

# Pothole Patching Equipment

## Background

The City of Greater Sudbury is committed to continuously reviewing and testing creative solutions for roads maintenance. This report highlights the various types of pothole repair equipment available today. It is well understood that the effective repair of potholes as part of a routine road maintenance program minimizes the interruption of movement of goods and services across the City.

### Pavement Maintenance

There are many forms of pavement maintenance. A combination of techniques, applied at the right time, is required for a program to be effective. The categories listed below are typical to the City of Greater Sudbury's pavement maintenance program and consistent with industry best practices:

1. Preventive Maintenance – Treatments to prevent premature deterioration of the pavement or to slow the progression of the pavement defects. This is completed when the pavement is in very good or good condition. An example of this type of treatment would be crack sealing or crack repair.
2. Corrective Maintenance – Actions taken to repair defects that seriously affect serviceability. This can also be referred to as “reactive maintenance”. This is applied when the pavement structure is in good to fair condition.
3. Holding Maintenance – This includes maintenance actions designed to hold the pavement surface together until a more permanent or substantial rehabilitation takes place.

The repair of potholes is typically considered corrective maintenance or holding maintenance. These repairs are to address potentially hazardous conditions affecting the safety of the travelling public. These repairs are considered temporary or semi-permanent depending on the technique used.

Quality pothole patching is achieved through a combination of material selection and repair procedures. A pothole repair study is currently underway, as presented to Operations Committee June 15, 2020, to monitor the effectiveness of both new and current materials and placement techniques. This study would also include any new pothole repair equipment or technology as it becomes available.

### Pothole Repair Techniques

1. Temporary Pothole Repairs

#### a) Throw and Roll

Most frequently used pothole repair technique. This approach is used regardless of the weather and is considered an efficient method of repair due to how quickly it can be completed. Because of this, it is the most commonly used repair method during pothole repair campaigns or where high productivity is required due to a high volume of potholes.

This repair process involves:

- Identifying the pothole area to be repaired
- Clearing debris, water and ice from the pothole by sweeping
- Shoveling cold mix, hot mix, warm mix, recycled mix asphalt into the pothole
- Tamping with a vibratory roller, hand tamper
- Moving on to the next pothole

### 2. Semi-Permanent Pothole Repairs

#### a) Detailed Patching

The second most frequently used repair technique. This approach is used in favourable, dry, weather conditions. This technique uses Hot Mix Asphalt that is available during the late spring, summer and fall months. Occasionally, this method is also utilized when potholes are particularly severe during the spring melt and increased freeze – thaw cycle periods. Warm Mix Asphalt is hauled in a heated truck box from Southern Ontario for these repairs. This type of repair takes more time to complete than the “throw and roll” technique but provides greater performance because of the repair technique.

The repair process involves:

- Identifying the pothole area to be repaired
- Remove all of the deleterious asphalt with a mechanical grinder
- Sweeping the hole removing any loose debris
- Applying a tack coat to the bottom and sides of the area to be patched
- Shoveling and raking hot mix, warm mix or recycled mix asphalt into the pothole
- Tamping with a vibratory plate tamper, double drum or mechanical (finishing) roller
- Moving on to the next pothole

Also in this category is the large asphalt patching program completed each year through contract services. This program uses techniques very similar to the approach described above. The difference being that the areas are generally larger, removing further deleterious materials and the hot mix asphalt is placed using a mechanical spreader rather than by hand providing increased compaction and smoothness. This technique can address a combination of preventive, corrective or holding maintenance. When used as corrective or holding maintenance, it can extend the service life of a pavement by approximately 3 to 5 years and when used as

preventive maintenance it can extend the service life of the pavement up to 7 to 11 years.

#### b) Spray Patching

This pothole patching technique has been used infrequently at the City. It involves spraying a heated asphalt emulsion/aggregate mix into a pothole with a spray injection device.

The repair process involves:

- Identifying the pothole area to be repaired
- Using a blast of air, clean all the loose debris and water out of the pothole.
- Applying a tack coat to the bottom and sides of the area to be patched with the spray nozzle
- Using the same nozzle, fill the pothole with a heated mixture of asphalt emulsion and aggregate.
- Once filled, applying a coat of heated aggregate to finish the repair
- Moving on to the next pothole

When performing pothole repairs, matching the material surrounding the repair aids in its longevity. Because of its material composition, as well as the method of placement, spray patching can also be used to effectively address potholes on surface treated roadways. The durability of this repair is dependent on the quality of the aggregate and the curing of the asphalt emulsion. Colder temperatures can affect the curing process and dry aggregate may be difficult to access during the winter months.

