesel trains	

4.1.7 Insulation of car body

The insulation standard required depends on the climate. Two ways of minimizing heat losses are:

1) Reducing door opening time, e.g. by automatic closing after a certain time without anyone passing

2) Optimizing heating and ventilating systems, e.g. by extensive re-circulation of air or automatic adjustment according to the number of passengers (load).

	Requirements	*References/comments*
Minimum	K value shall be < 1,1 W/ (m^2K) for a stationary train or < 2,0 W/(m^2K) at 120 km/h. Relevant temperature conditions shall be taken into consideration. Cold bridges shall be avoided. Heating and ventilation shall be optimized (low losses)	A compromise between the energy consumption caused by the weight and heating/cooling of the train.
Optional	Entrance doors should close automatically at platforms when they are not being used. Air exchange rate for ventilation systems should be automatically adjusted according to payload.	

4.2 Noise, vibrations and electromagnetic fields

This chapter deals with three kinds of waves:

- External and internal noise (airborne pressure waves)
- Vibrations (soil borne pressure waves)
- Electromagnetic fields

4.2.1 External noise

The emission of noise from railway operation is affecting the travelers, the railway personnel and the environment, for instance nearby residents. External noise is generally restricted according to national legislation, which shall be observed in the project. Speed restrictions or similar limitations may be enforced, where noise limits cannot be met by the rolling stock.

Measures to reduce airborne or direct noise should be studied and incorporated into the rolling stock as early as possible. These measures should preferably focus on the noise sources themselves or nearby components. The primary noise sources are the wheel-rail contact, the brakes and the engines, electric motors, gears, cooling fans and aerodynamics. The wheel-rail contact can be divided into noise emitted by the wheel, which can be reduced by damped wheels, and noise emitted by the rail, which is not possible to reduce when designing the rolling stock.

An important point is to keep the wheels in good condition during maintenance. Recent development enables the conditions of the wheels to be monitored by a sound-measuring device at trackside combined with a vehicle identification system.

The external noise optional values in Table T.1 generally require a dedicated approach towards noise reduction, such as damped wheels, disc brakes, silent cooling fans and gears etc. Apart from these values additional requirements should be anticipated for standstill and parking noise according to local conditions and regulations.

Polymer brake pads enable a certain noise reduction. However, such pads need to be investigated carefully, in order to avoid any harmful substances from being spread to the environment. Future requirements for use of polymer brake pads are dealt with in the UIC.

	Requirements	*References/comments*
Minimum	The external noise shall not exceed the minimum values shown in the table T.1.	Measured at 25-m distance according to ISO 3095 or CEN/TC 256 N 165 E (Draft). Warning devices must comply with the specifications given in UIC -leaflet 644.
Optional	The external noise should not exceed the optional values shown in the table T.1.	

4.2.2 Internal noise

The noise inside the vehicle is mainly a comfort factor. Nordic railways do not have minimum requirements (maximum values) concerning internal noise, but it shall generally be possible for passengers and staff to speak normally without raising their voices.

The requirements specified as optional in the table T.2 can be finally specified in a contract, but the potential weight increase from extra insulation should be assessed.

	Requirements	*References/comments*
Minimum		
Optional	The internal noise should not exceed the values shown in the table T.2.	Measured according to ISO 3381 or CEN/TC 256 N 166 E (Draft)

4.2.3 Vibrations

Vibrations in the ground are created as an interaction between the rolling stock and the actual track, which is difficult to quantify in rolling stock requirements. The most serious vibrations appear when heavy freight trains run on soil with a high percentage of clay. There are no straightforward connections between types of buildings, geo-technical circumstances, as well as the design and the speed of the trains.

However, the level of vibrations is dependent on the mass of the trains and their speed. Lower weight, axle load and inelastic mass (wheels, axles etc.) reduce vibrations to the environment. A European standard for external vibrations is being prepared at the moment.

4.2.4 Electromagnetic fields

During recent years the existence of electromagnetic fields from both catenary wires traction vehicles have caused a widespread discussion, and there is extensive research going on in this field.

The electromagnetic fields that staff and passengers are exposed to, shall within reasonable costs be as low as possible. This means that the field density generated by the vehicle should be lower than that from the catenary system.

