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## **REMEDIAL WORK ON ASPHALT COVERING WITH INFRA-RED HEATING WITH USE OF ASPHALT R-MATERIAL**

**Technical regulation for execution of routine maintenance by means of SILKOT  
device**

Recommended for use in the scope of a quality system of the maker of maintenance work

## 1. INTRODUCTION

Technologies performed in the scope of a routine maintenance of roads of overland communications of other traffic surfaces are necessary tools for preservation of serviceability in a required level. In many cases, the surface technical conditions are not worsened continuously in a full area but degradation occurs only locally from various reasons. So it is necessary to remove the defect operatively for safety reasons of road traffic. In most cases, the local maintenance has a feature of a temporary measure.

The term road recycling can be defined as use of materials from the original road that are reused in the road structure in the way suitable technically and ecologically. In case material from the original road is again used in the same place of the road structure without carrying away, it is recycling in-situ.

With recycling can be achieved:

- efficient use of wastes through their transformation to recycled material instead of their disposal to controlled waste dumps,
- limitation of exploitation of natural resources,
- energy saving,
- decrease of some of undesirable influences (noise, pollution, construction time, etc.).

Asphalt road layers composed of a mixture of aggregate coated with asphalt binder can be recycled successfully. With optimal recycling technology the final quality of the structure with used a layer (layers) of recycled materials would not differ from the quality of the road made of only new materials. In case of use of recycled materials in the scope of the routine maintenance of roads in critical or unsuitable condition the remedial work is always of short time nature due to occurrence of construction failures.

## 2. SUBJECT

This technical regulation contains general rules for execution of the routine maintenance of compacted asphalt layers with repeated treatment of the original asphalt mixture in a hot way in-situ; this is performed by its melting with the SILKOT device, addition of asphalt R-material, manual mixing and machine compaction.

The regulation does not include recycling of bituminous material, i.e. material that contains tar fully or partly instead of asphalt, or possibly other binders polluting the environment. It is necessary to apply special technologies and working procedures for maintenance and repairs of roads with tar, which are removing or at least limiting this environmental strain. In case of tar occurrence, it is required to follow TP 150.

*With regard to time limited practical experience with application of the SILKOT device and with evaluation of resulting remedial work in Czech Republic, this regulation is created as preliminary. More substantial investigation of this technology has not been accomplished. Therefore device users, communication administrators and professional public ask for providing of practical experience first of all with the resulting quality of executed remedial work to e-mail address [info@siltek.cz](mailto:info@siltek.cz).*

### **3. TERMS AND DEFINITIONS**

- 3.1 As remedial work according to this regulation a local repair of road covering with use of a hot asphalt mixture is understand. Remedial work are especially repair of pot-holes in the wearing course or in the whole road covering, exceptionally repairs of a local depression (e.g. after excavations and cross-cuts). Remedial work is mostly carried out as a completed surface treatment of the wearing course in the place of damage. Remedial work solves current problem of a pot-hole by its removal.
- 3.2 Recycling in-situ in a hot way (in the sense of this regulation) is repeated processing of an asphalt mixture in the build-in place with replenishment of missing mixture amount with heated additional asphalt R-material.
- 3.3 Recycling material in the sense of this regulation is an asphalt mixture in the place of remedial work acquired by heating and disconnecting from the original compacted asphalt layer, usually from the wearing course.
- 3.4 R-material is a homogenized mixture of aggregate and asphalt acquired by milling from covering road layers or by destroying, crushing and sorting, and it is determined for further use, especially in technologies of hot recycling. Material of better quality is obtained by separate milling of the wearing course and the base asphalt course.

### **4. BUILDING MATERIAL**

- 4.1 Recycling material (material of the original road structure) is basic construction material. A building mixture of the recycled layer has to meet requirements of a maximum grain size corresponding to the thickness of the resulting layer. In most cases recycling material is used only from the wearing course of the road.
- 4.2 R-material (added asphalt mixture)  
Grain-size composition of the added asphalt mixture should comply with requirements for asphalt concrete for wearing courses of ACO 11 or ACO 16 type. Verification will be carried out by a separate laboratory analysis.
- 4.3 Recycled asphalt mixture  
The resulting mixture of remedial work composed of recycling material and R-material.

### **5. CONSTRUCTION MACHINES**

- 5.1 The special device SILKOT 70-80 for remedial work of compacted asphalt layers is a mobile device for melting of asphalt material of the original road structure layer in the place of remedial work execution by infra-red technology. The device is also equipped with a container for storage and heating of asphalt R-material. The device is not provided with possibility of forced stirring of this R-material.

The SILKOT device is pulled by a tractor or it is located on a lorry and it is equipped with infra-red radiators located in a rear warming-up hinged face, and as well with an insulated heating container of R-material.

Work with the SILKOT device is included in a flow of partial technologic procedures for execution of remedial work as a key procedure.

5.2 Machinery for remedial work technology with use of the SILKOT device:

- SILKOT device
- tools and aids for manual stirring and levelling of a heated recycled mixture and R-material
- compacting device: a small manually-driven vibratory roller

## 6. TREATMENT OF RECYCLED ASPHALT MIXTURE

6.1 Laboratory preparation is recommended only for work of larger extent at a homogenous section on communications with more important traffic and/or in cases when it is required by the customer of this routine maintenance technology.

