

<b>Instructor:</b> John Berner	<b>Unit Title:</b> Demo on Pneumatic Engraving
<b>Course:</b> Power and Energy	<b>Lesson Number:</b> 010
<b>Grade Level:</b> 11 <sup>th</sup> and 12 <sup>th</sup>	<b>Time Allotted:</b> 45 – 50 min.
<b>WI Standards:</b> A.12.1	<b>STL:</b> Standard 3, 12, 14, 16,
<b>Rigor/Relevance:</b> A <b>B</b> C D	

Contrast the increasing complexities of technology with its ease of use.

Students will develop an understanding of relationships among technologies and the connection between technology and other fields.

Students will develop an ability to use and maintain technological products and systems.

Students will develop an understanding of medical technologies.

Students will develop an understanding of energy and power technologies.

**Objectives and/or Purpose:**

Given a piece of 3 X 3" wide mirror, students will be able to demonstrate the proper set-up and use of a pneumatic engraving stylus by patterning and engraving their initials while following all of the safety instructions and procedures presented with a C or better on a grading rubric.

**Terms to Know:**

- Stylus
- Engraving
- RPM
- PSI
- Regulator
- Air Compressor
- Rotary Actuator

---

**Method/Procedure:**

---

<b>Materials</b>	<b>Time Estimate</b>	<b>Assignment</b>
Sheet of Paper Protractor Ruler Combination Square Stencils (optional) Pneumatic Engraving Stylus w/ Air Compressor Access to a Firm Table	30 minutes	Engrave their initials in a piece of mirror.

Quality Control Check List Safety Glasses		
--	--	--

**Pre-assessment**

1. How many have you have ever been to the dentist?
2. How many of you have ever had a cavity drilled and filled?
3. How many of you have ever used an electric Dremmel tool?

**Formative Assessment**

1. Why wouldn't dentist's want to use an electric Dremmel tool on your mouth?
2. Why is it important to plan and pattern before engraving?
3. What are possible outcomes if the regulator isn't set to proper pressure?

**Summative Assessment**

**Engraving Demonstration Grading Rubric**

**A** The cutting tool followed its intended path matching the designed pattern. The cutting path is continuous and cosmetically pleasing to the eye. There are no sharp or jagged edges. Mom and dad would be proud to hang on the wall.

**B** The cutting tool followed its intended path, but slightly off the pattern. The cutting path shows occasional stops. Shows understanding of the process.

**C** Engraved initials are within the pattern's boundary but not on its intended path.

**D** The part appears as if a two year old went to town with a crayon or marker to a wall; although safety and instruction was followed.

**F** Was the student even present for the instruction because there is evidently a high risk of safety and control.

Inspected by \_\_\_\_\_

**Method/Procedure:**

---

**Introduction/Motivation/ Set Induction:**

Think of a time when you visited the dentist. The tools used to clean, polish, and drill holes in your teeth are pneumatic. The tool you will be using today works the same way, but we will be using it to do a little art work. Absolutely no artwork is to be performed on your classmates' teeth. Dentists go to school for many years to do their job.

### **Overview:**

By the end of this lesson, you will be able to safely and properly set up and use a pneumatic engraving stylus, similar to that of dental equipment, to demonstrate how you will carve your initials into a piece of mirror. When you are done, you will inspect your work.

### **Instruction**

The tool you are going to use today represents a rotary actuator. That means that air is applying a force to a rotating turbine. A linear actuator is a tool that acts like a piston sliding in and out of a cylinder.

Because the air compressor is electric and can produce a higher pressure than what is set on the regulator, we will not need a reservoir; however, an air tank may also be used.

### **Content Presentation**

1. Safety
  - 1.1. wear safety goggles
  - 1.2. air pressure is fast, powerful, and dangerous
  - 1.3. tools involve sharp edges for cutting
  - 1.4. maintain a safe clear area away from other students or individuals
  - 1.5. do not attempt without supervision and proper instruction
2. Layout
  - 2.1. decide a location and angle for engraving on the mirror
  - 2.2. specify the intended size
  - 2.3. use measuring tools to layout and create a pattern for initials on a piece of paper to be used in evaluation
  - 2.4. layout the pattern on a mirror using a fine dry erase marker or an adhesive plastic with a pattern on it
  - 2.5. clamp mirror to work surface
3. Set-Up
  - 3.1. connect foot pedal to an electrical outlet
  - 3.2. connect power plug from air compressor into the foot pedal
  - 3.3. attach a large hose to the air compressor
  - 3.4. attach regulator to the large hose and set at 30 – 40psi
  - 3.5. attach small hose to regulator
  - 3.6. attach cutting stylus to small hose