	Requirements	*References/comments*
Minimum	Electromagnetic fields shall meet the requirements in ENV50166 part 1+2.	
Optional		

4.3 Restricted materials in vehicles

The following internationally adopted principles should guide the choice of materials:

- the precautionary principle
- best available technology
- the demand for knowledge
- the principle of economizing and recycling

The supplier shall at development and manufacturing of the vehicles take these principles into consideration and shall during the development document all doubtful material choices and inform the customer for approval.

4.3.1 Material declaration

General	*Requirements*	*References/comments*
Minimum	The supplier shall document and inform the customer about all materials with targets on limitation or restrictions in application. The documentation shall include the reason for the choice, the application, available alternatives and amount of the material. The customer shall examine, assess and approve or prohibit it.	See 4.3.2 and table T.6.
Optional	The supplier should provide a complete list of type and amount of materials used, divided into separate systems.	

Air quality in passenger and crew areas

	Requirements	*References/comments*
Minimum		
Optional	Describe the air quality in an empty rolling stock compared with EU-recommended background max. level for living areas (NO2,PM10,VOC)	

4.3.2 Materials with targets on limitations

For the selected substances in the list below there are international agreements for targets on limitations adopted within the Helsinki Commission, North Sea Conference and/or Oslo/Paris Commission.

It is also known that these substances exist in vehicles. The limitation principle may apply to either the extent a material is used, or the application. For instance, copper can be used in electrical installations, but not in brake pads because of the spreading problem.

This list is not complete – every material choice has to be environmentally evaluated. A more detailed list of restricted materials can be found in table T.6. These substances are either totally forbidden by law, or considered especially undesired (specific approval necessary in each case).

Internationally regulated materials and substances:
- Arsenic and its compounds
- Cadmium and its compounds
- Chromium and its compounds
- Copper and its compounds
- Lead and its compounds
- Mercury and its compounds
- Nickel and its compounds
- Zinc and its compounds

Halogenated organic compounds in general (chlorinated, brominated and fluorinated) is a group of environmentally critical substances, which require special attention. The same applies for rare wood species, tropical hardwoods etc.

	Requirements	*References/comments*
Minimum	Materials mentioned in T.6 shall be avoided in the train.	
Optional		Additional material lists from authorities may be used in an invitation to tender.

4.4 Resource management

Careful resource management is a key issue to minimize resource depletion and consequently attain a low environmental impact in this respect. In this context resources are natural resources (air, water, land, plants, fossil fuels, minerals etc.). Resource management aims at minimizing waste production and the content of hazardous or other unwanted substances in the waste. Resource management is also used to accomplish reuse, recycling, productive combustion of waste and an environmentally satisfactory handling of the final deposit.

The resource management concerns the entire process from "cradle to grave" - from the production of raw materials via manufacturing, use and maintenance of the rolling stock to the final scrapping and renewed use of the natural resources.

Dismantling and changing parts:	*Requirements*	*References/comments*
Minimum	Parts shall be easy to separate and change individually if damaged or for maintenance. The size of such wear parts must be adapted to avoid unnecessary material consumption and waste generation.	
Optional	The supplier has the end-of-life responsibility for the rolling stock material.	

4.4.1 Recycled and renewable materials in production phase

Recycling and reuse	*Requirements*	*References/comments*
Minimum	Documented satisfactory material characteristics for any recycled or reused materials. The tenderer shall state percentage of recycled material for the main components or materials as specified in the invitation to tender.	The demands are made concerning non-renewable resources on Earth and the energy consumption. The aim is to maximize the use of recycled and reused materials
Optional	The share of recycled or reused material shall fulfil the percentages stated in the invitation to tender for the main materials or components, e.g. Al, Fe, Cu, Zn, plastics, glass etc. Specified re-used parts in the rolling stock.	

Renewable materials	*Requirements*	*References/comments*
Minimum	The tender shall state the use (%) of renewable materials in interior components concerning wood, textiles (cotton and wool) etc.	The aim is to maximize the use of renewable materials in the interior (floors, walls, ceiling, lighting, seats etc.)
Optional	Specified use of renewable materials (wood, plant fibre, wool and cotton etc.)	