6.2 If point 6.1 is applied, the laboratory with relevant professional authorization will create a proposal of recycled mixture treatment with additional R-material, based on laboratory analysis of mixture samples taken from places where remedial work is to be executed (core hole or cut-out) and of samples taken from the stock of R-material.  
The sampling frequency depends on executed repair extent and possible qualitative changes of the road surface.

6.3 With core holes following is find out:

- thickness of the wearing course (or the wearing and the base course)
- volume weight
- void fraction
- aggregate grain size
- binder content

In case of tar occurrence, or other binders that are classified as danger substances from the viewpoint of environmental protection, this procedure according to article 2 cannot be used.

## 7. TECHNOLOGICAL PROCEDURE

Remedial work can be carried out at air temperatures above 0 °C and the air temperature in last 24 hours would not be lower than -5 °C. In exceptional cases if there is a requirement to remove failure of road practicability, it is possible to carry out remedial work also at minus air temperatures, but it is necessary to modify technological procedure so to observe the compacting temperature of the asphalt mixture min. 130 °C. The road surface has to be always dry or only slightly damp. Remedial work cannot be carried out in rain or snowfall. Remedial work cannot be carried out if the pot-hole is filed with water.

### 7.1 Preparation work

7.1.1 Representatives of the customer and the maker specify work extent before its start, with regard to the current condition of the road.

7.1.2 It is necessary before beginning of work to verify that the repairing place has the failure cause only in the repairing course and not in the lower laid layer (layers) or even in the road bed.

7.1.3 Working area is delimited by placing of traffic signs or traffic devices. Remedial work is usually carried out with running traffic, with its partial limitation. Location of the traffic signs has to be discussed and approved in advance (see point 9.3.2).

7.1.4 Before remedial work is executed, the road surface is properly cleaned from earth, dust and other dirt (by sweeping, jetting with pressure air).

## 7.2 Work performance itself

7.2.1 Thickness of the original wearing course (or possibly the wearing and also partly the base course) of the road has to provide the thickness needed for recycling. In case a part of the base course could be recycled together with the wearing course, the condition of original wearing course does not need to be met and the construction mixture of both courses could be recycled in one working cycle. However it is limited only to overland communications of lower traffic importance.

During working procedure has to be avoid overburning of the old asphalt binder in recycling material and the road has to be heated into such a depth that the temperature of the recycled mixture reaches the required temperature. It is recommended to perform heating into a thickness of 2030 mm. Further it is necessary to match up working time of heating, gas pressure in infra-red radiators, their height above the road. Working on a damp covering, with cold and windy weather creates higher risk of uneven heating of the whole thickness of the processed course.

Too high temperature of infra-red radiation is characterized by strong smoke generation, the low temperature by mechanical damage of aggregate grains with material destruction of the original road course. For this reason it is necessary to perform continuous temperature inspection with a manual thermometer. Cross and longitudinal connection to the existing road layer is secured by heating of the original road covering from both sides in the width min. 10 cm larger than the working pot-hole width.

Amount of additional R-material is done by a geometric shape of the road surface (pot-hole depth, profile levelling in the place of road depression) and by wear of the wearing course due to material loss (depth corrosion).

### 7.2.2 R-material preparation

R-material is located and heated in the SILKOT device according to corresponding producer's manual for device operation. The operation consists of addition (feeding) of milled-off or pre-crushed R-material in a required volume.

7.2.3 The treated pot-hole up to a depth of max. 55 mm will be filled with R-material. Levelling of recycling material to the road profile is carried out with wooden or metal stirring arms with a required superelevation of ca 20-30% of the layer thickness.

To keep the required superelevation in the whole area and especially at edges and corners, it is recommended to use bordering laths or balks so to enable mixture levelling with a smoothing lath.

The temperature of the recycled mixture with stirring depends on penetration of the asphalt binder and it is stated in Table 1.

Table 1

Operation temperatures of recycled mixture

Penetration of final binder of recycling material	Mixture temperature (°C)	
	MIN	MAX
> 100	125	160
66 – 100	130	165
≤ 65	145	180

7.2.4 Compaction of the spread and levelled mixture is executed with manually driven vibratory rollers. It is proceeded in direction from working joints. Compaction with vibrating plates or other devices is not recommended.

Compaction is carried out immediately after mixture levelling, while this is still hot, and so long until the surface of remedial work is flat, compact and without marks of a compacting machine. The surface of remedial work must be in one level with the surrounding road surface.

Place of remedial work could be powdered with fine-grained spreading.

7.3 Finishing work includes cleaning of the workplace, removal of traffic signs, carrying away of machinery and working aids, and release of the road for traffic. The road release for traffic is recommended only after mixture cooling to the temperature lower than 60 °C.

## 8. WORK ACCEPTANCE, TESTING AND INSPECTION

For work handover and takeover provisions of TKP, Chapter 7 – Appendix no. 2 – Maintenance and repairs of compacting asphalt layers are valid.

