



User's Manual

SYSTEM OPERATION AND MAINTENANCE

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SYSTEM OPERATION AND MAINTENANCE

Part 1: Getting Started

The Utilivac® system is the result of a focused research and development effort with the goal of providing a practical vacuum excavation system when operated from a portable 185 cfm compressor. It is designed to provide years of trouble free service under the most extreme operating conditions.

Theory of Operation

The Utilivac® system generates a powerful vacuum suction at high rates of flow by converting the energy contained in compressed air into vacuum. This is accomplished through a series of computer designed nozzles, venturi and entrainment chambers connected by neoprene differential pressure valves. The operation of the valves is automatic and provides the operator with the exact level of vacuum or flow needed at any moment. The Utilivac® is an optimized system, meaning that it has been precisely balanced by maintaining tolerances of .001" on internal working surfaces. Each unit is individually handmade to these tolerances; any modification of the vacuum generator by the end user whatsoever will render the system inoperable. The Utilivac® is a closed vacuum system. This means that there must be a sealed vacuum container attached to the vacuum generator in order for the system to work. The Utilivac® is not intended to have material pass directly through the vacuum generator, and cannot dump material directly onto the ground without the use of some kind of air lock. Every piece of the Utilivac® system is protected by patents domestic and foreign.

System Components

A complete Utilivac® system for digging applications consists of the vacuum generator, the control valve, the hopper, and the air lance. We also provide a 4" material pickup hose assembly. We do not recommend the use of other air lances, or other types of pickup hose with the system. The system has been carefully designed to operate at its best with the supplied lance and hose. Other air lances may consume too much compressed air and are less effective than the one available with the Utilivac® system. When your pickup hose is worn out it can be replaced by calling the factory or your local hose supplier.



Figure 1: Basic system components: hopper, vacuum generator, control valve, pickup hose assembly

The VE-75 hopper lid fits standard 55 gallon drums. Utiliscope also manufactures a separator head designed specially to fill 55 gallon drums for environmental and remediation applications. Select drums that have a good rolled lip where the lid will seal. Damaged drums may collapse under high vacuum or develop air leaks that will reduce the effectiveness of the system.

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Selecting the Proper Configuration for Your Application



Fig. 2

The Utilivac® was intended to be a portable system. By keeping the material handling hoses as short as possible you will achieve the greatest efficiencies. The type of hopper used will be dictated by a number of factors specific to each project, and you may find that you need several hopper configurations to cover all possible situations. The following guide is suggested to help in selecting the proper hopper for the job.

Hopper Type: Utilivac VE-75 Hopper

Advantages:

1. Light weight and very portable
2. Designed specifically for excavation
3. Simple to empty
4. Material is kept off of the ground
5. Dewatering attachment available
6. Fast set up and break down

Typical Applications:

The hopper is ideal for most small to medium size excavations projects, including utility pot holing/ locating applications, smaller cleanrage utility pot hole will not fill a hopper, and the site is kept clean. The hopper is emptied by opening the door at the bottom. The empty hopper can be easily moved from location to location by tipping the hopper onto its wheels and rolling it. Applications involving large amounts of water, such as pot holes in areas of high water tables may require a dewatering attachment. This device allows water to be ejected from the hopper while solids remain.

Hopper Type: VE-55 High efficiency drum packer.

Advantages:

1. Light weight and very portable
2. Direct drumming of material for disposal



Fig. 3

Typical Applications: Drums are used when material needs to be hauled off site, or when material will be packed into drums for disposal. Although the top of the VE-75 hopper fits the top of 55 gallon open top shipping drums the VE-55 system provides better separation and allows drums to be filled to the top.

VE-75 Hopper with De-Watering Valve

Advantages:

1. Unlimited water capacity
2. Separates solids
3. Light, no maintenance
4. Will not clog
5. Fast, high capacity
6. Vacuums dirt, water, mud, and slurries

Typical Applications:

When ground water or other sources of water infiltrate the excavation, the dewatering attachment allows the hopper to collect both solids and water. Water is naturally decanted and released out of the hopper each time the system is idled (each time the control valve is released). Outlet is standard 6" Schd 40 female slip fitting which must be equipped with a check valve for water pumping operation. The discharge is gravity flow.

The Utilivac system, when equipped with a check valve makes an excellent trash pump, because of its ability to handle 4" solids and the fact that it does not need to be primed. The check valve is any 6" schedule 40 "backwater" valve available at commercial pumping supply stores or from the factory.



Part 2: System Requirements

To achieve maximum benefit from your Utilivac® System it is important to set the system up correctly. One misconception about vacuum excavation is that you must run the air lance and vacuum simultaneously in order to dig effectively. This is not always true. The most efficient vacuum excavation technique often uses the vacuum and air lance alternately. This allows the smallest possible hole to be dug, minimizes wear and tear on the equipment, and keeps operator fatigue to a minimum.



