

Background to the proposal for criteria document covering passenger-, buss- and truck-vehicle tyres.

Introduction and definition of the product group.

The ecolabelling criteria for passenger vehicle tyres were concluded 15th June 1999. Afterwards, at 3rd December 1999, some changes to the document were done by Nordic Ecolabelling Board (NMN). After some corrections of grammatical points, the present version of the criteria for passenger vehicle tyres is 1.2. When approved the passenger vehicle tyre NMN also decided to continue criteria developing work for heavy vehicle tyres including buss- and truck-vehicle tyres.

Later NMN has decided that it is possible to revise the requirements for passenger vehicle tyres at the same time with the criteria development for buss and truck tyres. Nordic Ecolabelling Board has so given a mandate to update also passenger vehicle tyres requirements, and also some changes have been done in the requirements for passenger vehicle tyres. The present criteria document for passenger vehicle tyres, version 1.2, is valid until June 2002, in spite of the new criteria document.

Applicants may apply for a ecolabelling licence according to the present criteria (v. 1.2) until they expire or according to the new proposed criteria document after it is valid. The new proposal of the document version 2.0 will be valid for four years.

The following chapters have been changed or added compared to the present criteria document for passenger vehicle tyres (compared to version 1.2):

- Lay-out has been changed.
- Definition of the product group is changed to include also buss- and truck tyres (chapter 2 in version 2.0).
- Requirements regarding PCA compounds is changed tyres (chapter 4.1.1 in version 2.0).
- Requirements regarding substances classified as dangerous for the environment and health is removed (chapter 4.1.2 in version 1.2).
- Requirements for lead and cadmium as impurities in zinc oxide is added (chapter 4.1.2 in version 2.0).
- Requirements for the use of organic solvent in production is changed to cover a tyre as a product (chapter 4.1.3 in version 2.0).
- Documentation of rolling resistance is changed (chapter 4.1.4 in version 2.0).
- Documentation of noise is changed (chapter 4.1.5 in version 2.0).
- Requirements regarding design is removed (chapter 4.1.8 in version 1.2).
- Documentation of safety considerations is changed (chapter 5.1.1 in version 2.0).
- Alternatively the requirement for durability is added.

Further the requirements for buss- and truck tyres are added in chapter 4.2 and 5.2. The following requirements are covered for heavy tyres in version 2.0:

- PCA compounds in the process oil and documentation of PCA compounds in thread rubber (chapter 4.2.1).
- Substances classified as dangerous to the environment and health in the protective agents (chapter 4.2.2).
- The amount of lead and cadmium in zinc oxides (chapter 4.2.3).
- The use of organic solvents (chapter 4.2.4).

- Rolling resistance (chapter 4.2.5).
- Noise (chapter 4.2.6).
- Instruction for marketing of tyres (chapter 4.2.7).
- Waste handling and strategy (chapter 4.2.8).
- Safety considerations (chapter 5.2.1) and durability (chapter 5.2.2) as alternative to each others.

More detailed information about the background of requirements is presented in chapter “CRITERIA FOR ENVIRONMENTAL LABELLING” in this document.

The original consultant study on feasibility of establishing ecolabelling criteria was made by Rencon Consulting Ky. The original study was focused especially on passenger vehicle tyres. In order to get more information about the heavy vehicle tyres Technical Research Centre of Finland (VTT) studied environmental impact of heavy vehicle tyres in their survey for Nordic Ecolabelling. Studies are available by the request from the Nordic Ecolabelling Secretary.

A Nordic expert group for developing heavy tyre criteria was formed in 1999. This expert group is composed of representatives of manufactures of heavy new tyres, heavy tyres rethreading agencies, research institutions representing both passenger and heavy tyres and organisations in the line. The expert group hold three meetings before the public hearing. After having received the hearing comments, the expert group discussed about the hearing answers and developed further the criteria for tyres with less environmental impact. In addition, the discussion with passenger car tyre interest group was organised before the final formulation of the requirements for passenger car tyres.

The product group of vehicle tyres is composed of new tyres and rethreaded ones for passenger-, buss- and truck-vehicle. The ecolabelling requirements in chapter 4 and 5 are shared in tow parts. The first part is considering the requirements for passenger vehicle tyres and the second part for buss- and truck-vehicle tyres.

