

# Fluid Injection System Installation and operating instructions.

*Adhesive Evaluation Systems, Inc. 2008*

Note: the following instructions show installation on a MARK II ABES (2006 onwards). They do, however, also apply to older (Mark I) systems.

## 1. Introduction

The fluid injection system can be configured in a wide variety of formats to achieve diverse functions. These may broadly be divided into the two categories of “Steam Injection” and “Pressurized Chemical Injection”. Both involve using computer- or manually-switched air-activated valves to apply the fluid to test bonds through perforated stainless steel injection blocks. Injection blocks and the valves are clamped into the pressing heads of the ABES.



**Please note: Attention is drawn to the safety and liability limitation statement which appears at the end of this document (page 7).**

Before the components may be mounted and activated for **steam injection**, it is necessary to adjust and commission the steam generation unit, manufactured by Reimers Inc., (Section 2.1). Instructions for installation of fluid injection hardware and tubing on the ABES (Section 2.2) and software (Section 2.3) follow.

## 2. The steam injection system

### 2.1 Setup of the steam generation unit.

*1. Introduction:-* The steam generator (Model JR, 1.5kW by Reimers Electra Steam, Inc.) easily provides enough steam for use with the ABES injection accessory. The unit is capable of providing saturated steam at pressure up to 80psi. **The ABES is, however, designed to handle steam up to 20psi only.** Pressure setting is, therefore, necessary before the unit may be connected to ABES (this may have been set by AES Inc – but must be checked). Once set up, the unit should be positioned within about 1 m to the left of ABES. It may be mounted alongside or below the main unit. Access is, however, necessary for periodic manual re-filling of the unit’s reservoir (rear funnel). Re-filling is necessary after about 4 hours of continuous use. The water level in the unit’s reservoir is evident on a front-mounted sight glass.

**Great care is needed when handling steam at pressure. Never have your face near any pressure-carrying components.**

*Checking and setting the steam pressure value:-* The following procedure should be followed **BEFORE the ABES injection system is connected to the steam generator.** The generator must be adjusted to provide steam at a maximum pressure anywhere between 15 and 20psi. **It should on no account be operated with ABES at higher pressures.** Pressure adjustment is done internally and, once set, should not need re-adjustment. Care should be taken while doing this – and AES Inc takes no responsibility for safety.

**NOTE: IF the generator’s pressure has already been set to 15-20psi (by AES Inc.)— which is very likely -- then skip stages 3 and 4 below (but do look at 1 and 2).**

Reference should be made to Reimers Inc. directly and their information sheet in case of uncertainty.

1. Unpack the generator and screw the gray plastic filling funnel into the rear fitting as shown in the Reimers sheet.
2. Ensure that the two black sight-glass valves on the front of the unit are open, and that the lower blue handled gate valve at the bottom/rear (marked “blow-off”) is closed (both are normally shipped that way). Open (turn anti-clockwise) the steam delivery valve on the right side of the unit (to let air out when filling) and open the upper rear yellow-handled gate valve below the funnel.



Then charge the generator with clean water. Pour water through the funnel until the sight-glass shows nearly full. Then close the yellow gate valve. Dry the surroundings. **Note:** if the unit has not been used for a while, **flush out the tank repeatedly.** Do this about every month too. Use the bottom (blue) drain valve for this. Shake the unit about to slosh junk from the bottom of tank!

***IF you think the pressure is already set, then skip to step 5 below.***

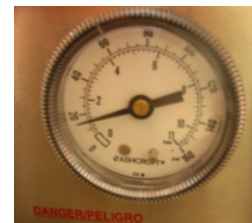
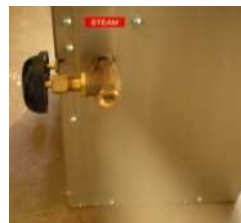
3. To set the working pressure, first carefully remove the top cover by removing the five cross-head screws holding it down (one centre front and two on each side).
4. Locate the black plastic adjustment wheel used to adjust the pressure setting. This is part of one of two pressure switches. Do NOT adjust the rear one marked “safety device”, but the other one at center-right. Start by setting the working pressure to a minimum by very carefully unscrewing the wheel with two fingers (anti-clockwise) as far as it will go (without forcing it). Then advance the wheel clockwise about ¼ of a rotation. Replace the top cover (for electrical safety).



5. Connect the generator to a GROUNDED 110VAC electrical supply. Push the “Heater Power” toggle switch on the front (left of three); the centre red reset light (“Alarm-water low”) should shine. Then press the centre reset rocker switch. The “Heater Power” light (left one) should then come on and heating will begin (some hissing sounds may be heard).



