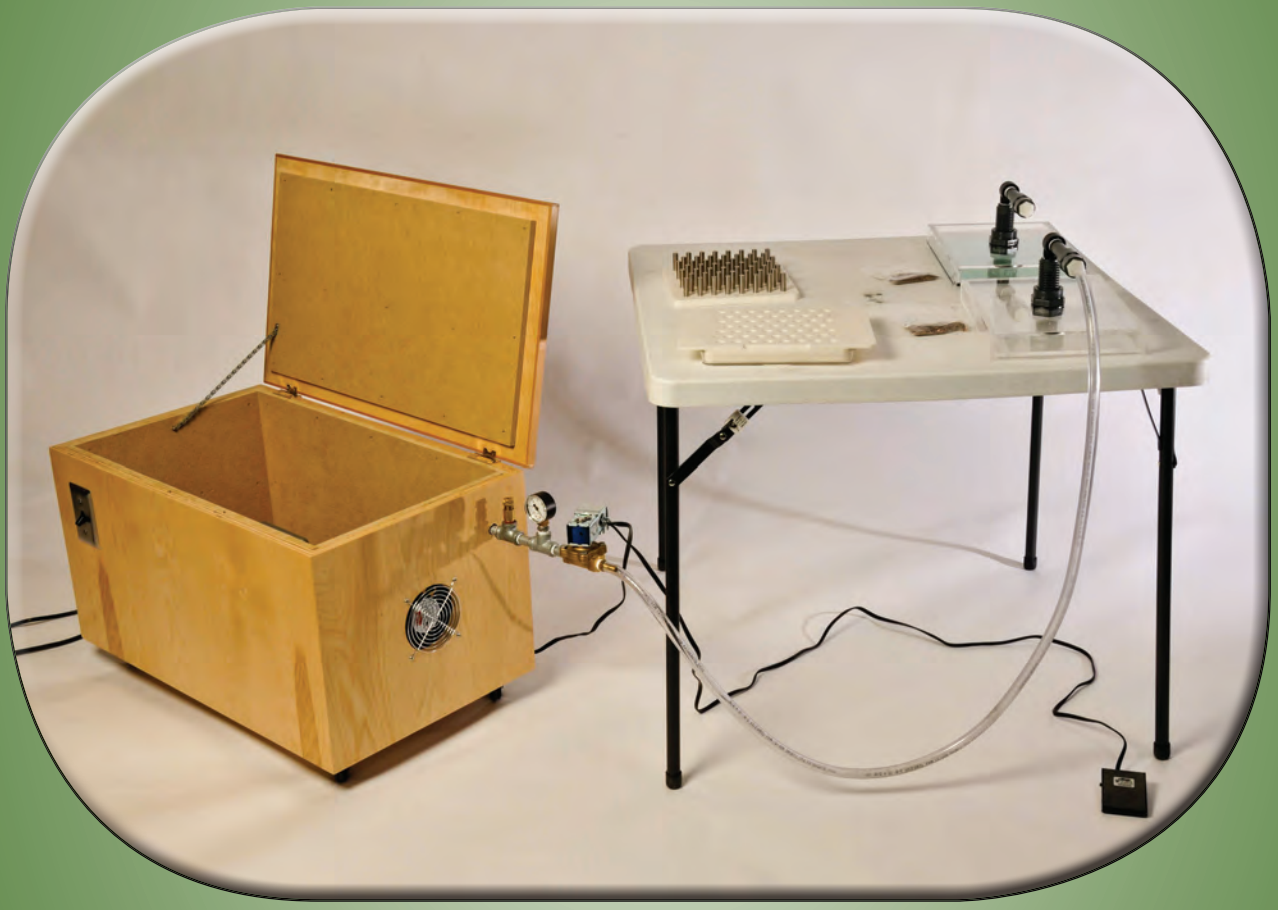
United States Department of Agriculture

Seed Vacuum Pickup System: Operator's Manual



Forest Service | National Technology & Development Program | 1224–2824–NTDP Reforestation & Nurseries | September 2017

Seed Vacuum Pickup System: Operator's Manual

Keith Windell
Project Leader

USDA Forest Service
Technology and Development Center
Missoula, MT

0E02E84—Pine Seed Screening

September 2017

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

The Forest Service, an agency of the U.S. Department of Agriculture (USDA), has developed this information for the guidance of its employees, its contractors, and its cooperating Federal and State agencies. The Forest Service assumes no responsibility for the interpretation or use of this information by anyone except its own employees. The use of trade, firm, or corporation names is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval of any product or service to the exclusion of others that may be suitable.

Contents

Introduction 1

Vacuum Seeding 2

Vacuum Seeder Components 3
- Vacuum Pump 3
- Vacuum Control 4
- Vacuum Pickup Head 5

Adjustment of Vacuum to the Pickup Head 6

Suggested Method to Pick Up Seeds 7

Appendix: VPS075 Operating Instructions 10

Introduction

The U.S. Department of Agriculture, Forest Service, National Technology and Development Program (NTDP), developed a prototype seed crusher assembly and a vacuum seeder for the Southern Region Resistance Screening Center (RSC) to aid in screening seedlots for infestations. The RSC tests seeds for the presence of the pitch canker *Fuserium circinatum* (a quarantined pathogen in pines). This operator's manual, which describes the seed vacuum pickup system, will help employees during vacuum seeding (figure 1).