The expert group has in its work assessed the total lifecycle of tyres, beginning from the production and selection of raw materials to the manufacture of tyres, the use of tyres, rethreading and finally recycling of tyre bodies. The requirements do not cover all properties of the tyre, because some of them have not been considered appropriate.

Market overview

Three companies manufacture passenger vehicle tyres in the Nordic countries and a total of about 20- 25 companies rethread vehicle tyres. There is only one company that manufacture new buss- and truck tyres in Scandinavian. The number heavy tyre retreaters is over 100 in Scandinavian.

The 1999 sales figures for vehicle tyres are summarised in the table below. The data was obtained from the different Nordic vehicle tyres organisations.

Table1 sales figures for vehicle tyres.

	Denmark Tyres/yr.	Finland Tyres/yr.	Norway Tyres/yr.	Sweden Tyres/yr.	Iceland Tyres/yr.
Passenger vehicle tyres					
Vehicle tyres, New	2 280 000	1 470 000	2 100 000	3 800 000	150 000

Rethreaded tyres	300 000	320 000	155 000	1 200 000	87 000
Total sales	2 580 000	1 790 000	2 255 000	5 000 000	237 000
Buss- and truck tyres					
New tyres	135 000	100 000	120 000	210 000	10 000
Rethreaded tyres	110 000	250 000	120 000	220 000	30 000
Total sales	245 000	250 000	240 000	430 000	40 000

Environmental impact of tyres

After the consultant study by VTT the Nordic expert group proposed environmental criteria for tyres. In this work the outside consultants as well as the work of the expert group and available literature were taken into account.

With view of life cycle it is possible to emphasize the production and use of tyres as well as the reuse of rejected tyres. Environmental impacts are caused from the use of chemicals and different raw material during the production, during the use of the vehicle and in the handling of reject-tyres. An environmentally adapted tyre has characteristics such as low rolling resistance, low noise level and good wear proofness. Further the tyre should work so that there is no need to reject it too soon. The designs of tyres and client's habits to use tyres are factors that finally effect on the durability of tyres. However it is not possible to involve those facts in ecolabelling criteria. A low energy consumption during production and environment-friendly raw materials are also the base for environmentally labelled tyres. Reuse of the tyre body as material, energy or in other way forms the last phase of the life cycle of tyres.

The studies have particularly examined some eventual environmental risk caused by rubber chemicals, primarily high aromatic process oils, zinc, protective agent in rubber and sulphuric chemicals. The expert group determined to establish requirements for some of the most significant chemicals used in the manufacturing of tyres. The group likewise took a stand in noise and noise levels of tyres. The construction of tyres may have an effect on the noise levels of tyres through dimensioning and stiffness of tyres, and surface design of wearing surface. Further requirements for rolling resistance, durability, decrease of materials, safety facts and handling of reject tyres have been studied.

Raw materials

Tyres are composed by rubber compounds, textile fibres, steel texture and brim threads. A tyre of passenger vehicle has a weight of about 8 kg. Materials used in buss- and truck vehicle tyres manufacturing are quiet similar compared with passenger vehicle tyres, but of course the amount of chemicals in heavy tyre production are higher then in passenger vehicle production.

A tyre rubber is composed approximately of:

Polymers (natural or synthetic rubber)	40- 60 %
Filling (black carbon, silica)	25- 35 %
Softening agents (process oils)	20 %
Protection agents (wax, antioxidant, antiozonant)	1- 2 %
Activators (zinc oxide, stearic acid)	2- 5 %
Accelerators	0,5- 2 %
Vulcanising agent (sulphur)	1- 2 %

Synthetic rubber may include styrene butadiene, polybutadiene and polyisoprene rubber. Process oil is a rest fraction of raffinate. It may include, depending on the manipulating of oils, different amount of poly aromatic hydrocarbons (PAC). The total amount of PAC in a tyre may vary a lot due to used measuring method and quality of used oil fraction in the production of tyre.

Most protective agents and accelerators are classified as environmentally harmful chemicals and typical antiozonant is classified as environmentally dangerous. Protective agents and accelerators have been developed particularly for the rubber industry and production of tyres. With view to occupational health point of you the tyre industry has in late fifteen years intensively co-operated with raw material producers in order to obtain less harmful agents. The tyre industry has with time succeeded in substituting all eventually carcinogenic and toxic chemicals by less risky alternatives.

Usually a combination of several accelerators is used which in vulcanization phase react further with polymers and other agents. The most usual accelerator are sulphur amides and guanidines.