4.4.2 Materials recyclable after use

	Requirements	*References/comments*
Minimum	The tender shall include a high-quality scrap manual including the % weight for potential re-use, recycling, combustion and final deposit for each type of material. The manual shall describe the dismantling procedures.	Concerning maintenance and the final phase. Environmental standards shall be from when the tender is sent.
Optional	The supplier should have the overall EOL (end of life) responsibility for the train. This means taking back the train for reuse, recycling, dismantling or environmental proper disposal according to the same concept provided by law for cars, where applicable.	

4.4.3 Interior and exterior design

The exterior design is normally made up of painting, foiling and glued glass blinds. The aim is to make the train more attractive to passengers, being adapted also for easy maintenance, cleaning etc. Carbon steel and aluminum needs painting as a protection against corrosion, which is not necessary for stainless steel.

Depending on the type, painting causes environmental impact at application, maintenance, graffiti removal, repairs, removal and recycling. Therefore the painting should be minimized on stainless steel, solvent content should be minimized; water-borne paints should be used as much as possible.

Glass blinds may increase the weight, which means higher energy consumption.

Design is an area, where environmental requirements can be difficult to handle, because aesthetic values cannot be assessed with scientifically measurable parameters. The following table is a way to point out that every design solution has some environmental consequences, which have to be investigated in order to make the best possible decision.

Internal design:	*Requirements*	*References/comments*
Minimum	The rolling stock material shall be designed in order to facilitate easy cleaning and maintenance with environment friendly substances. This means taking care in the design of e.g. chair legs, rounded corners, material surfaces etc. Inseparable blending of materials shall be avoided in interior fittings and components.	
Optional	The trains should be constructed for redesign, i.e. the interior (fittings etc.) should be easy to replace.	

4.4.4 Waste management in passenger trains

Waste management is a comprehensive issue. There are two arguments for managing the waste in an environmentally friendly way:

- The amount of waste newspapers, food and bottles can be high. The taxes of handling not sorted waste are expected to increase considerably.

- The level of waste management is one of the most important signals to the customer. It gives the first impression of the environmental standard in the company. The waste management in the households is improving and gives an incentive to improve waste management in the passenger trains.

	Requirements	*References/comments*
Minimum	Each passenger coach shall have waste units separated for three fractions (e.g. paper, glass/plastic and the remaining waste) or be prepared for this, if the buyer does not want it installed.	The size of the fractions will depend on the types of trains and the possibilities of buying food.
Optional	Each passenger coach should have flexible waste units for handling up to six waste fractions.	

5. Manual revision

This manual is the work of a Nordic working group pointed out by the four Nordic Environmental Managers in Lillehammer, October 1997 and approved by the technical and environmental managers September 1999. Furthermore the Manual is approved by the Directors of the rolling stock Departments of the Community of Nordic Railways on November 10th 1999 in Stockholm.

5.1 Organization

This part describes the organization to take care of future revisions of this manual.

Each company appoints a person from the environmental and technical department to be responsible for the manual. It is the job of this person to stay in contact with the other companies and participate in the co-ordination of the work including the name of a possible successor. When it is time for a revision the person responsible shall inform the relevant colleagues to participate in a status meeting.

The overall responsibility for this version 1.0 is DSB. After this revision (version 1.0) the responsibility moves to SJ. Organization at present (November 1999):

Company	*Environmental department*	*Technical department*
VR	Not available at present	Vesa Stenvall
SJ	Anna Granholm-Thorén	Göran Glivberg
NSB	Dag Wilhelmsen, Gardermobanen	Hans Kristian Beck
DSB	Mads Bergendorff	Kåre Ledertoug

5.2 Schedule

The first revision will take place in the first quarter of the year 2001. The revision will require time resources from each company, but will only take two meetings:

Status meeting	The parts to be updated will be determined. The work will be distributed among the companies' responsible persons. The status meeting decides which parts need to be updated, and the work is distributed between the four railways.
Progress meeting	To be held approx. 2 months after the status meeting. The suggested alterations are evaluated and the meeting decides what should go in the revision. After this, the overall responsible railway makes the decided changes in the document and distributes the new version.

5.3 Implementation plans

Each operator has done the following implementation plans.

5.3.1 Implementation plans for VR

The purchasing of the rolling stock is made in close co-operation between the purchasing unit and technical people. VR has unit "VR Engineering" which has responsibility to set technical requiremets for the rolling stock in the case of purchasing.

The environmental requiremets has been set as a part of setting other technical requirements. The responsible person for the implementation of the manual is a person from VR Engineering who is nominated to be the technical project manager. The nominating of the project manager is made case by case.