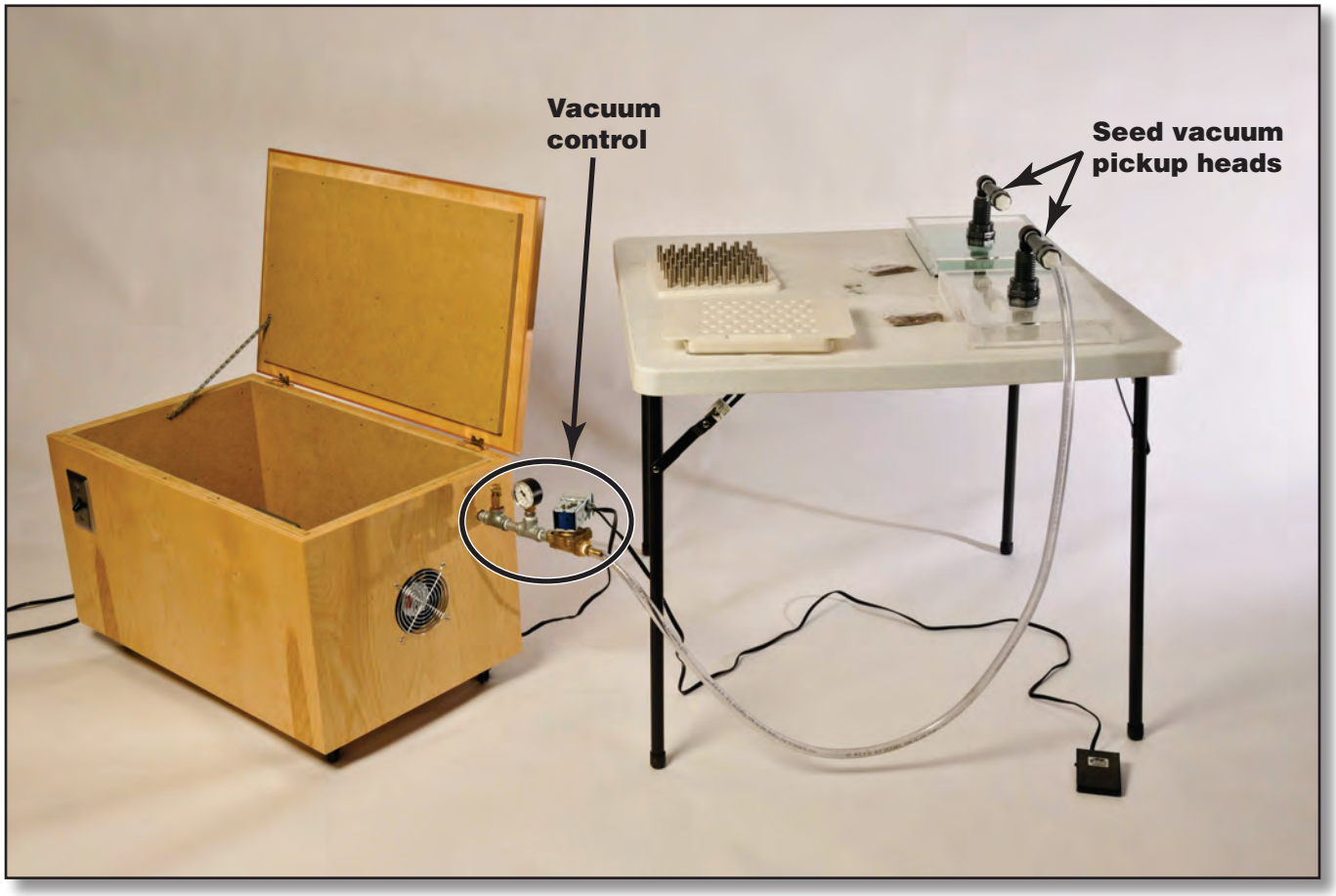


Figure 1—This seed vacuum pickup system includes a vacuum pump, electric motor, and cooling fan in a wooden box; vacuum control; and pickup heads.

Vacuum Seeding

Commercial greenhouses use vacuum seeding—a high-volume process—in their operations. Employees use vacuum seeders to quickly populate blocks, containers, and seed trays with many different types of seeds. The basic procedure is:

1. Turn on the vacuum source.
2. Sprinkle seeds across a plate with holes drilled in the desired grid pattern.
3. Tip the pickup head back and forth to cover holes and rid the plate of excess seeds.
4. Invert the seeder over a growing tray.
5. Release the vacuum pressure to drop the seeds.

For our purpose, instead of using a growing tray we dispensed the seeds into a prototype lower seed crusher plate with 53 holes and that was set in a commercially available sterile clear plastic lab dish (figure 2). We then inserted the upper seed crusher plate and placed the prototype seed crusher assembly in a modified arbor press (figure 3) for crushing.