6. After about 20 minutes, the steam pressure displayed on the front gauge will start to slowly climb. As heating progresses, the pressure will rise. The heater will eventually switch off (the heater light will go out). The objective is to achieve “switch off” at a pressure lying between 15psi and 20psi. If the pressure is outside this range, then go to step 3 above and do the following. **OTHERWISE now go to STEP 7 below.** Re-adjustment of the plastic wheel will be necessary. To do this, switch off and unplug the unit and vent some steam (carefully open steam delivery valve partly) until the pressure has fallen below the target range (say to 14psi). Close the valve and then remove the top cover again and carefully rotate the black plastic wheel –



rotating it a small amount (maybe 1/8 turn) in or out as appropriate (clockwise to increase pressure and anti-clockwise to reduce it). Repeat this procedure again if necessary until the “switch-off” pressure lies between 15 and 20psi.

7. Once set up, then turn off and disconnect the power. Note: Check for any leaks in the pipe fittings and tighten with power disconnected and pressure below 5psi (or have a technician do it) as necessary (see Reimers sheet). Now put the unit aside till the ABES components have been installed.

## Section 2.2 Installing the fluid injection system for steam

**NOTE: The following procedure should be conducted with the power and air turned off and the ABES pressing blocks cold. The steam generator should also be off (unplugged).**

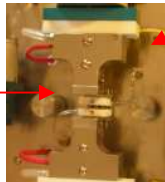
The components of the system are shown. Not all parts will be used for all applications, however.

The following instructions are for applying steam from one or both sides of bonds.

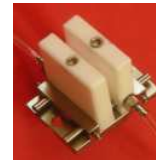
Injection from just one side may be appropriate. In this case, the activation system for the unused head can be disconnected (see below). Alternatively, the whole steam supply line can be removed from one of the two control valves. The system is normally shipped pre-configured for steam injection from both sides – with all tubes connected. Follow the following steps.



1. *Disconnect and remove the cool head:-* It is recommended that the cool head be removed when the injection blocks are installed. Either way, the air lines to the cool head must be disconnected since their supply ports are used to actuate the steam and fluid injection valves.



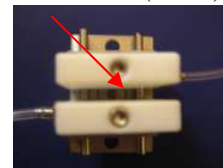
Carefully unscrew the two air lines which are normally used to supply cooling air to the cool head. These connectors protrude from the base of ABES and are located on either side of the bond cooling head (see red arrows on photo) Do this by turning the nickel plated knurled connectors anticlockwise. Leave the free ends lying on the base plate (do not remove the two tubes from the white plastic blocks of the cool head).



The cool head is held in place with a single hex head screw which lies between the two white (PTFE) plastic cooling blocks. Carefully insert a hex wrench (0.1160 in across flats)



down between the blocks to withdraw the screw and cool head while restraining the head from rotating with fingers. The screw will remain trapped in the cool head. BE SURE to retain the small stainless steel spacing collar that lies between the cool head base and the piston rod below it. Carefully ease the head away from under the pressing blocks and store it along with the spacing collar (which can be retained on the screw with a nylon 10-32 nut).

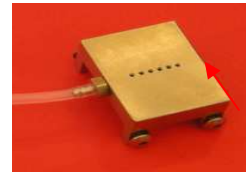


2. *Install the steam valves and injection heads:-* Carefully remove the steam injection system from the wooden case. It is shipped with all parts connected together ready for installation. Neoprene rubber tubing is very fragile so be very careful when handling it.





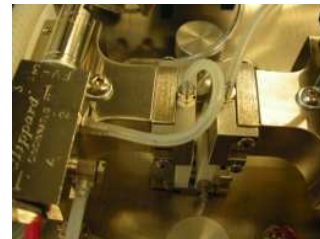
Using the appropriate US hex-wrench, carefully remove the two button-head machine screws located in the top of each of the pressing heads. Identify front and rear valve assemblies (labels on air supply lines). Carefully lift and position each valve assembly in turn (with injection head attached by its fragile neoprene tube) on the head. Be careful not to damage the tube by pulling on it. Use the two button-head machine screws to hold the valve assembly in place with the attached angle brackets. **Be very careful not to cross-thread the screws when re-inserting them in the head.** Tighten the screws only gently. Repeat for the other head.