Protective agents, a combination of wax and different kinds of p-phenylamides, are used to protect the tyres against heat, oxygen, u.v. radiation and ozone. The protective agents proceed to the tyre surface to protect it from dissolving. The protective agents, instead of rubber polymers, can also react later on. With time the old protective agents will be rinsed out from the surface and new ones will proceed on it. Active protective agents have to be used in order to get a long life time for the tyres. An opinion has been presented that the protective agents being rinsed away will have an impact on the environments. Some toxicity tests with water extract from rubber have been made on fish by several research institutes. The results have varied from a low toxicity to higher degrees.

With view to the environmental aspects the activator zinc oxide and vulcanising agent sulphur shall also be estimated. Both type of raw materials are necessary or the vulcanization of tyres. Zinc oxide with lead and cadmium as impurities (lead about 0,2% cadmium about 0,001%) can effect on the distribution of heavy metals in to the nature. Theoretically sulphur participates in the souring (acid rains), but the amount is minimal compared with other souring origins in the society.

The wearing surface rubber gats lose in to the nature through wearing away of tyre tread as rubber particles or chemicals. Rubber dissolves very slowly in nature, fine divided particles with in some years. There is no significant knowledge about chemical compounds of chemicals when they get loos from a rubber material in to the nature. The particles emitted from road surface are also significant risk for human health and for environment. Unfortunately, ecolabelling criteria for tyres can't include the requirements for the road.

Over 80 % of the raw material of the tyre contains produced oil or natural gas, i.e. not renewable natural resources. Accordingly the energy content of a new tyre is very high and in a used tyre the energy still remained about 70- 80 %. The energy content combined in the material of a new tyre for a passenger vehicle falls in the class of over 300 MJ witch corresponds to 7- 8 kilograms of heavy crude oil. Due to grate amount of sulphur and other extra components in tyres, burning is not quiet so an attractive alternative compared with other fuels. Accordingly, it is important that the life time of a tyre is long, tyre body can be rethreaded, rethreaded tyres are of high quality and finally that reject tyres are reused, primarily as materials, secondarily as energy. In the Nordic countries the state/authorities

have together with tyre sellers tyre industry rethreading agencies agreed about collecting of reject tyres and about reuse. It is not allowed to leave tyres on rubbish heaps/dump.

Production

Production of tyres implies energy during mixing and preparation of rubber compounds, and during vulcanization of tyres. During recoating and scraping of the old wearing surface and vulcanization process require quite allot of energy. Besides it is not appropriate to limit energy consumption during manufacture of materials or raw materials because of the fact that the tyres include small amounts of different kinds of raw materials. Energy calculations are not sufficiently exact in such a situation or it is impossible to realize the exact calculations. It was also notice that energy consumption vary quiet a little between different machines in the production. That's why the exact limit value for energy consumption was not decided to be established in present criteria.

As auxiliary facilities during production (organic soaking agents and rubber glue) are used to combine different rubber compounds. The used soaking agents will dispersed into the air during the production. During recoating also emissions of small particles are possible, but any limit value has not been established in the current criteria because technical decisions are missing.

Handling and recovery of production waste is important because minimizing the amounts of rejects going dumping and re-use of material. In many cases the waste handling is controlled by the legislation in the Nordic countries but still it is useful to develop waste and reject handling techniques.

Use of tyres

Environmentally-friendly characteristics of a tyre in use are considered to be such as low rolling resistance, low noise level and good wearing strength.

A requirement for new vehicle models is the reduction of fuel consumption. Tyres have an effect on fuel consumption through its weight, by aerodynamic resistance and rolling resistance. The portion of a tyre as regard to the fuel consumption of a vehicle is at present about 13- 18 %. By decreasing rolling resistance of tyre by 35 % it is possible to save 5 % of fuel and decrease exhaust emissions. Decrease of rolling resistance shall not at the same time impair other important technical characteristics e.g. safety of tyres.

Within the road traffic noise caused by the most modern vehicles the noise from tyres dominate over the driving unit noise and cause environmental problems in the society. The driving units of vehicles have during past years become less noisy. By reducing noise emissions from tyres it is possible to reduce considerably the road traffic noise.

The behaviour of tyres under a vehicle is a result of different characteristics. The environmentally-friendly characteristics of a tyre can have negative impact on other technical characteristics.