Compressed Air Supply

The quality of your compressed air supply is the most important factor in insuring the success of operation. This system was designed to be used with a 185 cfm size compressor capable of producing 100 to 125 psi. A larger compressor will not provide improved performance of the vacuum generator, although it will not hurt. The vacuum

pump is equipped with a pressure gauge (Figure 5) at the air inlet port on the back end of the unit. During operation, this gauge should read at least 68 psi when used with a 185 cfm compressor. The unit will not operate properly with less than 68 PSI showing on this gauge. **THE GAUGE ON YOUR COMPRESSOR CAN NOT BE USED TO CHECK THE FUNCTIONING OF THE VP850 PUMP. THE GAUGE ON THE VP850 MUST HOLD 68 PSI FOR PROPER OPERATION!** See Figure 5.

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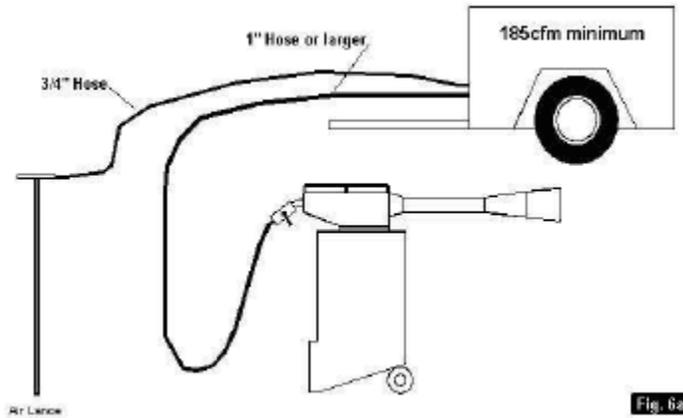


Figure 6a - Recommended, double hose arrangement.

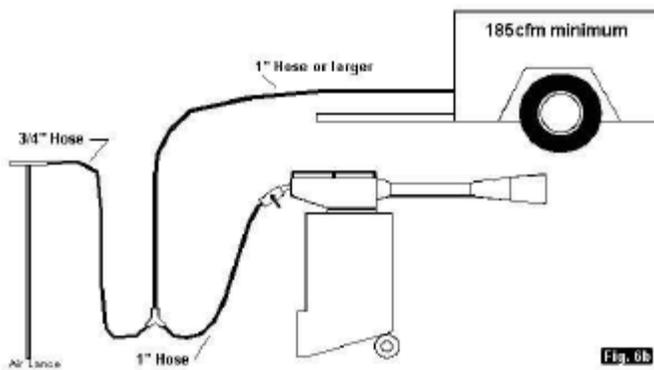


Figure 6b - Alternate, single hose arrangement. This arrangement will not allow simultaneous operation of the vacuum and air lance.

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Material Handling Hose

The supplied 4" smooth bore hose is ideal for most applications of this system. Call the factory if you have a mud or water pumping application. The shorter the material handling hose (FLEX) the better. We recommend that 8 to 10 feet of flex hose be the maximum if at all practical.

Gulper tube is best made of schedule SDR35 PVC sewer pipe. Schedule 40 pipe is too heavy and is difficult to maneuver, while schedule 10 pipe is too flimsy and will collapse under the vacuum. Aluminum pipe works very well as gulper tube, but is not very durable and is expensive when compared to plastic. Gulper tube can be extended to 20 feet or more by using the bell connections as the application demands. For valve box cleaning applications, you may find that 3" gulper fits into the valve better. If you use smaller gulper tubes you should also use smaller flex hose.

NEVER OPERATE THE UNIT WITHOUT A CATCH BAG IN PLACE!

The VP850 vacuum pump is supplied with a Catch bag. This bag must be used at all times to prevent possible injury or death from material which might pass through the vacuum generator if the hopper is over filled. There are many types of exhaust bags available depending upon your application. For most outdoor vacuuming, a mesh bag is a good choice. If you are concerned about fine dust, custom bags are available in available in many micron ratings.



Figure 7 - Installing the exhaust bag.

Figure 8 - Release the latch and lift the clip.

These exhaust bags can be rinsed and reused many times. For applications where vacuuming must be done in an enclosed area, it is necessary to duct the Utilivac® exhaust outside. The VP850 pump was designed to allow standard 8" exhaust duct to be attached to the exhaust end. This 8" exhaust duct is available in 25' sections from the factory or your local hose supplier.

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System Assembly

The following is a typical system set up procedure for use with the hopper arrangement.