The persons of the purchasing unit shall be aware of the environmental requirements as well, but they have only second hand resbonsibility to implement them.

In general speaking the practise to use the manual is similar as with the previous common requirement manual "NARMA 2-T4: Environment".

5.3.2 Implementation plans for NSB and NSB Gardermobanen

The implementation plans for NSB are still to be elaborated. Concerning NSB Gardermobanen AS, they have recently received all their new rolling stock. There are no immediate plans for procurement of new rolling stock.

- Mr. Tom Lund (Trafikk - Teknisk enhet/Traffic - Technical unit) (E-mail: tom.lund@nsb-gmb.telemax.no) NSB Gardermobanen AS, N-0048 OSLO, is our owner of the manual and responisible for the implementation.

- Dag Wilhelmsen (Sikkerhet/Kvalitet/miljø-enheten/Safety/Quality/Environment-unit) (E-mail: dag.wilhelmsen@nsb-gmb.telemax.no) will also be available concerning revision and implementation of the manual.

5.3.3 Implementation plans for SJ

The participants in the working group is suggested to be the owners of the Manual and also responsible for the implementation and improvement of it at the beginning. Later on, maybe other persons could take over.

With regards to the radical reorganisation within SJ at the moment, it is difficult to point out an appropriate unit just now. Some key-persons have already been informed about the Manual.

The Manual should be spread within the company e.g. to the environmental coordinators at the Passenger and Freight traffic divisions and also have some kind of education/seminars for persons involved in procurement. This will be the platform for a lot of ideas for improvement of the Manual.

5.3.4 Implementation plans for DSB

The participants in the working group is suggested to be the owners of the Manual and also responsible for the implementation.

In the Environmental Policy Office (DSB Miljo) the manual will be used in relevant projects and will be added in relevant project descriptions.

In the technical department (DSB Materiel teknik) a reference to the manual will be added in the ISO 9000 quality assurance system in relevant procedures and instructions.

Manual owners in DSB

From DSB Miljø	*From DSB Materiel teknik*
Head of Environmental Policy Office John Sørensen	Head of technical department Kaj Lund
Rikke Næraa	Niels Damgaard (project leader)
Mads Bergendorff	Henrik Kudal (project leader)
	Peter Jørgensen (project leader)
	Kåre Ledertoug

6. References

(From NUP manual, 1994)

1. CEN/TC 256 N 165 E Railway applications - Noise emission - Measurement of external noise emitted by rail bound vehicles (Committee Draft 1993-06-14)

2. ECE-R 49: Uniform provisions concerning the approval of diesel engines with regard to the emission of gaseous pollutants, Geneva 1982.04.15

3. Convention for the Prevention of Marine Pollution from Land Based Sources, Paris 1974 and later revisions. Basis for national legislation.

4. Convention for the Protection of Marine Environment in the Baltic Area, Helsinki 1974 and later revisions. Basis for national legislation.

5. Council Directive 75 / 422 / EEC (Rev. 91 / 156 / EEC) on waste, and other directives related to waste handling.

6. National regulations concerning the use of certain plastics, solvent-diluted

7. Paints, etc., regarding pollution of workplace and environment.

8. Council Directive 91 / 157 / EEC on accumulators and batteries.

9. Council Directive 19 / 382 / EEC on asbestos, and national laws on the prohibition of asbestos and asbestos-containing materials.