Position each of the stainless steel injection heads onto the pressing heads. To do this unscrew (but do not remove) the four small locking cap screw on the injection heads so they do not protrude into the inner parts of the tabs of the heads. The injection heads should then slide into place on the stainless steel anvil of the pressing block. Gently tighten the four locking screws so the head stays in place. **Do not over-tighten these screws.**



Now connect the pilot actuator lines (small diameter clear tubing fixed to the round actuator cylinders at the rear of the dosing valves) to the two air ports formerly used to provide air for the bond cooling head. Ensure that the connectors are fully screwed down (they can be stiff).

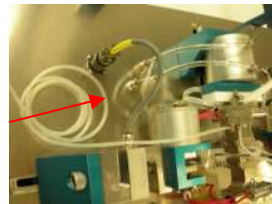


3. *Connecting the steam supply and vent lines:-* Screw the quick connect fitting body (shipped screwed into the quick connect end) into the outlet valve port of the steam generator (tighten only gently). Then connect the steam supply tube to the steam generator using the quick connect end. The generator should be located near ABES so there is no danger of the tube being pulled.



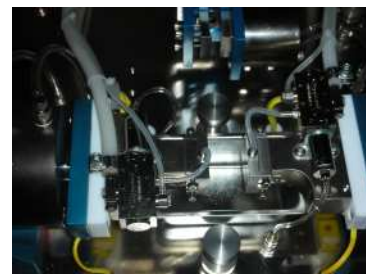
Unwind the soft neoprene tube and lay it so it hangs over the side of a water container (pointing away from ABES and the operator). Steam (and initially water) will come out of this when the system is running.

This steam may be allowed to vent to the room OR it may be immersed in a constant-head water container (container




with a constant small inflow of cold water which drains). The steam will then condense in the cold water and thus avoid elevating the room's humidity and temperature (particularly if in a small room – though this can make a lot of irritating noise!). **BE VERY CAREFUL to avoid being scalded by the steam from the tube if it moves around.** It should always be restrained to avoid such erratic movement.

Position the metal water collection tray under the pressing heads. Temporarily remove (unscrew) one of the sample supporting platforms to make



room for the tray to be inserted. Replace the platform.

### 2.3 Starting the system

- Adjust the pressing head position so as to center the pressing action on mounted wood samples. To do this, power up ABES (press start button) and turn on the air supply (but not the computer or heaters). Adjust the “Press” toggle switch to the lower (on) position. Rotate the adjustment collar on the front pressing cylinder clockwise until the pressing action is centered (loosen the hex screw on the collar if necessary and gently re-tighten once the collar is adjusted).
- 
- Set the “Cool Gas” pressure to a value of about 70psi (adjust the pressure regulator on the front of the unit). This pressure and the corresponding control logic will be used to turn the steam injection valve on and off.
  - Charge generator with water. When doing so, be sure that the steam generator is correctly configured (peak pressure set between 15 and 20psi. Open the black steam delivery valve on side of unit to let air out while filling, be sure the drain valve is closed (shipped that way) and then fill the tank through the gray plastic funnel with the yellow gate valve open. When filled (see sight glass), close yellow gate valve and steam delivery valve.
  - Connect and switch on the steam generator power (press center toggle and then the left toggle).
  - Power up ABES and set both pressing head temperatures to 110°C (there is no need to run the computer control program at this stage since you will be operating the system manually).
  - Heating the water from cold will take about 30 minutes. Wait until stable steam pressure is reached in the generator (between 15 and 20psi). **If the pressure rises above 20psi then turn off the system and contact AES Inc (541 760 9347; humphrep@peak.org).**
  - Now **very gently and slowly** open the steam delivery valve on the side of the generator. Water followed by steam should flow through the control valves and out through the vent tube. **Be very careful not to be burned by the vented steam.** This should be directed in a safe direction or, ideally, submerged in a cold water reservoir with continuous cold water flow to dissipate heat (essentially a constant head device). Check for leaks and consult AES Inc. if there is no steam flow or if there are any leaks.
  - Once steam is flowing smoothly out of the vent tube, momentarily move the “Cool Gas” toggle switch (on control panel) down to the “on” position. This should activate the injection function by re-directing the steam away from the vent tubes and into the injection heads themselves. Steam should be evident coming out of the perforations in the head (and audible too). Turn off the injection by raising the toggle to the center (off) or up (computer) position. If steam fails to be re-directed then adjustment may be needed and Philip Humphrey should be contacted. **If in ANY doubt, turn the steam off at the steam generator. Avoid getting water on the system of hands.**
  - As a preliminary trial, place a single wood sample across both supports so it rests between the heads. Close the press (toggle switch “Press”) and then briefly activate the steam (“cool gas” toggle). Minimal steam or water should be evident (wood seals holes). Switch steam off **before** opening the press.