- 3.7. insert cutting tool (will add more in depth instruction on this)
4. Application
  - 4.1. clamp mirror to work surface
  - 4.2. make sure the pressure is within 30 – 40psi
  - 4.3. hold the stylus like a pen or pencil
  - 4.4. keep the hose out of the way of the cutting tool
  - 4.5. use the foot pedal to turn the tool's power on and off
  - 4.6. cut slowly over the pattern
  - 4.7. use a brush to wisk away debris
  - 4.8. wipe surface clean with a damp cloth or remove adhesive plastic
5. Conducting Quality Control
  - 5.1. check to see if the engraving can be lined up with a straight edge
  - 5.2. check to see if the engraving matches the pattern designed on the paper
  - 5.3. check to see if the student has maintained control over the tool, not having damaged the rest of the mirror
  - 5.4. did the student follow safety procedures

**Procedure:**

1. Locate a work surface or table clear of debris and other items which could potentially be hazardous when engaged in engraving. No other individuals should be within 6 feet of this area.
2. **SAFETY- Wear safety glasses because engraving involves the removal of extremely small pieces of material using an extremely fast and powerful cutting tool.**
3. Use measuring tools to draw and dimension your initials on a sheet of paper larger than a 3 x 3" sheet of paper. This pattern will be used to evaluate your completed part.
4. If available, adhesive plastic or clear tape with a duplicate of your pattern may be placed over the mirror; otherwise, use a dry-erase marker to place a pattern on the surface of the mirror.
5. Clamp the mirror to your work surface or table so that it doesn't shift placement while cutting.
6. The equipment you should have:
  - a foot pedal to control on/off electrical power
  - a electric air compressor
  - a regulator
  - a stylus or cutting tool
  - a recommended cutting bit
  - a large hose to connect air compressor to the regulator
  - a small hose to connect the regulator to the stylus

The foot pedal plugs into the electrical outlet used to power the air compressor. The air compressor plugs into the foot pedal. The larger hose

connects the air compressor to the regulator. The smaller hose is used to connect the regulator to the cutting stylus.

7. **SAFETY- the regulator should be set between 30 and 40 psi, not to exceed 45 psi; at these pressures, the cutting tool is operating at approximately 400,000 RPMS.**
8. Hold the stylus like a pen or pencil keeping the hose over your wrist and away from the cutting bit to avoid any damage to the hose.
9. Trace the pattern slowly using the foot pedal to control the on/off function of the tool.
10. Brush away any debris with a paint brush. Wipe the surface clean with a damp cloth and remove plastic adhesive if it is used
11. Evaluate your finished product.

### **Repetition & Review – Feedback**

What are the safety rules we have discussed?

- wear safety goggles
- air pressure is fast, powerful, and dangerous
- tools involve sharp edges for cutting
- maintain a safe clear area away from other students or individuals
- do not attempt without supervision and proper instruction

### **Application & Practice/Learning Activities:**

#### **Closure/Summary**

Today we have demonstrated the use of a rotary actuator. We use pneumatics to power them because we can reach higher speeds and their clean to use. Pneumatics is used in many tools to perform tasks that are fast, clean and powerful. Pneumatic engraving is one example of a need for speed, because engraving requires removing hard material with an expectation of achieving a smooth cut. With permission and supervision you will be able to use the equipment to engrave your initials into other projects.

#### **Reflection/Self Evaluation**

#### **Resources**

##### **Profitable Hobbies**

<http://www.profitablehobbies.com/Parapak.html>

**Profitable Hobbies Corp.**  
**Copyright 2003.**

**Elements of a Basic Pneumatic System:**

**<http://ranier.oact.hq.nasa.gov/team116/2003/lessons/Lesson7-Pneumatics.pdf>**

**NASA.Gov**

**Updated 12/17/2002**

**Wikipedia, *Pneumatic Actuator***

**[http://en.wikipedia.org/wiki/Pneumatic\\_actuator](http://en.wikipedia.org/wiki/Pneumatic_actuator)**

**Wikimedia Foundation, Inc.**

**Updated 11/28/2006**

**Copyleft Material**

***Standards for Technological Literacy***

**International Technology Education Association. Reston, VA.**

**Copyright 2000.**