



Truck mounted coring unit with stabilizers

# Keyhole Basics: Coring 101

by **E. Marshall Pollock**

Over the past decade, as utilities and their underground contractors look for more efficient, economical and environmentally friendly ways to make repairs to underground utilities and install new buried infrastructure, they are beginning to realize the many benefits associated with Keyhole Technology – the process of making small, surgical circular cuts through the hard surface to gain access to the infrastructure buried below.

Besides a decrease in the need for a large variety of construction equipment on site and the resulting reduction in the environmental footprint when compared to traditional utility cuts, keyhole technology allows for the cored pavement, or “coupon”, to be saved for permanent reinstatement when the underground work is completed which results in substantial savings in permanent pavement repair costs. However, as with many new and emerging technologies, familiarizing new users and helping them to make an informed decision about equipment purchases and proper techniques to carry out these new procedures becomes critical to continued success.

Keyhole technology involves a rotary cutting unit, or core drill, that safely and accurately cores an 18-inch or larger diameter hole through asphalt, asphalt-concrete and reinforced concrete road systems and sidewalks to enable crews to vacuum excavate and view subsurface activity or to repair underground plant from the road surface using long-handled tools. Because the goal is to reinstate the original core back into the pavement after the underground work has been completed, precision and accuracy in the initial coring operation are essential.

There are four key success factors involved in the coring and reinstatement process:

- Choosing the proper coring equipment;
- Proper set up and coring procedures;
- A method of extracting the core; and
- A bonding compound to reinstate the core back into the pavement.

## Choosing the proper coring equipment

Because, at the end of the day, the intention is to put the core back into the road, the coring equipment used to cut it must produce an accurate and precise result. If you are going to throw the core away, any coring unit will probably work.

The selection of the proper coring equipment first depends on the size of core that needs to be cut: What is the diameter of the hole needed to perform the underground work and how deep is the pavement?

There are many small, portable coring stands on the market that can effectively cut a small core of between 4 to 6-inches in diameter. These are usually driven by a small, top-mounted gasoline engine, and are either controlled by a hand-held, horizontal “T-bar” or anchored to the pavement with lag bolts or a vacuum mechanism. Either do a reasonable job with small holes. But as the diameter of the hole that is needed gets bigger, like 12 to 24-inches (a typical keyhole is 18-inches in diameter) or the depth of the pavement increases beyond 4 to 6-inches or so, the choice becomes more limited. Only a truck-mounted, skid-steer mounted or trailer-mounted coring unit has the coring power and stability needed to get that job

done.

As with every piece of construction equipment, the size, design and performance capabilities of the coring unit, as well as its price, will depend on workplace conditions and the volume of work to be performed.

## Proper set up and coring procedures

The two most important factors to be considered in the selection of truck or trailer mounted coring equipment are (1) the stability of the coring platform itself and (2) the ability to properly adjust the angle of the coring drill so that the core is cut perpendicular and true or plumb with the horizon and not the road surface. This latter measure is important to neutralize the effect of gravity on both the coring and reinstatement processes.

Because most roads are crowned, or angled to allow surface water to run-off, if you cut the core perpendicular to the road surface, one side would be lower and affected by gravity more than the other and the core itself would not have “true” or vertical sides. Not only is the vertical nature of both the core and the hole important during reinstatement to prevent the bonding compound from pooling or migrating to the low side, but with deeper cores there is the added danger that the pull of gravity will cause the core to bind up inside the core drum or, even worse, cause the core drum itself to become stuck as it is driven deeper into the pavement – causing damage to the coring unit.

As for stability, because springs are integral to most wheeled vehicles, it is important that the suspension of the truck or trailer be isolated during the coring process. Otherwise, much of the downward pressure or vertical force required to initiate the coring action will be lost or

absorbed by the suspension and result in erratic cutting action.

Both of these issues can be resolved by the use of hydraulic stabilizers fixed to the deck or frame of the vehicle, on either side of the core drill. When adjusted, these stabilizers will take the spring action out of the suspension and concentrate the weight of the vehicle down through the core drum for an accurate and precise cut. At the same time, the stabilizers can be adjusted to position the core drill to be perpendicular to the horizon in the plane that parallels the width of road.

The core drill must also be capable of adjustment so that it is also perpendicular to the horizon in the plane that parallels the length of the road. This is usually done by adjusting the hydraulic cylinder that elevates the core drill to the upright position from the bed of the vehicle. When both of these adjustments have been made, the resulting core will be true and plumb to the horizon.