1. Select the appropriate location for the hopper and place it on solid level ground. Ideally the hopper should be about 6' (2m) from the excavation. Check the wheels if necessary to stabilize the hopper. (Figure 11)



2. Install the vacuum pump so that it points away from persons in the area. Be sure that an exhaust bag is securely installed. Secure pump with elastic hold down. (Inset) Check all neoprene sealing surfaces (upper lid, lower door) for snug fit. Damaged seals or improper attachment will rob system performance. (Figure 12)



3. Connect the hand operated compressed air control valve assembly to the vacuum generator. Attach hand tight only. (Figure 13)



4. Attach the 4' material pickup hose and SDR35. Remember to use the tapered bushing to connect the hose to the gulper tube. The straight bushing is used to connect hose to the hopper. (Figure 14)

Part 3: System Maintenance

The Utilivac® system is nearly maintenance free and requires only regular cleaning of its internal air passages and inspection of its sealing surfaces.

Cleaning the vacuum generator should be cleaned often depending upon the amount of use, types of material being vacuumed, or when you notice that the unit is not performing as well as usual. As dirt builds up on the inside of the vacuum generator, it changes the critical dimensions of the entrainment tubes. This buildup eventually will cause a loss of performance if not removed. Do not use abrasive, steel brushes or sandblasting equipment. Remove the back plate and clean out the primary cone and tube with a small brush. A power washer is very helpful in cleaning the vacuum generator if a lot of buildup has been allowed to form. Do not clean the neoprene check valves with the pressure washer as it will be damaged. Occasionally you should also wash out the area around the neoprene valves. If your air compressor has a very oily discharge, your vacuum generator will tend to get dirty faster.



Figure 15 - Clean the back of the hopper with a watering hose

Figure 16 - Cleaning the under-side with a watering hose. Use soap and water.

Figure 17 - Clean the nozzle of the hopper with a watering hose.

Figure 18 - Keeping the check valve sealing area clean is vital to performance. Thoroughly remove any buildup but do not use a pressure washer around this area.

Maintenance

Clean and oil the actuator valve as needed to keep it working smoothly. You should regularly inspect the gaskets on the sealing surfaces, and replace as needed. Replacement gasket material may be obtained from the factory or similar materials can be purchased locally as long as the gasket material provides a good air tight seal. Check the neoprene valves on the vacuum generator for free movement and signs of delimitation. If the valves do not move freely the unit is probably dirty. In the rare event that the valves have delaminated or broken in some way, a replacement can be ordered from the factory. A new valve can be installed in a matter of minutes. Complete instructions come with the valve replacement kit. Under normal use, the valve should last for several years. The air lance set requires only minimal attention. Oil the valve occasionally with air tool oil and check the connectors for wear. Keep the barrels as straight as possible. Check the gap and condition of the nozzle and replace it if it is excessively worn. Do not substitute other materials for the supplied air lance barrels as an unsafe condition may result. Worn nozzles will consume excessive air and be ineffective at digging. The nozzle can be reshaped with a grinding wheel to its concave shape, but you must be careful not to heat the tip too much as this will undo the heat treating and soften the steel.

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Part 4: Trouble Shooting

Almost every problem encountered with a Utilivac system is related to a problem with the compressed air supply, an air leak, or dirt build up.

Problem: Unit does not perform well and pressure gauge on vacuum generator reads less than 68 psi during operation. The gauge on the compressor reads 100 PSI.

Cause: Insufficient compressed air. This could be the result of using an undersized or defective air compressor, using the wrong size air lines for the length of run, leaky air lines, or a valve which is obstructed or not opening all the way. The pressure reading on the compressor is not relevant to the air flow at the pump.

Problem: Unit does not perform well and pressure gauge (on the pump) reads in the normal range (over 68psi).

Cause: There are two probable causes: 1) the system may have a vacuum leak at one of the seals. Other places to look for leaks are along the material handling hose. 2) The second cause may be dirt buildup in the vacuum generator, a clog in the material hose, an over full hopper, or an extremely clogged exhaust bag. If the unit does not generate much vacuum or flow, the neoprene flapper (check) valves in the base of the vacuum generator may be in need of replacement.

Problem: Air lance does not cut through the soil.

Check the air flow from the blade end of the lance and make sure it is not clogged with dirt. If the lance blade air gap is too wide or too narrow it will not dig efficiently. Check the air gap; it should be approximately .040 in. for proper operation. You may also have encountered very hard soils and you may have to alter your technique. It is usually more effective to bore pilot holes in hard soils than to jab into them with the blade. **GENERALLY YOU SHOULD NOT USE THE LANCE TO DIG THE FIRST 12" OF EXCAVATION. THERE IS TOO MUCH RISK OF INJURY FROM FLYING MATERIAL. USE A DIGGING BAR OR OTHER HAND TOOL FOR THE FIRST 12" OF EXCAVATION AS LONG AS YOU ARE SURE NOT TO ENCOUNTER UTILITIES.**

Part 5: Tips for Using the Air Lance and Vacuum

When practical do not use the standard air lance to dig the first 12" of depth. Not only is this dangerous to the operator and passersby, but the first 12" of soil can be very hard and compact. It is better to select a digging bar or other appropriate tool such as a "clay point" lance to break up the hard top layer, and use the vacuum to remove the broken soil. It is a good idea to know the approximate depth of the target utility. If you suspect the utility is less than 2 feet deep you may have no choice but to begin your excavation with the air lance so as to not damage the utility

Never push the standard air lance into the soil without the air turned on. This will clog the tip. A handy tool for unclogging the tip is a piece of hacksaw blade (Figure 20) with the teeth ground off. Make sure there is no pressure behind the lance before you try this. Disconnect the air lance from the air supply to be sure. Make sure that all connections in the lance are very clean. This will keep the connections from leaking.