#### c) Infrared Patching

This pothole patching technique has been used infrequently at the City. It involves heating the surface surrounding the pothole to a sufficient temperature that allows the area to be reworked with hand tools and augmented with additional asphalt and/or an asphalt rejuvenator leveled and compacted.

The repair process involves:

- Sweeping of the pavement area clean and free of moisture.
- Marking the repair area.
- Placing the infrared panel over the repair area.
- Heating the pavement to approximately 190 degrees Celsius.
- Raking the repair area.
- Working new asphalt into the repair area, and adding a rejuvenator if required.
- Grading the repair area to match existing surrounding pavement and compacting with a vibratory plate tamper, double drum roller or mechanical (finishing) roller.
- Moving on to the next pothole

Infrared is generally a more costly repair. Colder air temperatures affect the equipment's ability to reach the temperatures required to heat and rework the asphalt therefore the time it takes to complete the repair can result in loss of productivity. Roads Maintenance currently has a small infrared device that is used to level off asphalt around structures and with small patches.

#### Equipment/Labour Requirements for the Various Pothole Patching Techniques

The equipment and labour requirements vary based on traffic volume and lane configuration. For the purpose of this exercise, a high traffic volume multi-lane roadway (posted speed 60 km/hr) was considered. Table 1 indicates the equipment and labour requirements

**Table 1 – Equipment/Labour Requirements**

<b>Repair Technique</b>	<b>Crew Size</b>	<b>Utility Truck</b>	<b>Blocker Truck</b>	<b>Asphalt Grinder</b>	<b>Plate Tamper</b>	<b>Finishing Roller</b>	<b>Comments</b>
Throw and Roll	3	yes	yes	no	yes	no	<ul style="list-style-type: none"> <li>- If pothole patching equipment is used, the utility truck can be swapped out for the pothole patching truck.</li> <li>- If automated pothole patching equipment is used the number of crew members can be reduced by 1-2 people.</li> </ul>
Detailed Patching	4	yes	yes	yes	no	yes	<ul style="list-style-type: none"> <li>- Additional operator is required for the municipal tractor with grinder.</li> <li>- If pothole patching equipment is used, the utility truck can be swapped out for the pothole patching truck.</li> <li>- If automated pothole patching equipment is used the number of crew members can be reduced by 1-2 people.</li> </ul>
Spray Patching	2	yes	yes	no	no	no	<ul style="list-style-type: none"> <li>- Assumed the spray patching unit is mounted (roll off unit) on a truck with all applicable accessories. If the spray patching were a tow behind model, the truck would be a single axle dump to carry the aggregate.</li> </ul>
Infrared Patching	3	yes	yes	no	no	yes	<ul style="list-style-type: none"> <li>- Assumed the infrared unit is mounted on a truck with all applicable accessories. If the infrared heater were a tow behind model, the truck would be a single axle truck capable of holding a supply of hot mix asphalt, emulsion, compressed air and rejuvenator.</li> </ul>

# Pothole Patching Equipment

## 1. Asphalt Heaters/Recyclers (Hot Boxes)

A hot box is used to transport hot mix asphalt, warm mix asphalt or recycled asphalt to various locations year-round when needed to repair patches and potholes while maintaining a constant asphalt temperature of up to 150 degrees Celsius. Numerous manufacturers and configurations can provide customized hot boxes to meet operational needs. Hopper design can have a capacity of 2 to 8 tonnes depending upon the manufacturer and the agency requirements, and may be trailer-or truck-mounted, as shown in Figures 1 and 2 below.

Typically, agencies will have two-tonne or larger hot box trailer units subject to operational requirement towed by a truck to carry additional tools and supplies, and may also have a truck-mounted hot box to carry larger quantities of hot mix, tack tank and tools. In addition, self-contained all-in-one units can be outfitted to complete a range of pothole and patch repairs. Currently, the City of Greater Sudbury operates with five, two-tonne hot boxes that are towed by a truck.

When utilizing a two-tonne trailer mounted hot box, there can be significant crew downtime depending on the distance to the pothole repair area and where the crew refills the hot box with more asphalt. The benefit to the truck mounted hot box would be the ability to carry more material, reducing downtime.

The costs of truck and trailer mounted hot boxes vary significantly with user requirements. For example, a typical 4-tonne trailer mounted hot box will cost approximately \$50,000, while a well-equipped self-contained all-in-one unit will cost approximately \$250,000, including the truck.