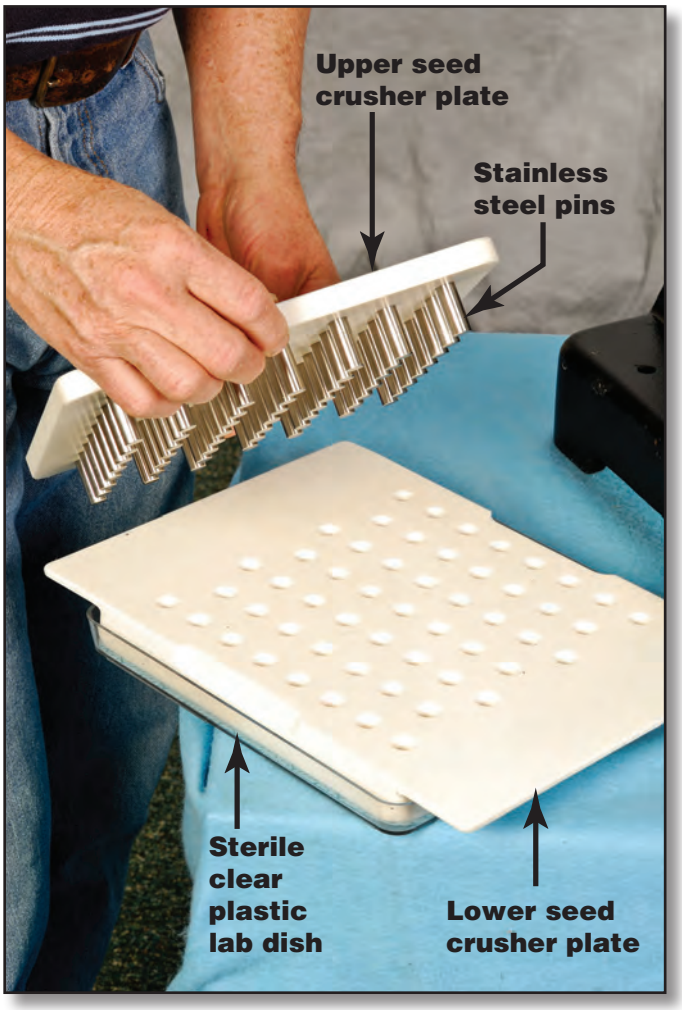


Figure 2—The prototype seed crusher assembly: upper seed crusher plate, stainless steel pins, lower seed crusher plate, and sterile clear plastic lab dish.

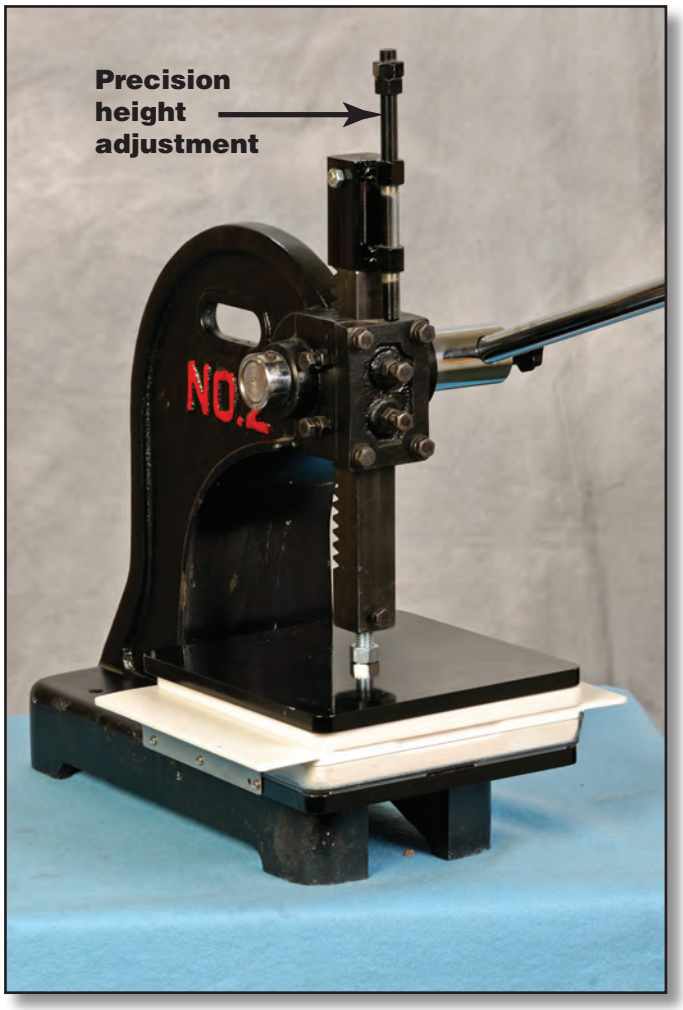


Figure 3—Modified arbor press with the prototype seed crusher assembly.

Vacuum Seeder Components

Three main components of the vacuum seeder are the pump, the control, and the pickup head.

Vacuum Pump

The vacuum pump is part of a preassembled unit available from Hoffman Manufacturing, Inc., (model number VPS075) that uses 115-volt, 60-hertz, single-phase power (figure 4). The unit (a ¾-horsepower electric motor, a vacuum pump, and a cooling fan) sits in an insulated, sound-dampened box (figure 5) on caster wheels.

Figure 4—Commercial vacuum unit from Hoffman Manufacturing, Inc.

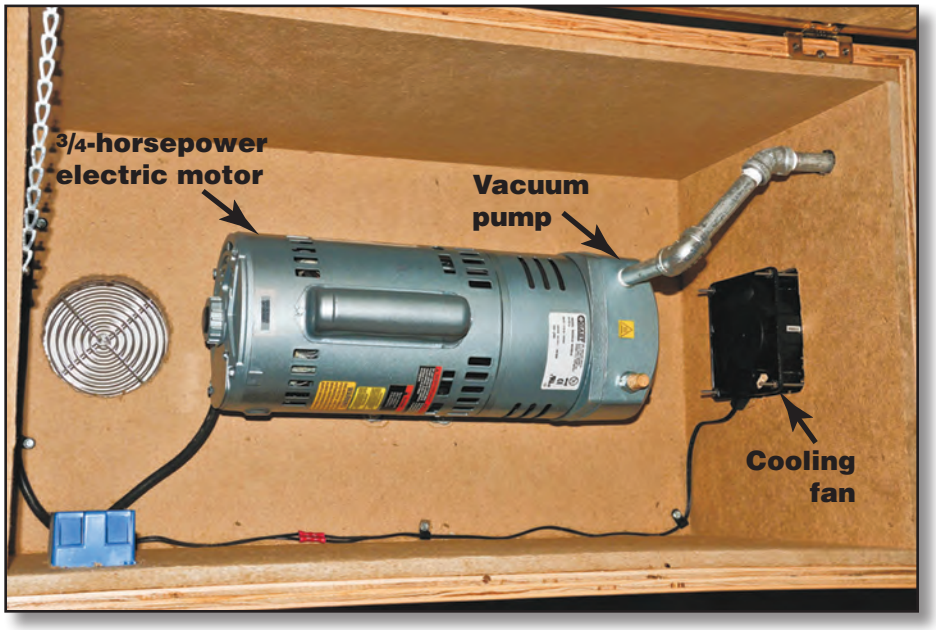


Figure 5—The motor, vacuum pump, and cooling fan are contained in an insulated, sound-dampened box.