In very hard soil, add about a gallon of water to the test hole after it is about a foot deep. Then use the lance to drill a pattern of pilot holes and allow the water to combine with the cuttings in the hole to form a slurry. Once you have drilled five or six pilot holes this way, you should be able to break up the hard pan and continue on down to the utility. If you are working in difficult soils contact the factory, there are several different types of air lances available to handle problem soils such as hard pan or tight clay.

In frozen soil, use the pilot hole method to break up the frozen soil. Gently "dance" the lance over the frozen soil. Do not force the lance or drive the lance into the soil; let the air do the work. For valve box cleaning, start by using the air lance to loosen the dirt; then apply vacuum and air lance at the same time to complete the process. You may find that a 3" pickup hose works better.

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In very sticky mud and clay use the vacuum alone to pull up "plugs" by taking advantage of its high vacuum capabilities. Push the vacuum pickup pipe into the soil then pull it out and allow the plug of soil in the tube to be pulled through. Caution, when the plug comes through the pipe, it will be moving fast. This can be a very effective technique. Some types of clay soils can be excavated using a "clay point" style air lance. Call the factory to discuss which lance is best for your soils.

In very unstable soils, you may need a casing pipe for the spot hole to prevent cave-ins. A section of 6" or 8" plastic pipe works well for this. Before using a casing pipe, it is best to pre-locate the utility with your air lance to make sure you don't waste any effort. It may not be possible to remove your casing pipe from the hole.

Attempting to empty the hopper by tipping it forward is not recommended. A full hopper can



weigh in excess of 900 pounds! Open the lower door and remove vacuumed material with a shovel, as shown in this photo. Once the hopper has been shoveled out, the hopper can be tilted forward to completely empty it.

Figure 20: A hacksaw blade with the teeth removed is a good tool for clearing a clogged nozzle. Relieve all air pressure in the lance before doing this.

Part 6: Locating Utilities



Setting up the Jobsite

Before you start the utility location work, you should get to know your jobsite. Is the job in a city setting? What traffic control devices will you need? Will you need to close a lane? Do you need to obtain a state or local permit? Is the jobsite "off-road" easement work, or limited access highway? Knowing the answers to these questions ahead of time may save you a headache later. Knowing your jobsite needs early will help save

you time in setup and help provide a safe work area for you and your crews. Be sure to notify the local utilities to mark their lines in advance of your work. (Figure 21)



Setting up the Test Hole (Spot Hole)

The Utilivac® system can excavate very rapidly. The operator must resist the temptation to dig blindly until the target utility is uncovered. Pinpoint the location of the target utility to insure that you are not wasting time by digging in the wrong spot. Utiliscope recommends using and sells electronic utility locating equipment. Remember: the smaller the spot hole, the faster it can be dug and filled in. Because the Utilivac® is

capable of digging to depths of over twenty feet, a one foot horizontal error may result in hours of time wasted. (Figure 22)

Setting up the Equipment Once you have determined the exact point to dig, bring your truck and compressor into the work area. If you will be working in a travel lane, we recommend placing your truck between you and oncoming traffic. Remember, when working around a vehicle; make sure the wheels are always chocked. Next, bring out the hopper and set it at the opposite side of the hole away from the truck, about 3-6 feet from the hole works well. By placing the hopper there you will not have to walk around it if you need to go back to the truck for equipment and may prove helpful when working in traffic or close quarters. Next bring out your vacuum generator. Set the generator on the hopper making sure the compressed air connection on the generator faces the same direction as the pickup hose. This will point the exhaust away from you. Attach the pickup hose to the material inlet. Note: **REMEMBER TO USE SAFETY PINS IN ALL OF THE AIR FITTINGS.** Next connect the hand operated valve assembly to the vacuum generator **HAND TIGHT ONLY.** Now, connect the air supply hose from your compressor to the other Chicago fitting on the hand operated valve assembly. Connect a separate air supply line to the air lance if desired. If cutting asphalt or concrete is required, you will need a paving breaker and bits. Also, don't forget the asphalt or concrete patch.



