Patch repair systems explained

To the highway engineer patch repairs offer a fast, efficient and cost-effective way of removing defects; safety hazards; maintaining skid-resistance; preserving and protecting roads against the damaging effects of water. To obtain the best results it is necessary to give careful consideration to a wide range of detail, to plan and design the work carefully. The speed of the patching operation and the short duration of time during which motorists are inconvenienced is also an important consideration and an advantage on roads carrying high volumes of traffic during peak periods. Howard Robinson from the Road Surface Treatments Association (RSTA) examines the different types of systems that can be used.

There are two types of systems: Spray injection patching and thermal road repairs.

Spray injection patching uses high volume low-pressure air to clean the road surface defect before applying a bituminous bond coat of either a hot or cold bitumen emulsion. Aggregate is then propelled, using high volume air at low pressure, before mixing it with the bitumen emulsion moments before it is compacted as it is placed in the patch. For heavier trafficked applications, compaction by a vibrating plate is often used. The new repairs can then be trafficked immediately after laying. The process is also included in BS 434-2:2006.

Thermal road repair involves applying heat to the upper 20-30mm of the surface course of a defective area to soften the material so it can be easily reworked with any extra materials added prior to compaction. The compaction of the heated materials creates a homogenous bond between the repair and the adjacent surfacing.

Determining the specification

All innovative patching materials and processes can be specified in accordance with clause 946 www.dft.gov.uk/ha/standards/mchw/index.htm and also the HMEP Clause 946SR in Guidance for the Development of Standard Specification and Standard Details for Local Highway Maintenance Contracts Version 1.

The selection of the right type of patching techniques to be used in highways maintenance depends on the depth and the type of defect. Each site must be considered in the light of its unique characteristics, including nature of surface, geography, volume/speed of commercial and other traffic using the section of road.

Spray injection patching technical details

Examples of typical spray injection patching machines are shown below:

Typical materials used are:
- Binders - used for spray injection patching are cationic bituminous emulsions complying with the requirements of BS EN 13808. Spray injection patching machines generally use either 60 or 70 per cent bitumen emulsion bond coats, applied either hot or cold. Some emulsions are available in summer and winter grades. Consideration should be given during the planning stages of the programme to traffic volumes, road type, skid resistance requirements, weather, and future resurfacing plans as these may all affect the binder selection.
- Aggregates - must comply with BS EN13043 and are selected dependent on end use, in particular the site’s PSV requirements. The designer of the spray injection patching asphalt mixture shall select suitable aggregate sources and sizes to ensure the installed product will be durable.

Site suitability

The spray injection patching process is satisfactory for use as a semi-permanent road repair to highway defects such as potholes, haunching, cracks and crazing and pre-surface dressing patching. It is particularly suitable for remedial works to the rural network.
Installation
Spray injection patching produces material in a continuous controlled operation and should only be installed by fully trained and NVQ qualified operatives and supervisors. National Highway Sector Scheme 13 (NHSS13) for the supply and installation of surface treatments onto road surfaces now includes spray injection patching. If a contractor is registered to NHSS13 it means the workforce have been properly trained and qualified and are competent.

Traffic management and weather considerations
The spray injection patching process requires appropriate traffic control as and when deemed necessary by the highway authority or as a result of a risk assessment by the contractor. This shall be carried out in accordance with National Highway Sector Scheme 12. Work should be carried out when the road temperature is 5°C and rising and below 45°C depending on the binder being used. Work should not be undertaken during periods of rain. However, it is possible to commence works on a damp substrate subject to spray injection patching guidelines being met.

Preparation
High volume air is used to remove all dust and debris from the area to be repaired before an application of bond coat is applied to seal the treated area. Road preparation is important to avoid de-bonding failures. Mechanical sweepers are used to clean the road surface before works are carried out. In extreme conditions such as heavy soiling additional measures may be required including the removal of loose material, vegetation, moisture and debris to the defect.

Addition of bitumen emulsion and asphalt
The bitumen emulsion bond coat should be introduced into the airstream enabling it to be forced into every crack and crevice to improve the adhesion of the bond coat while at the same time sealing the repair and the road base from further water damage.

The bitumen emulsion and an approved aggregate are delivered by the application tube, then immediately sprayed into the void at high speed. The new material is keyed into the existing surface.
**Compaction**

Compaction is not normally necessary as material self-compaction is part of the process however it may be required on more heavily trafficked roads. Loose chippings larger than 6 mm can cause vehicle damage and should be removed as soon as possible following treatment by light sweeping.