Vacuum Control

The electric motor and vacuum pump are connected to a vacuum relief valve (A), a vacuum gauge (B), and a foot pedal-actuated shutoff valve (C), as shown in figure 6. The foot pedal regulates vacuum control (figure 7). Turning the vacuum relief valve clockwise increases vacuum in the pickup head, while turning the vacuum relief valve counter-clockwise decreases vacuum. The jam nut secures the desired vacuum relief valve setting.

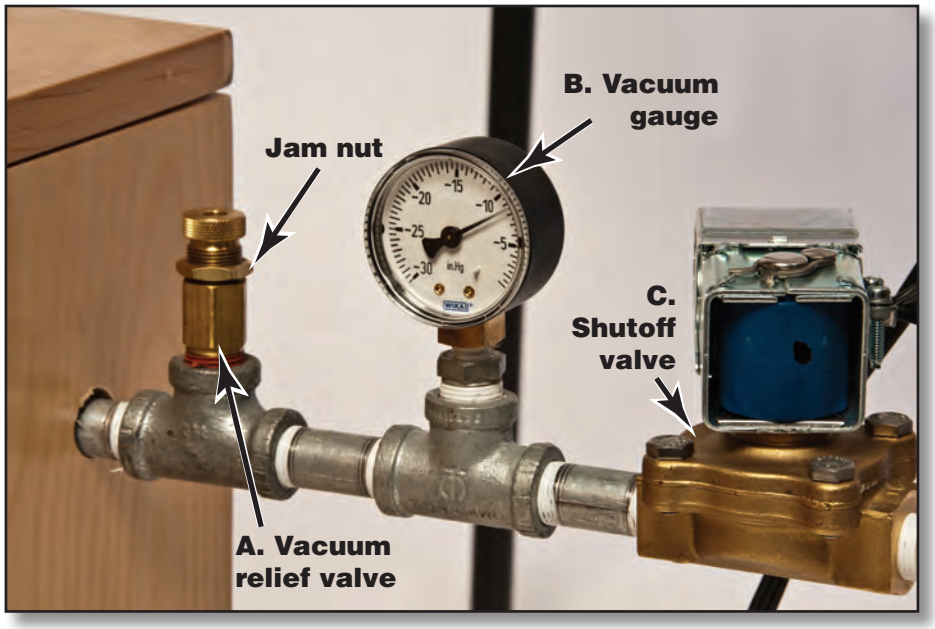


Figure 6—Vacuum control—adjustment, readings, on/off.

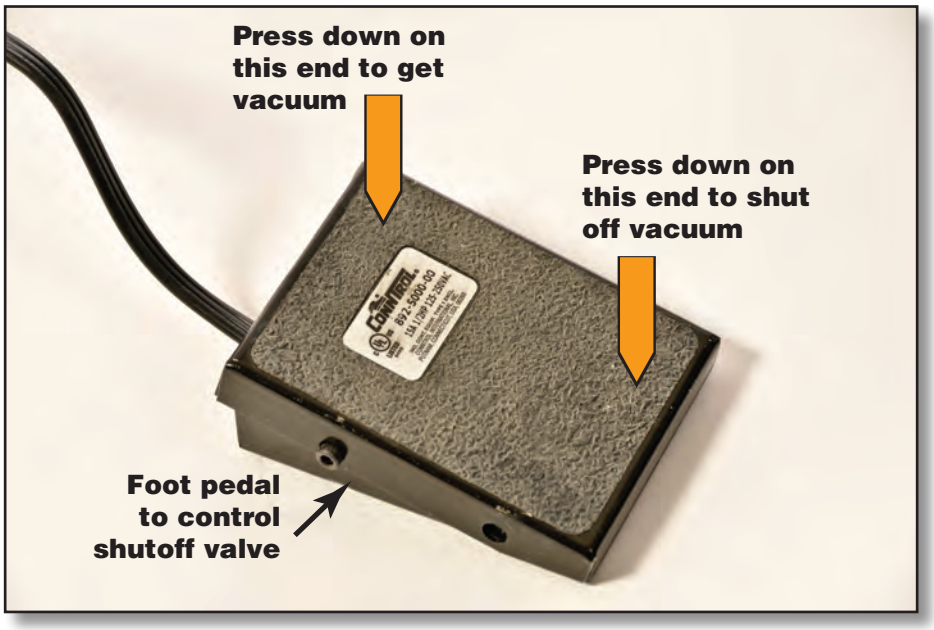


Figure 7—Foot pedal for vacuum control.

Vacuum Pickup Head

The vacuum pickup head is made of acrylic plastic and fits over the top of the lower seed crusher plate that sits in a 245- by 245- by 25-millimeter polystyrene sterile lab dish (figure 8). Each pickup head has holes that are positioned on the same center distances as the lower seed crusher plate. NTDP developed two pickup heads to handle seeds of different sizes; a clear pickup head (0.0625-inch diameter holes) for larger seeds and a tinted head (0.0200-inch diameter holes) for tiny seeds (figure 9). These two hole sizes were able to effectively pick up seeds of several pine species that RSC sent to NTDP. NTDP staff used different color tints for quick field identification because the holes were so small. Other hole diameters may be needed depending on the seed size.