10. Council Directive 76 / 403 / EEC on the disposal of PCB and PCT, currently under revision.

11. United Nations Environmental Programme, Montreal Protocol on substances that deplete the ozone layer, 1987.09.16.

12. Swedish Regulation SNFS 1992:16 MS:54, "Köldmediekungörelsen"

13. UIC-leaflet 644-1980: "Warning devices used on traction units employed in international services".

14. Finnish Standard SFS 4428, "Quick coupling", 1980.12.31

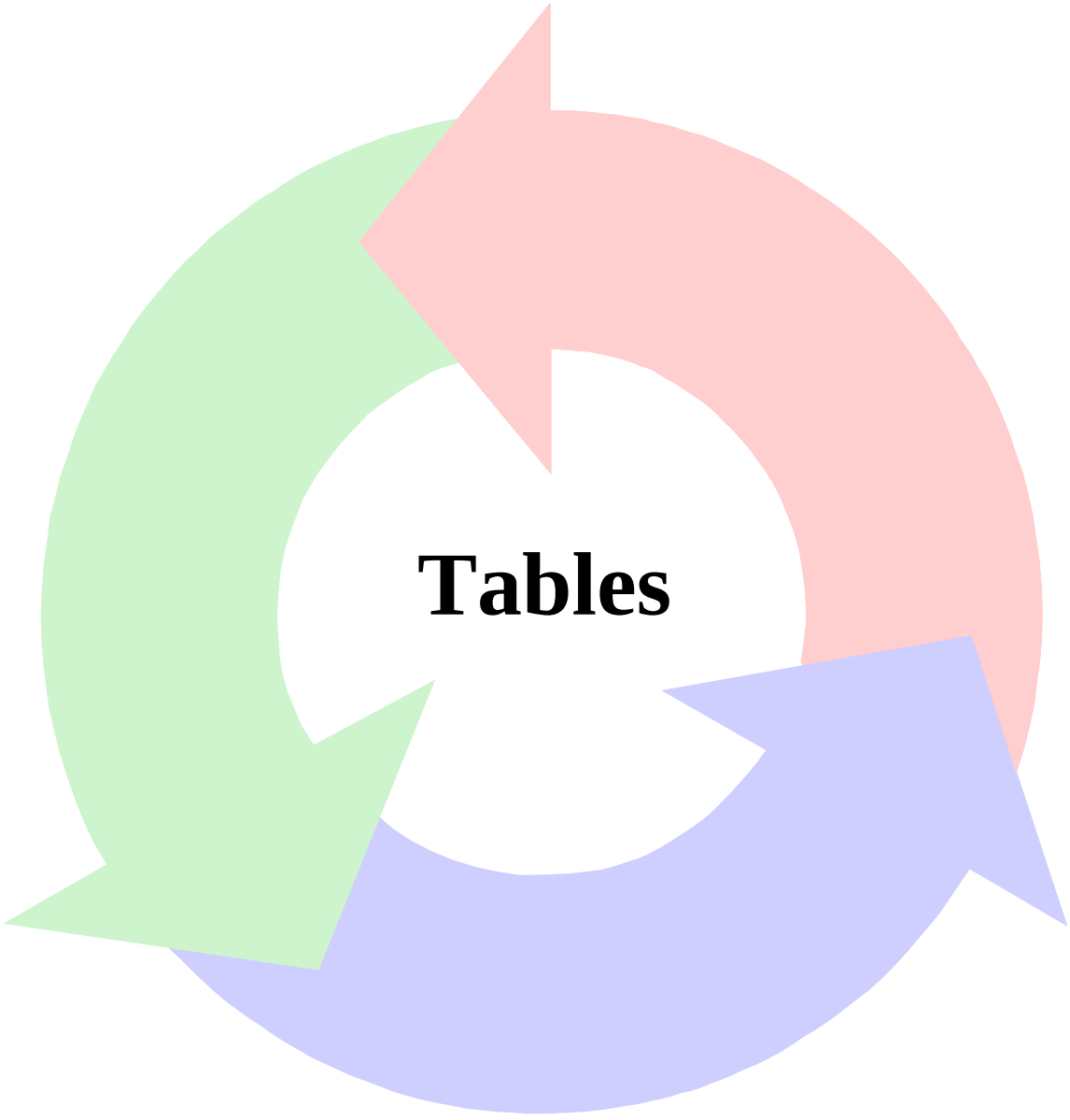
6.1 Tables

Number	*Table*
T.1	External noise values
T.2	Internal noise values
T.3	Exhaust emissions from diesel engines
T.4	Reduction of mass
T.5	Aerodynamics
T.6	Restricted materials

6.2 Appendices

(To be elaborated)

Nordic Environmental Manual



Tables

Table T.1: External noise values - Optional

Type of vehicle	Speed, km/h	Sound level, L_{Amax}, dB(A), acc. to ISO 3095	
		Minimum requirement	Optional requirement
Electric locomotive,			
< 2000 kW	130	90	87
≥ 2000 kW	140	86	83
	200	90	87
Diesel locomotive,			
< 1000 kW	60	82	79
	100	90	87
≥ 1000 kW	120	90	87
Passenger coach	160	85	82
Motor coaches,	160		
- electric		88	85
- diesel		90	87
High speed trains	200	90	87
	250	92	89
Cargo wagons			
- with cast iron brake shoes	100	90	87
- with disc brakes or synthetic/ composite shoes	120	85	82