Once you have the core drill properly adjusted, coring operation can begin. The working end of a good quality coring bit has cutting teeth or segments made of a composite matrix in which layers of diamond crystals are embedded. Unlike carbide, high speed steel, and other types of drills, that cut material with a sharp cutting edge, diamond drills work by grinding away material on a micro level. As they wear their way through the material the diamond crystals in outer layer are worn down and replaced by those in the next layer and so on. The rate at which this wear takes place depends on the hardness of the material to be cut (concrete or aggregate in asphalt or re-bar in reinforced concrete), the rotational speed and down pressure on the drum, as well as the matrix in which the diamonds are embedded. A properly segmented coring drum can be expected to cut between 70 and 100 cores before needing to be re-tipped. But optimum performance and life can only be achieved when the correct segments are chosen and the drum operated at the proper speed (RPMs) and pressure.

Faster drill speed or greater pressure may appear to increase production efficiency, but the trade-off will be a significant increase in friction and heat which considerably reduces the life of the bit. A drum that spins too quickly will glaze the segments and result in slowed penetration and longer cutting times. Conversely a drum that spins too slowly cannot properly expose the diamond layer and will slow the penetration rate. As a rule of thumb, an 18-inch diameter coring drum should

rotate between 180-200 RPM.

Too much down pressure leads to premature diamond loss and could even cause the segments to break-off or the drum to jam. The cutting process through typical pavement should take approximately one minute per inch of pavement thickness. Anything more and the segments being used in your specific application, or your coring procedures, are not correct.

### Method for extracting the core:

Now that you have selected the appropriate equipment to successfully complete the coring portion of the job, the next challenge is how to safely extract that heavy core from the roadway.

An 18-inch diameter core 10 to 14-inches deep can weigh almost 175 pounds. Besides the weight, pavement cores sometimes have the tendency to delaminate – or separate – between the asphalt top layer or layers and the concrete base. Sinking a lag bolt, or the like, into the top of a core only lifts out that top layer and is an unsafe procedure as it can easily pull out of the core and cause injury. This is most prevalent on warm days when the asphalt surface becomes soft.

The best way to extract the core is to drill an access hole through the center of the core and use a core lifting device. This can be done with a bar hole or hammer drill either before or after coring process. The better approach is to use a coring drum that is fitted with a pilot drill in its center that can cut the center hole at the same time that the core is cut. (Think of a hole saw for the installation of a door knob assembly). This central pilot hole, not only stabilizes the coring operation, but allows for the insertion of a special core puller tool that extends through all the layers, right to the bottom of the core. It has a rubber stopper that expands, friction-tight, inside the pilot hole, allowing the worker to quickly and easily lift the core out by himself. If it is too heavy, a pry bar can be inserted through the ring at the top of the core puller, and the lifting load shared with a co-worker. For really heavy cores (a 24-inch diameter core, 16-inches deep can weigh 450 pounds) some coring units come with an electric hoist or crane.

### Bonding compound to reinstate the core

The next step is the process of core reinstatement after the underground work has been completed.

There are several key factors that need to be considered when choosing the proper core reinstatement compound. Most important, it should be easy to use and achieve a very strong, waterproof bond with the remaining pavement. To minimize traffic delays and public inconvenience, it should



Core extracted with core puller

also have the ability to gain that strength quickly so that the road can be safely reopened to traffic as soon as possible after the repair. That is important for municipal approval, as is the ability of the bonding compound to create a mechanical joint that restores the road to its pre-excavation strength and load sharing ability.

Generally speaking, the core bonding product should create a solid bond that can support a single wheel load of at least 30,000 pounds – which, for safety, is three times the AASHTO H-25 minimum load bearing standard. It should also do so as quickly as possible. There are some commercially available products that can set-up and gain full strength in just 30-minutes. The bonding compound should also be easy to store and transport and easy to mix with the exact amount of water required. Too much water and the strength of the bond will be dramatically reduced. Too little water and the material will not gain sufficient fluidity to pour and completely surround the core with no voids. Always use a product that eliminates the guesswork on how much water is needed.

Off the shelf, run of the mill, bulk concrete mixes or grouts are really not suitable for core reinstatement. They are unpredictable and there is no way to accurately measure their strength gain. Neither are epoxy type products which are difficult to use in the field. The best strategy is to use only those core bonding compounds that have been specially formulated to deliver all of the performance characteristics needed for this application. Otherwise, you run the risk of reinstatement failure – and failure of the entire keyhole process. Remember, the price differential between good and bad is usually small.

### Conclusion

As with any task, having the right tools to do the job is important. As shown, there are many different components involved but, when properly chosen, they can make this innovative construction process worker friendly, easy to perform, and most importantly, cost-effective. And remember, whether it is truck, trailer or skid-steer mounted, if you choose a coring unit that is suited to your coring needs from a reputable and experienced manufacturer, and operate and maintain it in a responsible fashion, it will give you many years of satisfactory coring service.

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Keyhole properly reinstated with core bonding compound