Fig. 23

Starting the Spot Hole Although it is not necessary, you may want to start the test hole with a shovel, digging bar or other hand tool. This will reduce the amount of blowing dust and dirt once the air lance is inserted. If working around fiber optic cables, gas lines or PVC piping, extreme care must be taken when using hand tools. Keep the opening in the ground as small as possible. We recommend an initial cut of 8" x 8". After the hole has been started, use the air lance to pinpoint the

utility by "pre-locating". "Prelocating" means using the air lance to "bore" a hole through the soil until you can feel the utility on the tip of the lance. Excessive downward force is not necessary. A steady "twisting" or 90 to 180 degree rotation is normally all that is needed. By "pre-locating" the utility in this manner you can save countless hours of digging, and will let you know right away how deep the line is. Even though you may feel the utility through the pilot hole, it is imperative that you visually verify. As the soil becomes aerated and breaks up, use the vacuum to remove the loose soil. When you reach the top of the utility, start working on the soil to the side of the pipe. It is a good practice to expose the top (crown) and the side (spring line) of the utility. This will help give you a clearer picture of the utility. Size, material and condition are more easily obtained in this manner. (Figure 23)



Fig. 24

Recording the Data If there are specific details about the utility that need to be recorded, we recommend you create a standard form to write them on. Recording the data should be done while the hole is open. If you are digging several holes a day, recalling the details of one from another is tough. Some of the things you may want to write down are: size, depth, material, color, condition of utility, soil condition (type of fill, wet or dry), trend of utility, fittings, joints or bends if found. A typical data sheet is illustrated in

Appendix 1. Appendix II shows a data sheet with information recorded. (Figure 24)