NTDP staff designed and fabricated the pickup heads at their facility. Contact NTDP's drafting department for available drawings—ask for the "Seed Crusher Assembly" drawing number MTDC-1086, which also contains details for the pickup heads and the arbor press.

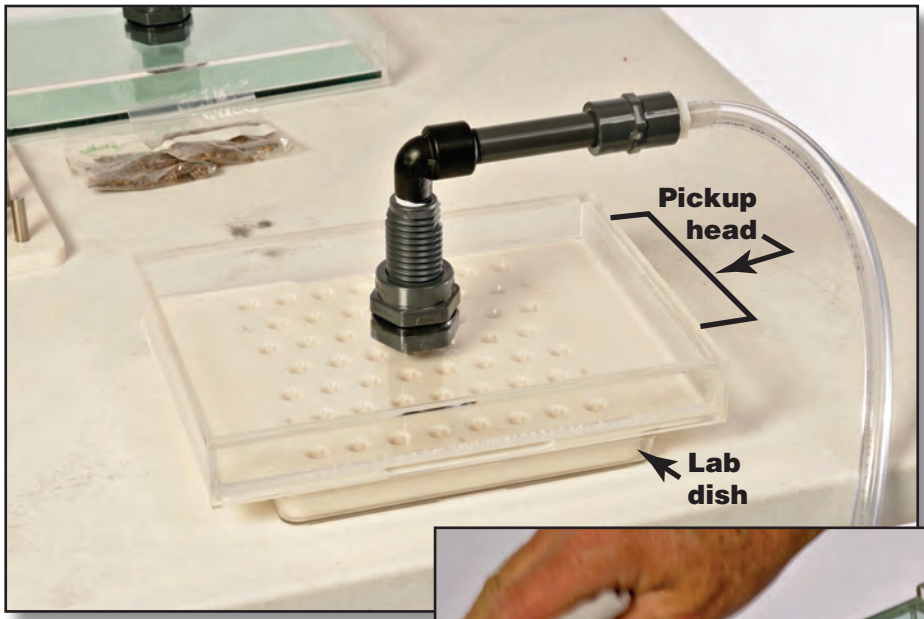


Figure 8—The clear vacuum pickup head (for larger pine seeds) is positioned over the lower seed crusher plate and the sterile lab dish.

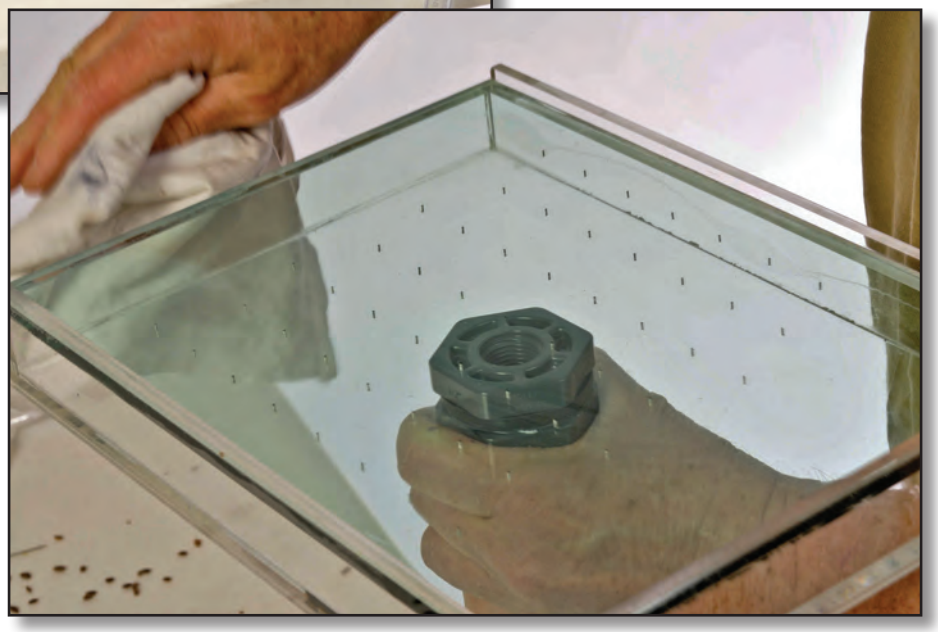


Figure 9—The tinted vacuum pickup head is for smaller pine seeds.

Adjustment of Vacuum to the Pickup Head

The vacuum relief valve adjusts the vacuum. For larger seeds, like loblolly and slash pine, turn the vacuum relief valve all the way clockwise until it seats and then back out 2½ turns counterclockwise as a starting point. For smaller seeds, like whitebark pine, turn the vacuum relief valve all the way clockwise until it seats and then back out 1¼ turns counterclockwise as a starting point. Fine adjustments (either more or less vacuum) will depend on personal seed pickup style. Test the vacuum for individual seed type by picking up seeds and turning the pickup head with the holes facing downward and shake it. If too many seeds remain attached, reduce vacuum; if too many holes don't retain seeds, increase vacuum. After establishing the desired setting, turn the jam nut clockwise until you have secured the valve position. Record the valve position for future reference. These acrylic pickup heads are prone to generating static electricity. If seeds do not fall off when the pickup head is turned with holes facing downward and the vacuum is turned off, use antistatic solution on the acrylic face (figure 10).

Occasionally, chaff from the seeds will clog the holes in the vacuum pickup head, especially the smaller holes of the tinted pickup head. In this case, remove the polyvinyl chloride (PVC) tube from the back of the pickup head and replace the tube with an air hose to force air through the holes. Use silicone sealant on any of the acrylic cement seams that may fail after pressurizing the pickup head to blow out the clogged holes.