In the proposal criteria the expert group wants to emphasize the rolling resistance, noise levels, safety and good wearing strength of tyres. It considers that product development of

tyres can be improved by innovative development of different characteristics so that both the environmental requirements and the important technical driving characteristics are fulfilled.

Safety is also a very important character of tyre in the traffic. Environmental requirements of tyres are developed such a way that the requirements are not causing any risk or problems for the normal safety of tyres.

Reuse of carcass

In order to minimize the need/use of natural resources for tyre production, it shall be able to reuse the tyre body.

For passenger vehicle tyres usually one rethreading is allowed, and several rethreading may be made on heavier tyres. It is usual that heavy tyres are rethreaded 2,5 times in Finland. In other Nordic countries tyres will be rethreaded approximately too times. It is noticeable that rethreading is more common among the heavy tyres than passenger vehicle tyres

Nowadays it unfortunately is difficult to purchase sufficient amount of carcasses of high quality. There are different reasons for scraping of used tyres. Either is the construction of the tyre body not sufficiently strong, the tyre has been used wrongly and the body has been broken or the dimensions of the body vary so much that they do not fit the quality requirements of rethreaders. Accordingly the life time of the body can be influenced by manufactures of new tyres, tyre sales and consumers who use tyres. Depending on those facts the used time of passenger vehicle new tyres is approximately 40t km- 50t km. Life time of heavy tyres is higher; approximately 120t km- 170t km.

Rethreading shall not impair the character of tyre or have a negative effect on the fuel consumption of the vehicle. The Economic and Social Council of UN has compiled E rules for rethreading that will be introduced within the years to come. The dimension variations stated in the rules are adapted to the tyre standards for new tyres. Dimension variation in the measure around the wearing surface for rethread passenger vehicle tyres enables a weight variation of wearing surface rubber bigger than one kilogram. Accordingly it is possible to produce heavier rethreaded tyres than corresponding new tyres. The weight of the tyre effects on the rolling resistance of tyre and further to the fuel consumption of the vehicle. The expert group thinks that with view to the environment, rethreaders shall use only a necessary amount of new wearing rubber compounds and propose a minor tolerance variation of weight. This lead to the quality requirement for rethreaders.

Rethreading of heavy tyres differ from the rethreading of passenger vehicle tyre. Technique of rethreading varies between the Nordic countries. Pre curing is in use especially in Finland and in Sweden but mould curing is more popular in Norway and Denmark. Differences between the techniques are anyway not so large that they could influence a lot on self environment requirements. In the case of pre curing carcasses are transported directly from consumer to rethreading and back again to consumer. In mould curing the markets are open and the specified collection systems of tyres are in use. In pre curing the identification of different type of carcasses is possible but not in mould curing after one vulcanization it is difficult to identify the original carcasses without any extra marking.

Recycling of used tyres

After rethreading used tyres still shall be recycled primarily as material and secondarily as energy. Priority is regulated by legislation on waste. Because the Nordic countries have a co-ordination of collection and recycling of used tyres the expert group does not take any stand particularly to the self recycling. Rubber material that has been removed from production or rethreading of tyres shall also be reused as material or energy.

Criteria for environmental labelling/ background

The requirements are divided into to parts. Chapter 4.1 and 5.1 considers the requirements for passenger vehicle tyres and chapter 4.2 and 5.2 for buss- and truck vehicle tyres.

Special reasons for stroking out some requirement concerning passenger car tyre criteria

STRO (Scandinavian Tyre and Rim Organisation) has criticised that the present requirements in version are not applicable for the new tyres because the requirements are covering also the production of tyres. STRO has argument that global manufactures can have difficulties in documentation the requirements concerning specially the production of tyres. This is the main reason together with new received information from the hearing that some requirements are changed compared to the old criteria version of passenger vehicle tyres (version 1.2). Those improvements are done to help new tyre producers to apply for a Swan label. Instead of stroking out all chemical requirements the criteria is being developed to cover specially tyres as a product. This way the difficulties of new tyre manufactures to apply for a license have tried to eliminate.