Work maker proves capability to carry out work, e.g. in accordance to Methodical Instruction to Quality System in Area of Overland Communications (SJ-PK). It is recommended to submit references that the same work has been already carried out by him in the past.

The obligation to prove capability is valid for a professional laboratory – a processor of a job instruction further in accordance with the Methodical Instruction to SJ-PK for Part II/3 Testing (laboratory activities).

### 8.1 Type tests

For local remedial work the type test of the asphalt mixture must not be approved by the customer.

### 8.2 Check tests

By this straightness, void fraction, rate of compaction (at core holes or non-destructively) of the finished asphalt layer is proved in frequency defined by the customer.

8.3 Work handover and takeover is executed by authorized personnel of the maker and the customer. At acceptance following is checked:

- Integrity of the remedial work surface,
- connection tightness in working joints,
- surface straightness according to ČSN 73 6175; to evaluate straightness of local remedial work of asphalt layers a tolerance of 8 mm is valid; in case of customer requirement at communications of higher traffic importance the maximum permissible tolerance is 5 mm,
- records of performed laboratory tests and volume of build-in materials.

## **9. WORK SAFETY AND HEALTH PROTECTION**

### **9.1 General rules of work safety and health protection**

Workers are required to observe at work general rules of work safety and hygiene and to use prescribed protective equipment.

At handling with asphalt materials it is necessary to observe relevant provisions of work safety.

9.2 Operators of the SILKOT device and other machines must be provably trained in their operation (according to producer's instructions) and their knowledge must be verified practically. They have to have relevant certifications for machine operation.

### **9.3 Work safety during road traffic**

#### **9.3.1 Safety of workers**

At work with road traffic the workers have to be equipped with warning cloths with marking of retro-reflective material with high visibility.

The towing car and the SILKOT device have to be provided with warning beacons of orange colour and they have to be operated constantly during work.

9.3.2 Safety of road traffic participants is secured by traffic regulation by means of a system of vertical traffic signs and traffic facilities.

It is a temporary arrangement of traffic on overland communications according to provisions of §61 par. 4 of Act no. 361/2000 Coll.

Rules for temporary traffic signs on overland communications are specified in TP 66 MDS CR. However the required base for their application to specific cases are provisions of Act no. 361/2000 Coll. as amended and the implementing regulation – Notice of Ministry of Transport of Czech Republic no. 30/2001 Coll. as amended, especially as for a location and a kind of traffic signs.

9.3.3 Rules for work safety on motorways and main roads, of which management the Road and Motorway Directorate of CR is responsible, are specified by the General Manager Regulation no. 2/02 – Rules of work safety on motorways and roads with traffic.

## **10. ENVIRONMENTAL PROTECTION**

During work execution the maker is liable to act so that no risk of environment damage occurs and that all regulations related to environmental protection are observed.

## 11. QUOTED AND RELATED STANDARDS AND REGULATIONS

ČSN EN 12591	Asphalts and asphalt binders. Specifications for road asphalts.
ČSN EN 1427	Determination of softening point. Ring and ball method.
ČSN EN 13108-1	Asphalt mixtures – Specifications for materials – Part 1: Asphalt concrete
ČSN EN 13108-8	Asphalt mixtures – Specifications for materials – Part 8: R-material
ČSN EN 13108-20	Asphalt mixtures – Specifications for materials – Part 20: Type tests
ČSN 73 6100	Road terminology
ČSN 73 6121	Construction of roads – Compacted asphalt layers – Execution and check of compliance
TP 66	Rules for temporary traffic signs on overland communications
TP 82	Catalogue of failures of non-rigid roads
TP 87	Designing of maintenance and repairs of non-rigid roads
TP 105	Disposal of waste resulting from construction, repair and maintenance of overland communications
TP 150	Continuous maintenance and repair of roads of overland communications containing tar binders
TP 208	Recycling of construction courses of non-rigid roads in cold way
TP 209	Recycling of asphalt layers of non-rigid roads in-situ in hot way
TKP Chapter 7	Compacted asphalt layers
SJ-PK	Quality system in area of overland communications (SJ-PK) ref. no. 20840/01-120, from 10.4.2001 (Traffic bulletin 9 from 2.5.2001) as amended by changes ref. no. 30678/01-123 from 20.12.2001 (Traffic bulletin 1 from 10.1.2002), ref. no. 47/2003-120-RS/1 from 31.1.2003 (Traffic bulletin 4 from 19.2.2003), ref. no. 174/05-120RS/1 from 1.4.2005 (Traffic bulletin 9 from 27.4.2005) and ref. no. 678/2008-910-IPK/1 from 1.8.2008 (full version including repair of printing errors was announced under ref. no. 678/2008-910IPK/2 in Traffic bulletin 18 from 27 <sup>th</sup> August 2008) and change ref. no. 980/2010-910-IPK/1 from 9 <sup>th</sup> November 2010.
Act no. 361/2000 Coll.	about traffic on overland communications
Notice of Ministry of Transport no. 30/2001 Coll.,	by which rules of traffic on overland communications and adaptation and control of traffic on overland communications are implemented.