The system is now ready for preliminary trials using either manual (toggle) of computer controlled steam application.

NOTE: Press head temperature should NOT exceed 120°C (limited by valves and fittings).. An initial temperature of 110°C is suggested. Excessive condensation of steam will occur in the injection heads if they are set below about 90°C.

#### 2.4 Software activation.

*Modifying the ABES control sequence for steam injection:-* The control cycle of the ABES may be adjusted to incorporate a steam injection stage after the press has closed on the bond. This is done by installing an appropriate **BOND.PRG** file in the sub-directory “BOND” on the C: drive. Alternatively, the text editor “Edit” may be used to modify the BOND.PRG file currently active on the system. Given below is a BOND.PRG version which activates steam injection for 4 seconds. This file is saved on the CD provided and will also be emailed. Some important notes appear as comments on this file. They should be read.

```
! FLUID INJECTION CONTROL PROGRAM (BOND.PRG)
! *****
!
! IMPORTANT: AES Inc. takes no responsibility for fluid choice
! and its behavior in the treatment system. The system is a
! specialized research instrument and there are numerous ways
! in which it can be configured.
! Safety of each configuration of this system is the responsibility
! of the experimenter. No responsibility is taken for
! any consequences of steam escape.
! October 8th. 2006 onwards.
!
!
! NOTE: insertion of "!" in line 1 of the control matrix below
! de-activates that line (makes it a comment).
! Use a text editor (such as "EDIT" which is resident)to
! modify the matrix(type "edit bond.prg" rtn).
! Alternatively, MS WORD may be used, but be sure to
! save the file in text format. Such edits may be used
! to activate or remove functions such as fluid injection,
! cooling etc. and/or to change times ("T" column).
!
! A steam injection time of 4.0 seconds is used below. This
! may be de-activated by placing a "!" in front of that line or
! the value may be change to a different time.
!
! Explanation of the matrix logic terms:
! T ==> Time length(seconds) of this event cycle
! a ==> A/D status: (taking data)
! Status (0 == OFF), (1 == ON)
! Valve #1 status : High Pressure Air to Press
! Valve #2 status : Press bond
! Valve #3 status : Grip
! Valve #4 status : not used
! Valve #5 status : Fluid injection (using cooling air lines)
! Valve #6 status : Cooling head(NOT to be used with injection heads)
! Valve #7 status : Pull bond
! Valve #8 status : not used
!
!T      a 1 2 3 4 5 6 7 8
2.0    0 1 1 1 0 0 0 0 0 ! Close Press (HP)and grips
4.0    0 1 1 1 0 1 0 0 0 ! INJECT FLUID (steam) for 4 seconds
-20.0  0 1 1 1 0 0 0 0 0 ! Press bond
1.0    0 1 0 1 0 0 0 0 0 ! Retract Press
3.0    1 0 0 1 0 0 0 1 0 ! Pull bond (collect data)
5.0    0 0 0 0 0 0 0 1 0 ! Remove sample
2.0    0 0 0 0 0 0 0 0 0 ! Return & transfer data
```

Install the new control sequence in the following way:

- Boot up the computer and enter the sub-directory C:/BOND
- Rename the existing version of BOND.PRG to BOND.HRG (for example) by typing:  
“rename bond.prg bond.hrg” rtn.
- Now copy the new version of BOND.PRG (with steam injection) into the sub-directory.  
Note: A copy of this control file is saved on the supplied CD. It is called “STEAM.PRG”. It is saved in the correct (.txt) format. Copy this file to C:\Bond and then rename it BOND.PRG by typing “rename steam.prg bond.prg” rtn.

The system should now run as before but with 4 seconds of steam injection.

It is suggested that, following installation of the steam injection hardware and software, Philip Humphrey should be consulted in order to check all is in order. Preliminary trials with steam injection may then be executed.

IMPORTANT SAFETY AND LIABILITY STATEMENT:

*Neither Adhesive Evaluation Systems Inc. nor Philip Humphrey (hereafter referred to as AES Inc.) take any responsibility or accept liability for the choice of fluids or their behavior and safety in the treatment system. The ABES system and the fluid injection accessory constitute a specialized research instrument and there are numerous ways in which it can be configured and used. Safety of each and any configuration of the system or component therein is the responsibility of the operator or their representative and not of AES Inc. No responsibility is taken by AES Inc for any consequences of the escape of fluids or steam. Effective from November 1, 2007 onwards.*

END