Figure 10—Apply antistatic solution on the acrylic face to prevent seeds from sticking to the pickup head. Fabric softener sheets also may work.

Suggested Method to Pick Up Seeds

A commercial vendor suggested a method for using the vacuum seeder. Turn the pickup head over (holes facing upward) and place a pile of seeds on top while the seed vacuum pickup system is actuated (figure 11). Swirl the seeds around so that at least one seed covers each hole (figure 12). Tilt the pickup head so the excess seeds slide off the end of the pickup head without a raised edge (figure 13).

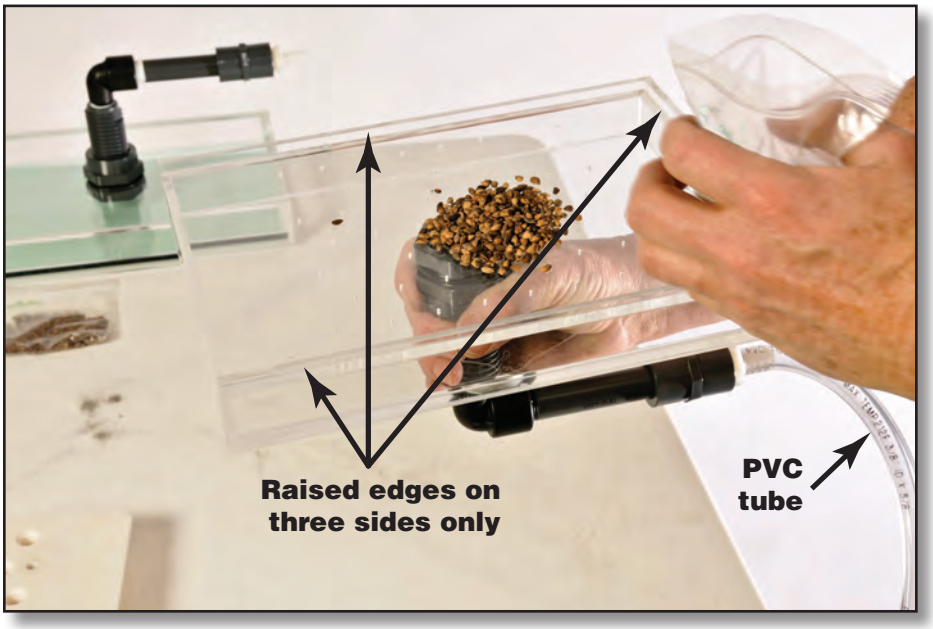


Figure 11—With holes facing upward, add seeds with the vacuum on.

Figure 12—When swirling seeds, cover the side of the pickup head that doesn't have a raised edge.

Figure 13—Tilt the pickup head and excess seeds will slide off.

Inspect to check that only one seed is at each hole and that it is the seed you want to test. If the hole has no seed attached, simply place a seed close to the hole and the vacuum will hold it in place. Turn the pickup head completely over (holes facing downward) and gently shake (figure 14). A slight variation is to gently tap the pickup head against an object to help place one seed at each hole. Gently displace excess seeds with a wooden toothpick (figure 15).

When the pickup head is populated with one seed per hole, place the pickup head over the top of the lower seed crusher plate. The plate will be sitting in the sterile lab dish with proper tissue in place. The three raised edges of the pickup head can be used to aid in the proper positioning over the lower seed crusher plate (figure 16).

Figure 14—Check seed placement by turning the pickup head over.

Figure 15—Remove excess seeds with a wooden toothpick.

Ensure that seeds are directly over the top of the holes. Step on the foot pedal to shut off the vacuum so that seeds will drop into the appropriate lower seed crusher plate holes (figure 17). The lower seed crusher plate, tissue, and sterile lab dish are now ready to have the upper seed crusher plate set on top and the seed crusher assembly put through the arbor press. Operators should wipe the pickup head with disinfectant and dry it before picking up the next batch of seeds. Refer to the tech tip "Improved Seed Crusher and Vacuum Pickup Head for Seed Screening" (1224–2323–MTDC) for details on the prototype seed crusher assembly.

Figure 16—Use the raised edges of the pickup head to properly align the lower seed crusher plate.

Figure 17—Step on the floor pedal to shut off vacuum; seeds will drop into the lower seed crusher plate and the sterile lab dish.

Appendix: VPS075 Operating Instructions

VACUUM SYSTEM
OPERATING INSTRUCTIONS

START-UP PROCEDURE

ELECTRICAL CONNECTIONS

TO INSURE PROPER OPERATION, YOUR NEW UNIT MUST BE CONNECTED TO AN INDIVIDUAL CIRCUIT THAT CAN SUPPLY THE FULL VOLTAGE AS STATED ON THE CABINET SERIAL DATA PLATE. FOR CORRECT VOLTAGE, POWER DRAW, AND WIRE ACCOMMODATIONS, CHECK THE DATA ON THE SERIAL DATA PLATE LOCATED ON THE UNIT OR THE TAG ON THE POWER CORD. VERIFY THAT THIS INFORMATION EXACTLY MATCHES THE ELECTRICAL CHARACTERISTICS AT THE INSTALLATION LOCATION.

115V, 60HZ, 1 PHASE CONNECTION

ALL 115 VOLT UNITS ARE PROVIDED WITH A U.L. APPROVED POWER CORD AND POLARIZED PLUG, WHICH IS FACTORY, INSTALLED. WARNING: ANY ALTERATIONS TO THIS CORD AND PLUG COULD CAUSE AN ELECTRICAL HAZARD AND WILL VOID THE FACTORY WARRANTY. TO INSURE PROPER OPERATION, THIS EQUIPMENT MUST BE PLUGGED INTO A NEMA 5-15R COMPATIBLE, GROUNDED RECEPTACLE THAT CAN SUPPLY THE FULL VOLTAGE AS STATED ON THE SERIAL DATA PLATE.