**Method of working**

The spray injection patching machine size and type is of major importance in assessing the following, due to the varying machine configurations available on the market.

On single carriageway trunk and principal roads, spray injection patching falls into the category of “mobile works”. Under this type of working, traffic will be controlled by the use of stop and go signs. The length subjected to this operation should be kept as short as possible consistent with safety requirements. Experience suggests that the safest method of operation is to treat one half of the road for the total length of the section. Traffic should be controlled to allow all plant and equipment to turn safely and position itself to treat the second half of the road. On minor roads, a decision will be required at the initial planning stage as to whether or not the road is to be treated in one pass.

Where the whole width is not to be treated in one pass and one way traffic operation past the spray injection patching process is contemplated, it is essential to ensure that the width of road available to passing traffic is not less than the desirable minimum of 3.25 metres or the absolute minimum of three metres set out in paragraph 2.5.1.6 of Chapter 8 of the Traffic Signs Manual.

**Limitations of the process**

Understanding the limitations of the spray injection patching process is key to the success and quality of the repairs carried out. Contributory factors for repair failure include:

- Incompatible material selection
- Operatives not trained and competent
- Repair mixture outside of specification
- Inclement weather immediately after application
- Incorrect process selection
- Road and air temperatures too high or low
- Quality control checks not carried out
- Aggregate contamination either on delivery or once delivered
- Binder outside of specification
- Lack of compaction where required.

**Thermal patch repairs technical details**

The thermal repair process is regulated under the HAPAS product approval scheme. It is a permanent road repair system for surface course defects that involves re-heating and recycling the existing in-situ material using a thermal heater.

Additional materials are added when necessary to facilitate the repair of the road surface.

The products used are:

- **Bitumen emulsion** – a proprietary bitumen emulsion, mixed into the re-heated surface before compaction
- **0/6 mm or 0/10mm asphalt** – two proprietary bitumen emulsion asphalts, mixed into the surface before compaction to ensure finished surface levels are restored
- **Coated chippings** – the types and sizes of coated chippings is determined by the site-specific requirements, including location and contractual requirements for polished stone value (PSV); texture depth and/or other properties of the existing surface course.

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Application and installation

Thermal road repair system is satisfactory for fixing defects such as potholes, chipping loss, joint failures, consequential damage and surface cracks on asphalt surfaces.

The system is installed solely by contractors approved by the HAPAS certificate holder using specialised equipment in accordance with the certificate holder’s laying procedure.

This should be in accordance with Department of Transport Traffic Safety at Street Works and Road Works Code of Practice and the following regulations:

- The Health and Safety (Safety, Signs and Signals) Regulations 1996

Works should be suspended during periods of continuous or heavy rain. Any free-standing water should be brushed away from the area prior to repair. The system should not be used when the air temperature falls below 0°C in anything other than calm, dry conditions. Use of the system should cease in all conditions when the air temperature falls below –3°C.

Preparation

The defective road surface is heated using the thermal heating equipment. Once the heater is removed the material temperature is then measured and recorded.

When the surface has been heated to the required temperature, a joint of 50mm inside the perimeter of the heated area is cut into the surface by hand.

The surface is then raked thoroughly to expose the maximum surface area within the material.

When necessary, bitumen emulsion is applied to the heated surface and raked in thoroughly with the existing material, prior to compaction. The addition of the emulsion is dependent upon the visual condition of the asphalt at the time of the repair. Additional asphalt mixture is added when necessary to ensure satisfactory finished levels. When required, coated chippings are applied to the surface taking care to ensure the finished texture level is achieved.

A temperature reading is taken of the repair to ensure it is between 80°C to 90°C and therefore ready for compaction.

Compaction and after care

Thermal road repairs are fully compacted immediately using conventional compaction equipment.

Visual checks for uniform surface texture, blemishes and any discernible faults are conducted by the installer and any remedial works carried out as necessary.

During the cooling period no disturbance or trafficking of the system is permitted. The repair can generally be trafficked within an hour.

Joints, binders and aggregates

The process provides a permanent seamless repair thus avoiding weak joints being formed. Thermal repairs can be undertaken across the pavement and do not have to avoid the wheel tracks of vehicles.

Binders used for thermal road repairs are proprietary bitumen emulsions and must comply with the requirements of BS EN 13808.

Aggregates shall be chosen from the appropriate properties and categories in BS EN 13043. Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas.

For heavy deterioration, thermal road repairs may be used as a short-term fix pending a permanent solution.