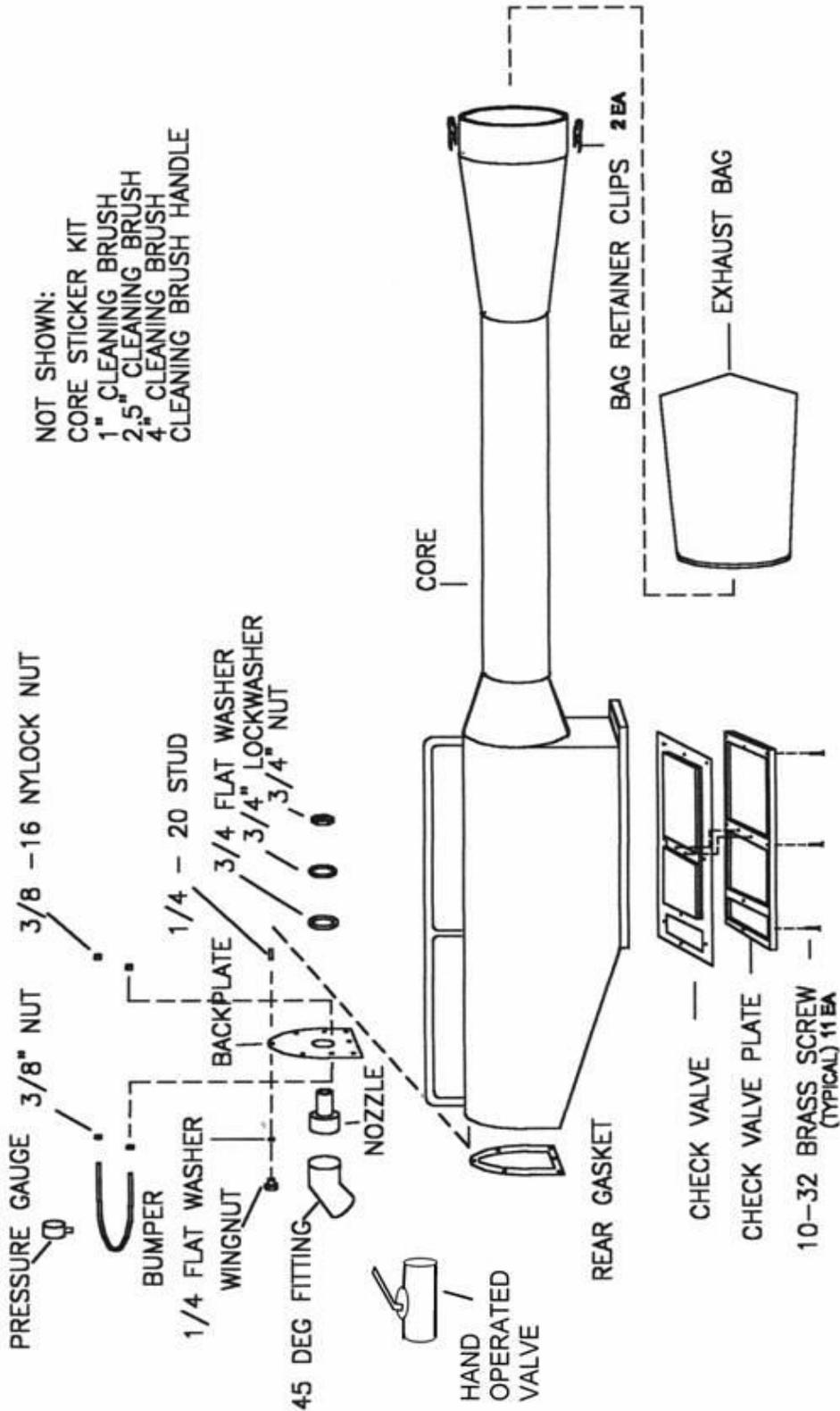
Fig. 25

Backfill and Site Restoration Proper backfilling of the test hole is very important. If the hole is not backfilled properly the utility may be damaged. Insure that select backfill goes in the hole first. The Utilivac® tends to keep the soils stratified in the hopper, so the last soil removed from the hole (from around the utility), will be on the top layer in the hopper. Dumping the hopper away from the hole will allow you to shovel or sweep the select material back into the hole first. When working under pavement, backfill only 12" - 18" at a time then tamp thoroughly. If it is available to you, we recommend using a pneumatic tamper (Figure 26). This will insure that your test hole will not cave in and cause a pothole. A pneumatic tamper will also help tamp the asphalt patch. If you use cold patch asphalt, make sure the area is dust free to insure a good patch.

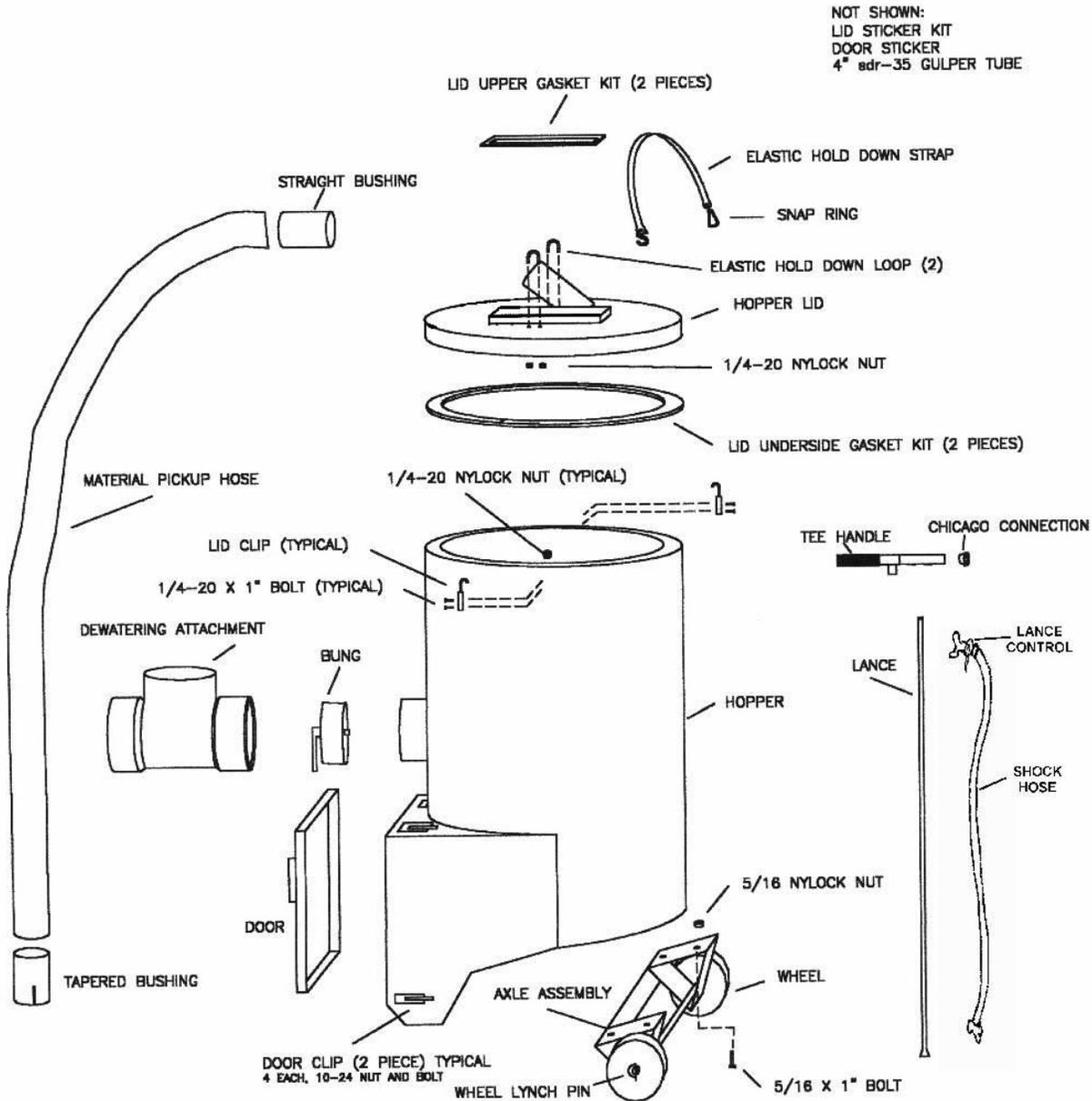
Broom the border of the pavement cut before applying the cold patch. Dusting the patch after it is done with road dust will help prevent it from sticking to tires and shoes. (Figure 25)

Tear Down and Clean Up Equipment tear down is basically opposite of the setup procedure. Just remember to shut off the air supply at the compressor first and then relieve the pressure from the hoses. Squeeze the trigger on the air lance and open the hand operated valve (or foot operated valve) on the vacuum generator. This will drain the lines. When all the air hoses are completely unpressurized, it will be safe to remove the safety clips and disconnect hoses. Inspect the vacuum generator. Remove any debris that has accumulated inside the vacuum chambers.