Figure 1 – Truck-mounted Hot Box  
(Transportation Association of Canada, Best Practices in Pothole Repair - 2019)



Figure 2 – Trailer-mounted Hot Box  
(Transportation Association of Canada, Best Practices in Pothole Repair - 2019)

## 2. Spray Patchers

Spray patchers can be either trailer-mounted, requiring a separate truck to supply and load aggregate, as shown in Figure 3 or self-propelled with aggregate hopper, as shown in Figure 4.

The self-propelled spray patcher is a two-person operation, including traffic control requirements, as described in Table 1. Repairs are performed from the truck cab with minimal disruption and open to traffic immediately upon the completion of the repair. Self-propelled spray patchers vary in capacity and may carry eight tonnes of aggregate. They provide a relatively quick pothole and patch repair using a spray injection system. Rear-mounted boom systems are also available; these are operated and controlled from the ground.

Depending upon options required, a trailer-mounter spray patcher might cost approximately \$100,000 and a self-propelled all-in-one spray patcher approximately \$300,000.



Figure 3 – Trailer-mounted Spray Patcher  
(Transportation Association of Canada, Best Practices in Pothole Repair - 2019)



Figure 4 – All-in-one Spray Patcher  
(Transportation Association of Canada, Best Practices in Pothole Repair - 2019)

### 3. Infrared Patchers

Infrared equipment manufacturers offer different-sized equipment and configurations to fit different size and shaped repairs. Larger infrared road repair units, are mounted on a truck with space for a hot box, propane tanks, hand tools, compaction equipment and rejuvenator tank storage, as shown in Figure 5. Smaller infrared units, may be loaded and transported to a location by trailer.

Infrared road repairs are generally suitable for shallow surface distress patch repairs up to 50 to 75 mm in depth. An advantage of the infrared road repair method is that it recycles asphalt, compared to removing and replacing distressed pavement areas and replacing with new asphalt. Repairs can take over 20 minutes depending upon the size of the repair area. The result is a sealed surface preventing water penetration that may cause additional damage, providing a longer-lasting repair.

Depending upon the options required, trailer-mounter infrared units may cost in excess of \$50,000, and self-propelled all-in-one infrared units can cost in excess of \$300,000.



Figure 5 – Trailer-mounted infrared unit  
(Transportation Association of Canada, Best Practices in Pothole Repair - 2019)

#### 4. Automated Pothole Repair Unit

When compared to conventional hot box repair systems, this equipment does not require the operator to leave the cab to complete the repair. Given the configuration of the equipment, the operator has a good view of the repair area from the cab. This is a two-person operation, including traffic control requirements, as described in Table 1. This equipment can dispense either hot or cold mix asphalt that is maintained at the desired temperature and repairs potholes typical to the “throw and roll” technique. To complete detailed patching, a separate municipal tractor equipped with a grinder would be required.

Depending upon the options required, an automated self-propelled pothole patcher will cost approximately \$350,000 to \$400,000.



Figure 6 – Automated self-propelled pothole patcher  
(Transportation Association of Canada, Best Practices in Pothole Repair - 2019)

## Analysis of Pothole Repair Equipment

Table 2 – Pothole Repair Equipment Comparison

Repair Equipment Type	Temporary Repair	Semi-Permanent Repair	Applicable in Wet Conditions	Applicable in Dry Conditions	Pavement Surface	Surface Treatment Surface	Crew Size
Asphalt Heater/Recyclers (Hot Boxes)	Yes	Yes	Yes	Yes	Yes	Yes	3 or 4
Truck Mounted/All-in-one Spray Injector	Yes	Yes	No	Yes	Yes	Yes	1 or 2
Truck Mounted Infrared Patcher	No	Yes	No	Yes	Yes	No	3 or 4
Automated Pothole Repair Unit	Yes	No	Yes	Yes	Yes	Yes	1 or 2

Note: The Asphalt Heaters/Recyclers (Hot Boxes) can be used for both “throw and roll” and detailed patching. Refer to Table 1.



## Conclusion and Next Steps

When carrying out a pavement maintenance program, it is important to utilize the right techniques at the appropriate time to maintain the serviceability of a road network. All of the techniques and equipment described in this report are viable options to consider when repairing potholes. When evaluating the decision to purchase pothole repair equipment, it is important to evaluate the benefit the equipment provides compared to the cost to purchase and maintain it.

It is therefore recommended to prepare a business case that includes a net present value analysis of each pothole repair equipment described above. This analysis would evaluate the initial equipment investment and ongoing maintenance expenses compared to the benefits realized through labour savings and efficiency of performed repairs.

## References

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