Table T.2: Internal noise values - Optional

Type of vehicle	Speed	On line		Stand still	
	km/h	Compartment	Driver's cabin	Compartment	Driver's cabin
Electric locomotive,					
< 2000 kW	130	-	75	-	-
≥ 2000 kW	200	-	75	-	-
Diesel locomotive,					
< 1000 kW	100	-	80	-	-
≥ 1000 kW	120	-	80	-	-
Passenger coach	160	65	-	60	-
Motor coaches,	160				-
- electric		65	70	60	
- diesel		70	75	60	
High speed trains	200/250	65/70	70/70	55/55	-

Table T.3: Exhaust gas emission from diesel engines

All values in g/kWh (limit values) Apply for cycle A	CO	NO_x	HC	Particles
Euro II 01.01.1995	4,0	7,0	1,1	0,15
Euro III (tentative) into force October 2000	4,0	5,4	<1,1	<0,1

Table T.4 Reduction of mass. (L) means that a relatively large potential exists

Carbody	Aluminium or composite bodies can often be lighter than steel (L).
Skirt hatches	Aluminium or sandwich materials are normally lighter than steel
Bogies	Articulated bogie design will reduce the nescessary number of bogies significantly. Bogies should be weight optimised (L)
Brake discs	Aluminium has lower mass and inertia than steel
Transformer	Elastic mounting can reduce the nescessary stiffnes of the body frame (electric trains) (L)
Floor constr.	Sandwich will normally be lighter than wood in floating floors (L)
Floor cover	Floor cover should be as thin as possible (for good qualities on the market)
Partition walls	Sandwich materials will normally be lighter than wood (L)
Seats	To be weight optimised, aluminium/wood supports/body may be lighter than steel (L)
Toilets, tanks	composite tanks may be lighter than steel, “dry” systems should be considered
Insulation heat	Thickness and material should be optimised. (Melamine) foams can normally be lighter than mineral wool (L)
Insulation noise	Use of damping compound to be optimised.. Noise absorbtion in compartments is lighter than using damping compound
Ventilation	Air-condition systems should be weight optimised, when they are nescessary, incl. ventilation channels
Cables	Use of lightweight cables can save weight, fibre optics may be an option.
Glass, Windows	Thickness optimising can save weight
Exterior doors	Electric operation will normally be lighter than pneumatic.

Table T.5: Aerodynamics

Speed range	Factor
NS, HS	Gaps between consecutive coaches should be < 250 mm
NS, HS	Fully enclosed underskirting should be applied.
NS, HS	Roof mounted equipment should be enclosed.
NS, HS	”Cowcatcher” type of protection should be applied.
NS, HS	The crossection of the train should be characterised by large transition radii between roof and sidewalls.
NS, HS	The front should be optimised in shape, also considering if several trains are coupled together.
NS, HS	Irregulaties on the outside surface should be avoided or minimized.
HS	Bogies should be enclosed in.

Rolling stock with maximum speeds up to 200 km/t are marked NS (normal speed), rolling stock with maximum speeds > 200 km/t are marked HS (high speed).

Table T.6: Restricted materials

Material	Comment
Arsenic	And its compounds
Asbestos	
Beryllium	
Brominated flame retardants	Especially PBB, PBDE
Cadmium	Except in recyclable batteries
Carbon tetrachloride	
Chlorofluorocarbons	
Chromium	And its compounds
Cobalt	
Copper	Except in recyclable cables and electronics
Halon	
Hydrochlorfluorcarbons	
Isocyanates	Except when bound in PU
Lead	Except in recyclable batteries or in soldering
Mercury	And its compounds
Methyl bromide	
Nickel	And its compounds
Polyaromatic hydrocarbons (PAH)	
Polychlorinated biphenyls	
Zinc	And its compounds

This list includes the substances regulated by international conventions etc.

See also the respective ”restricted and observation lists” at the environmental administrations in the four different countries:

Finland: http://www.vyh.fi

Norway: http://www.dep.no/md/

Sweden: http://www.environ.se

Denmark: http://www.mem.dk/love/htmlfiler/99b0011.htm