EXPLODED VIEW, PART 1



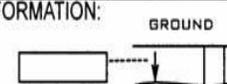
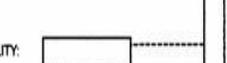
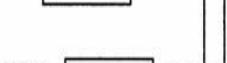
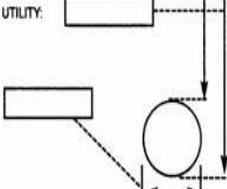
EXPLODED VIEW, PART 2

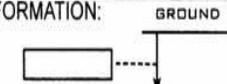
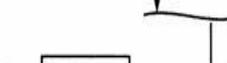
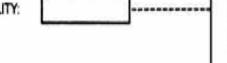
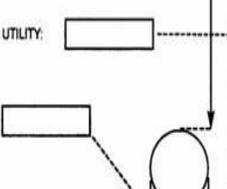


SYSTEM OPERATION AND MAINTENANCE

A1

APPENDIX I DATA RECORD SHEET (SUGGESTED)

VACUUM EXCAVATION RECORD	DATE:	HOLE #
PROJECT :	BY:	
UTILITY FOUND:		
VERTICAL INFORMATION:	GROUND	LOCATION SKETCH Measure to nearest inch
PAVING THICKNESS:		 INDICATE NORTH
DEPTH TO TOP OF UTILITY:		
DEPTH TO BOTTOM OF UTILITY:		
WIDTH OF UTILITY:		

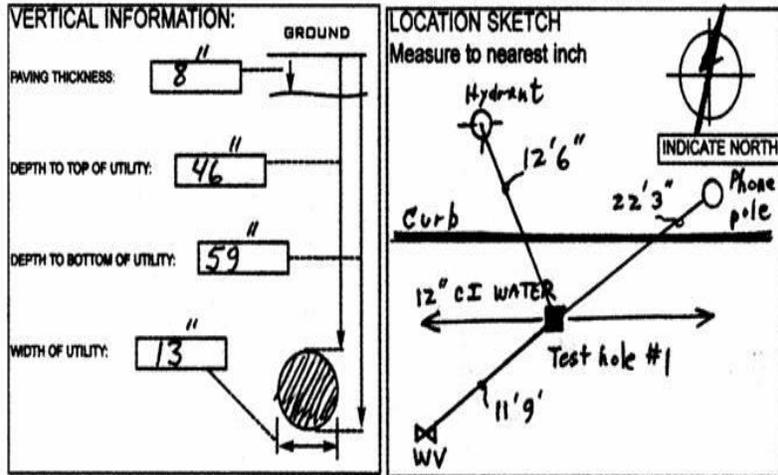
UTILITY FOUND:	HOLE #	
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DEPTH TO TOP OF UTILITY:		
DEPTH TO BOTTOM OF UTILITY:		
WIDTH OF UTILITY:		