Changed requirements are:

1. Analysis of individual PAH-compounds has removed. IP 346 together with IP 391 method are more commonly used methods than individual PAH- compounds in thread rubber.
2. Requirements regarding substances classified as dangerous for the environment and health is being removed. Global manufactures can have difficulties in documentation this requirement. For replace this, the requirement for lead and cadmium in zinc oxide is added.
3. Requirements for the use of organic solvent in production is changed to cover a product not the production.
4. Documentation of rolling resistance (RR) is changed. RR has to document according to load index instead of breath of tyre. Notice and see also the summering of the hearing.
5. Documentation of tyre noise is changed.
6. Requirements regarding design is removed because the requirement was not relevant.
7. Applicants can choice to document the requirement for friction properties of tyre or durability of tyre. Those requirement are so alternative to each others.

Also some grammatical and appearance change have been done.

General bases for the requirements:

Requirements for chemicals / passenger- buss- and truck vehicle tyres

Chemical aspects of tyres are quiet similar in both passenger and heavy vehicle tyres. Because the tyres do not differ a lot from each others similar requirements have also been established.

Polycyclic Aromatic compounds (PCA) (chapter 4.1.1 and 4.2.1)

The expert group has established requirements for the content of polyaromatic hydrocarbon (PCA) in process oils and further, documentation concerning PCA compounds in the extract from thread rubber. The process oil can be classified as a carcinogenic substance. Largely documented limit values for dangerous known concentration in process oil is 3,0 % according to method IP 346. Sveriges Provnings- och forskningsinstitut (SP) has studied the suitability of the test method IP 391 for determination of PCA compounds in thread rubber extract. According to the studies IP 391 method can be used for an analyse of PCA- fraction from the final thread rubber product. However, this method is not commonly known and used, and that's why IP 391 method used only in documentation purposes. More detailed information about the studies of IP 391 is available from the Nordic Ecolabelling Secretaries. IP 391 and IP 346 methods are mentioned for analysis the concentration of PCA both in process oils and in thread pattern. Using those two methods the checking of PCA concentrations in process oils but also afterwards in thread rubber will be possible. However, the hearing answers where against the IP 391 method and that's why the limit value concerning IP 391 method will be considered in next revision. The reason for stroking out the requirement for special analysis of PCA compounds is the difficulty to extract and purify the rubber material.

The total concentration of Polycyclic Aromatic compounds in the process oil must be analysed according to IP 346 method and the limit value suggested is 3,0 weight %.

In addition the amount of PCA compounds have to be informed in thread pattern by using method IP 391 with the extraction and purification method ISO 1407 and ISO 4645.

Substances dangerous for the environment and human health (concerning only heavy tyres; chapter 5.2.2)

When restricting the use of environmentally and human healthy dangerous agents in tyres the main emphasis has to be focused to the important protective agents. A limit value of 0,85 % for chemicals which are classified as dangerous for the environment and human healthy (according to EU 67/548/EEC classification and allocated risk phrases R46, R46, R49, R50+53, R51+53, R52+53, R60 or R61) in protective agents added to thread rubber shall be established to indicate the development trend of compensation raw material. This requirement covers only heavy tyres. Protective agents are in the first case technical chemicals which are necessary to preserve the protective properties of tyre. In heavy tyres the relative amount of protective agents are higher then in passenger tyres due to the lower amount of rubber and other additives used in tyre manufacturing, and also because heavy tyres have to fit rethreading two or even three times. Se also table 2.

However, this requirement concerning the passenger car tyres have been stroked out because manufactures of passenger car tyres are global and global producers can have some

difficulties to document the requirement. The reason for stroking out the requirement is mainly came by the request of STRO (Scandinavian Tyre and road Association)

Table 2 Compound recipes in general form for passenger car thread and truck thread.

Material	Passenger car thread	Truck thread
	Amount in phr*	Amount in phr*
Polymers (rubbers)	100	100
Fillers	80	50
Activators (includes several chemicals)	6	6
Processing oils	50	5
Protecting agents (includes several chemicals)	3	3
Curing system (includes several chemicals)	5	5
Total	243	168

* phr = Parts per Hundred Rubber = parts per weight per 100 parts per weight of rubber.
Example: If you have 100 g of rubber you take 80 g of filler etc.

Certain amount of protecting agent is needed to protect the rubber properly. Due to the different basic composition of truck thread compound the relative amount of protecting agent is higher than in passenger car thread compound i.e.

Passenger car tread $3 / 243 * 100 \% = 1,2 \%$
Truck tread $3 / 168 * 100 \% = 1,8 \%$

Lead and Cadmium impurities in Zinc oxide Chapter 4.1.2 and 4.2.3)