220V, 50HZ, 1 PHASE CONNECTION

ALL 208-230 VOLT UNITS ARE TO BE PERMANENTLY CONNECTED AND ARE PROVIDED WITH FOUR (4) FIELD WIRING LEADS WHICH EXIT THE ELECTRICAL CONSOLE BOX LOCATED IN THE MACHINE COMPARTMENT BEHIND THE FRONT GRILL. THIS WIRING SHOULD BE CONNECTED TO THE APPROPRIATE POWER SOURCE BY A QUALIFIED ELECTRICIAN AND MUST CONFORM TO ALL LOCAL ELECTRICAL CODES.

ASSEMBLY AND USE

TO ASSEMBLE YOUR SYSTEM, REMOVE THE HOSE & FITTINGS FROM INSIDE THE CABINET. SCREW THE VACUUM MANIFOLD ONTO THE PIPE NIPPLE LOCATED ON THE RIGHT SIDE OF THE VACUUM CABINET.

TO BEGIN COUNTING OR PLANTING, SCREW A COUNTING HEAD (SOLD SEPARATELY) TO THE END OF THE HOSE. THE FOOT SWITCH IS USED TO TURN THE SUCTION ON AND OFF AT THE COUNTING HEAD. IF YOU ARE USING AN OPTIONAL HAND VALVE, THE HAND VALVE WILL SCREW IN BETWEEN THE HOSE AND THE COUNTING HEAD. HOLD THE COUNTING HEAD IN ONE HAND WITH THE HOLES FACING UPWARD. SPRINKLE THE COUNTING HEAD WITH ENOUGH SEED TO COVER EACH HOLE. WHILE HOLDING THE COUNTING HEAD FIRMLY, ROTATE YOUR HAND IN A CIRCULAR MOTION TO MOVE THE SEED AROUND THE COUNTING HEAD UNTIL ALL HOLES ARE COVERED. IT MAY BE NECESSARY TO REMOVE DUPLICATES (MORE THAN ONE SEED ON A HOLE) WITH A PAIR OF FORCEPS. WHEN ALL HOLES ARE COVERED GENTLY TILT THE COUNTING HEAD TO POUR OFF THE EXCESS SEED. NOW PLACE THE COUNTING HEAD APPROXIMATELY 1/2" ABOVE YOUR PLANTING MEDIA AND RELEASE THE VACUUM (WITH THE HAND VALVE THIS WOULD BE ACCOMPLISHED BY TURNING THE WHEEL, WITH THE FOOT SWITCH ROCK THE FOOT PEDAL FORWARD TO TURN THE VACUUM ON AND OFF). THE SEEDS SHOULD FALL FREELY ON THE PLANTING MEDIA. IF THE COUNTING HEAD IS HELD TOO FAR FROM THE

MEDIA THE SEEDS WILL BOUNCE FROM THE INTENDED PLANTING LOCATION.

IN SOME DRY CLIMATES STATIC IS A PROBLEM. THE STATIC ELECTRICITY WILL CAUSE THE SEED TO CLING TO THE ACRYLIC COUNTING HEAD. THIS PROBLEM MAY BE ELIMINATED WITH THE USE OF AN ANTI-STATIC SOLUTION. ANTI-STATIC IS AVAILABLE IN MANY FORMS. FABRIC SOFTENER SHEETS MAY BE RUBBED OVER THE COUNTING HEAD OR AN ANTI-STATIC SPRAY MAY BE USED.

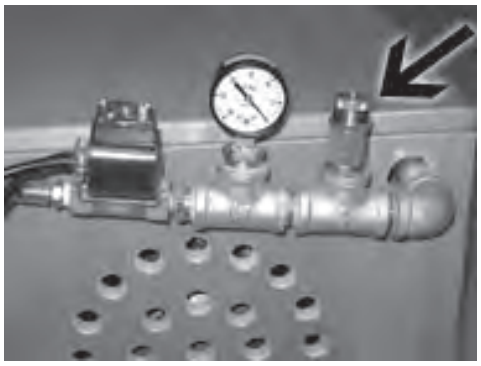


Fig 1

Fig 2

(Your system may vary slightly from system shown)

THE VACUUM RELIEF VALVE (Fig 1), WHICH IS FOUND ON THE VACUUM MANIFOLD, CAN BE ADJUSTED FOR MORE OR LESS VACUUM BY LOOSENING THE NUT AND ADJUSTING THE TOP VALVE IN OR OUT. WHILE PERFORMING THIS, WATCH THE GAUGE FOR THE DESIRED VACUUM. THE VACUUM SHOULD BE ADJUSTED TO BEST SUIT EACH VARIETY OF SEED.

IMPORTANT THERE ARE TWO **FILTERS** LOCATED ON THE VACUUM PUMP. (Fig 2) THESE SHOULD BE INSPECTED AND **CLEANED** PERIODICALLY.

IF THE SOLENOID ASSEMBLY HAS AN INDEPENDENT POWER SUPPLY THIS MUST BE TURNED OFF OR UNPLUGGED WHEN THE SYSTEM IS NOT IN USE. IF THE COIL IS LEFT ON IT WILL GET VERY HOT.