SYSTEM OPERATION AND MAINTENANCE

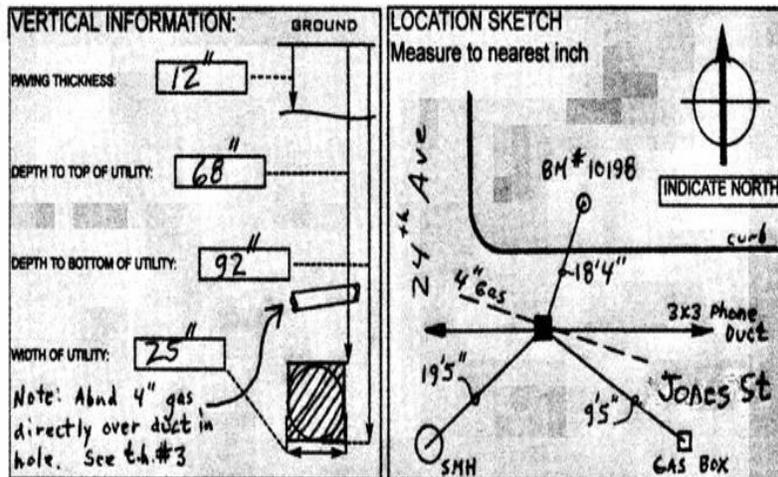
APPENDIX II: SAMPLE DATA RECORD SHEET

A2

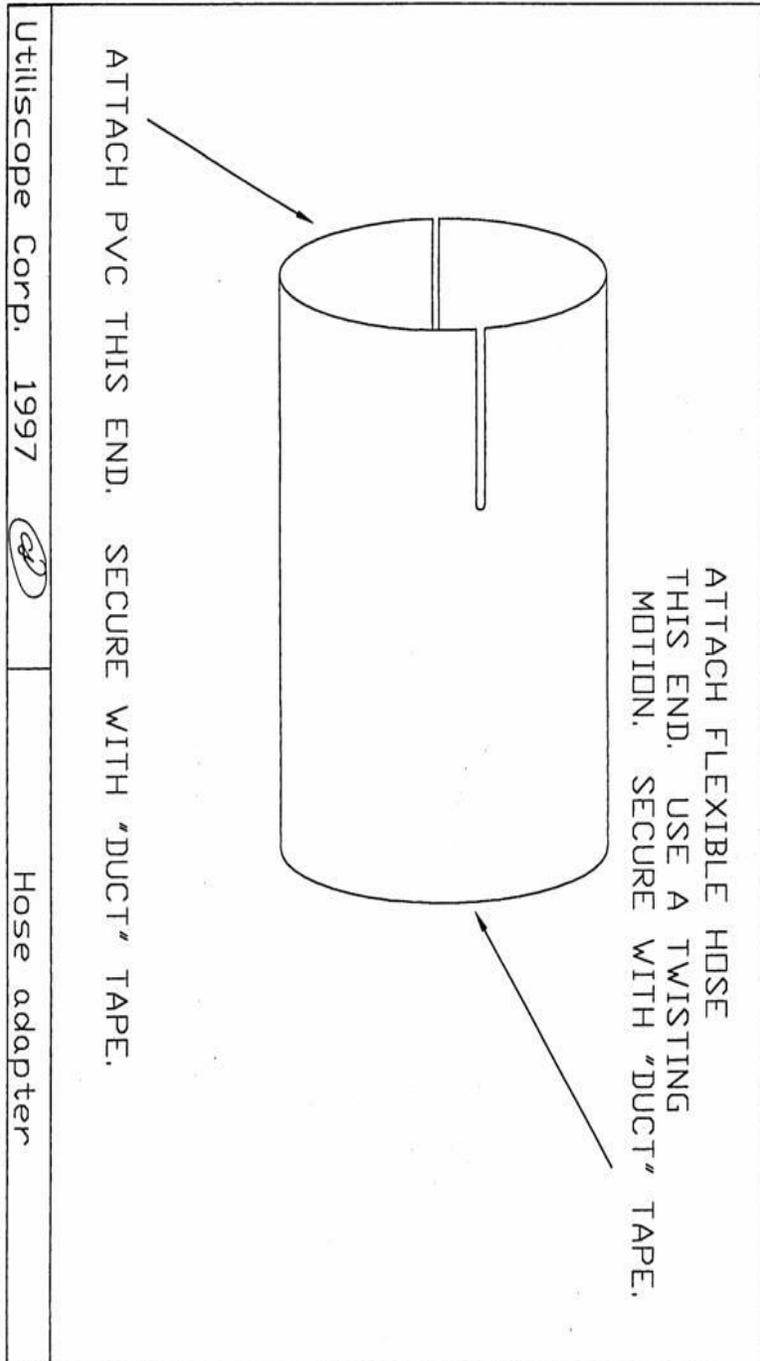
VACUUM EXCAVATION RECORD	DATE: 3-5-98	HOLE # 1
PROJECT: Spring Street		BY: C.F.
UTILITY FOUND: 12" C.I. Water		



UTILITY FOUND: 3x3 Phone Duct	HOLE # 2
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Air Lance Kit Assembly Instructions

DO NOT USE A PIPE WRENCH, VISE GRIPS OR PLIERS ON THE AIR LANCE OR THE EXTENSION BARRELS. THEY MAY BE DAMAGED AND WEAKENED, CAUSING AN UNSAFE SITUATION WHICH COULD LEAD TO SERIOUS INJURY OR DEATH.



1. To assemble the air lance for use, start by turning the locknut on the lance nozzle or extension barrel as far into the threads as possible. You may need to use a wrench or pliers for this, but do not force the locknut past the threaded portion of the lance or the extension.
2. Hand tighten the lance nozzle or extension onto the “T” handle as far as possible using just your hands. When attaching the lance nozzle, pay attention to the orientation of the blade, and turn it to whichever orientation you are most comfortable using. Utiliscope recommends keeping the blade parallel to the “T” handle.
3. Using a wrench or pliers (if using pliers, be careful not to use too much pressure on the locknut or it may deform), turn the locknut back towards the mating surface. Use sufficient torque to lock the barrel in place, preventing it from twisting while in use.
4. When disassembling the lance kit, always loosen the locknut before unthreading mated sections. It is good practice to protect exposed threads when they are in storage with couplings or plastic caps