***Counting Heads in picture are sold separately**

VACUUM SYSTEM

LIMITED WARRANTY

HOFFMAN MANUFACTURING, INC WARRANTS THAT IF YOUR VACUUM SYSTEM PROVES TO BE DEFECTIVE IN WORKMANSHIP UNDER NORMAL USE WE WILL PROVIDE, WITHOUT CHARGE, THE PARTS AND LABOR TO REMEDY ANY SUCH DEFECT FOR THE PERIOD OF ONE YEAR FROM THE DATE OF ORIGINAL PURCHASE.

TO OBTAIN SERVICE UNDER THIS WARRANTY YOU MUST CONTACT HOFFMAN MANUFACTURING, INC AND PROVIDE THE ORIGINAL SERIAL # AND MODEL NUMBER. YOU MAY CONTACT HOFFMAN MANUFACTURING INC. BY PHONE 1-800-692-5962 (INT'L. PHONE 001-541-926-2920), FAX 1-800-343-6724 (INT'L. FAX 001-541-926-3949), E-MAIL INFO@HOFFMANMFG.COM OR MAIL PO BOX 547 ALBANY, OR USA.

TO RECEIVE REPLACEMENT PARTS UNDER THIS WARRANTY THE ORIGINAL, DEFECTIVE PART MUST BE RETURNED TO HOFFMAN MANUFACTURING, INC. ANY POSTAGE, INSURANCE AND SHIPPING COSTS INCURRED IN PRESENTING OR SENDING FOR SERVICE ARE YOUR RESPONSIBILITY. PACKING SHALL BE IN CONFORMANCE WITH THE SHIPPING COMPANY'S GUIDELINES AND INSURED IF REQUIRED TO COVER THE COST OF THE PART BEING RETURNED.

THIS WARRANTY COVERS ONLY NORMAL CONSUMER USE. HOFFMAN MANUFACTURING, INC. IS NOT RESPONSIBLE FOR WARRANTY SERVICE PERFORMED WITHOUT PRIOR CONSENT OF HOFFMAN MANUFACTURING, INC. THIS WARRANTY DOES **NOT** COVER PRODUCTS WHICH FAIL TO BE PROPERLY MAINTAINED OR FAIL TO FUNCTION PROPERLY AS A RESULT OF MISUSE, ABUSE, IMPROPER INSTALLATION, NEGLECT, IMPROPER SHIPPING, DAMAGE CAUSED BY DISASTERS SUCH AS FIRE, FLOOD, LIGHTENING, IMPROPER ELECTRICAL CURRENT OR SERVICE PROVIDED WITHOUT THE AUTHORIZATION OF HOFFMAN MANUFACTURING, INC.

THIS WARRANTY AND REMEDY PROVIDED ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS WARRANTIES AND UNLESS STATED HEREIN, ANY STATEMENTS OR REPRESENTATIONS MADE BY ANY OTHER PERSON OR FIRM ARE VOID. THE DURATION OF ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL BE LIMITED TO THE DURATION OF THE EXPRESS WARRANTY SET FORTH ABOVE. EXCEPT AS PROVIDED IN THIS WRITTEN WARRANTY, NEITHER HOFFMAN MANUFACTURING, INC. NOR ITS AFFILIATES SHALL BE LIABLE FOR ANY LOSS, INCONVENIENCE, OR DAMAGE, INCLUDING DIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, RESULTING FROM THE USE OR INABILITY TO USE THE HOFFMAN PRODUCT, WHETHER RESULTING FROM BREACH OF WARRANTY OR ANY OTHER LEGAL THEORY.

SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS AND SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION AND EXCLUSION MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

HOFFMAN MANUFACTURING, INC
16541 Greens Bridge Road SE
Jefferson, OR 97532 USA

—Courtesy of Hoffman Manufacturing, Inc.

Notes

About the Author

Keith Windell is a project leader for reforestation, fire, and residues projects. He has a bachelor's degree in mechanical engineering from Montana State University. He has worked for the California Department of Forestry; U.S. Department of the Interior, Bureau of Land Management; and the Forest Service.

Library Card

Windell, Keith. 2017. Seed vacuum pickup system: operator's manual. Tech. Rep. 1224–2824–NTDP. Missoula, MT: U.S. Department of Agriculture, Forest Service, National Technology and Development Program. 10 p.

The Forest Service Southern Region Resistance Screening Center (RSC) technicians use seed screening to evaluate seeds for resistance to diseases, including pitch canker. The process requires seed loading, crushing, and testing in a sterile environment. To increase efficiency when loading seeds into the crusher, the National Technology and Development Program (NTDP) developed a vacuum seeder. This manual explains how to use the seed vacuum pickup system safely and efficiently.

For details about a seed crusher assembly built by NTDP for RSC, refer to the tech tip "Improved Seed Crusher and Vacuum Pickup Head for Seed Screening" (1224–2323–MTDC). Contact NTDP for the assembly drawing number MTDC-1086.

Keywords: acrylic plastic, arbor press, drawings, fabrication, instructions, laboratories, pitch canker, polystyrene, prototypes, safety at work, vacuum, whitebark pine seeds

Contact the National Technology & Development Program (NTDP) for additional technical information:

USDA Forest Service
National Technology & Development Program
Phone: 406–329–3978 or 909–599–1267
Email: wo_mtdc_pubs@fs.fed.us

Find electronic copies of NTDP documents on the Internet at:

Search NTDP <http://www.fs.fed.us/eng/pubs>

Forest Service and Bureau of Land Management employees can search NTDP documents, CDs, DVDs, and videos on their internal computer networks at:

Search MTDC <http://fsweb.mtdc.wo.fs.fed.us/search/>
Search SDTDC <http://fsweb.sdtdc.wo.fs.fed.us/>

Produced by
U.S. Department of Agriculture, Forest Service,
National Technology and Development Program
1224–2824–NTDP