

# PALO VERDE NUCLEAR GENERATING STATION

## Mechanical Maintenance Training Machining in a Chuck Classroom Lesson



<b>Mechanical Maintenance Training</b>	<b>Date: 10/1/2010 11:38:26 AM</b>
<b>LP Number: NMS60C000303</b>	<b>Rev Author: MARK TAGUE</b>
<b>Title: Machining in a Chuck</b>	<b>Technical Review:</b>
<b>Duration : 7 HOURS</b>	<b>Teaching Approval:</b>

**INITIATING DOCUMENTS**

Task Analysis of Tasks

**REQUIRED TOPICS**

None

**CONTENT REFERENCES**

Machine Tool Practices, Fifth Edition

Machinery's Handbook

Technology of Machine Tools, Third Edition

PVNGS OSHP Manual

TCS 03-0414 Revise NMS60 to incorporate Prevent Events

OE 20099 Worker sustains hand injury while operating lathe at Wolf Creek Nuclear.

Palo Verde Standards & Expectations Preventing Events

Technology of Machine Tools sixth edition Krar, Gill & Smid

**LESSON PLAN REVISION DATA**

Oct 01, 2010 Mark Tague

TCSAI 3534033 to update references, re-word Course terminal objective and Lesson terminal objectives.add more prevent event tools, add content to clarify various instructions.

Tasks and Topics Covered

The following tasks are covered in Machining in a Chuck :

Task or Topic Number*	Task Statement
-----------------------	----------------

Lesson: Machining in a Chuck

LATH002	Perform precision engine lathe operations
LATH001	Perform basic engine lathe operations and maintenance

Total task or topics: 2

**LESSON TERMINAL OBJECTIVE:**

- 1 Given a Lathe machine operation using a "chuck", the Maintenance Mechanic will describe the various methods used and tooling required to safely and properly operate the lathe using a chuck. Mastery will be demonstrated by successfully completing a written examination with a score of 80% or better.
  - 1.1 Describe the methods of mounting and machining work in a three-jaw chuck
  - 1.2 Describe the methods of mounting and machining work in a four-jaw chuck
  - 1.3 Describe the process of facing, grooving, and cutting off work held in a chuck
  - 1.4 Describe the process of drilling holes using a lathe
  - 1.5 Describe the process of reaming and boring using a lathe
  - 1.6 Describe the process of tapping an internal thread using a lathe

	CONTENT	METHODS & ACTIVITIES
I.	Motivation	Focus student attention on "What's In It For Me".
II.	Pre-Job Brief	
	A. <u>Pre-job briefing</u> on the day's activities modeling the use of the <b><i>Palo Verde Standards &amp; Expectations, Preventing Events</i></b>	
	B. Focus On Five (Task Preview)	
	Familiarize worker with the scope of work, task sequence, and critical steps.	
	1. Critical Steps (Lesson Terminal Objective)	PVNGS Standards & Expectation book (Focus on five) Highlight the critical steps (Terminal Objectives) on the power point presentation.
	Given a Lathe machine operation using a "chuck" , the Maintenance Mechanic will describe the various methods used and tooling required to safely and properly operate the lathe using a chuck. Mastery will be demonstrated by successfully completing a written examination with a score of 80% or better.	
	2. Identify error likely situations (error traps)	Look at Error Precursors in S&E book
	a. Discuss at least one specific error likely situation	
	3. Identify the Worst thing that can happen.	Apply to the setting you're in. (Lab versus Classroom)
	4. Identify specific error prevention defenses to be used.	What defenses can we employ to prevent the "Worst thing that could happen"
	5. Identify actions to assure proper configuration control.	This may not be applicable in every training setting.
	C. Break policy	
	1. Two Minute Drill – After lunch at a minimum	At Instructor's discretion, not to interrupt class flow
III.	Lesson Enabling Objectives	Read and/or discuss the lesson objectives
	EO01 Describe the methods of mounting and machining work in a three-jaw chuck	
	EO02 Describe the methods of mounting and machining work in a four-jaw chuck	

	<b>CONTENT</b>	<b>METHODS &amp; ACTIVITIES</b>
EO03	Describe the process of facing, grooving, and cutting off work held in a chuck	
EO04	Describe the process of drilling holes using a lathe	
EO05	Describe the process of reaming and boring using a lathe	
EO06	Describe the process of tapping an internal thread using a lathe	

**TO: 1**      **Given a Lathe machine operation using a "chuck", the Maintenance Mechanic will describe the various methods used and tooling required to safely and properly operate the lathe using a chuck. Mastery will be demonstrated by successfully completing a written examination with a score of 80% or better.**

**EO: 1.1 Describe the methods of mounting and machining work in a three-jaw chuck**

**Main Idea**

**CONTENT**

**METHODS AND  
ACTIVITIES**

I. Mounting and Removing Lathe Chucks

A. Hazards, HU Tools and Error Prevention

While moving a chuck can seem like a routine task there are many ways for machine damage or personal injury to occur. Some of the error precursors could be complacency or overconfidence because it is an evolution performed many times, or the error precursor could also be Unfamiliarity because it is a task that the technician is new at. Either way attention needs to be drawn to the specific hazards of moving a chuck.

Many Lathe chucks are heavy even if they are small. Any time a chuck is to be removed or installed the technician needs to employ the use of the 2 minute drill to make themselves aware of the hazards associated with moving these chucks.

The number one thing is safety. Be aware of pinch points and body position while moving the chuck. Don't place hands or fingers directly under the chuck or in a position where they might become pinched or trapped during the evolution.

Once the chuck is in place on the spindle, lock it in with at least one of the locks before removing hands from the chuck entirely.

Do not lift the chuck and then twist your body with the weight in your hands as this can cause back injury. If a hoist is needed, use it.

A piece of wood should be placed on the ways directly under the chuck in the event the chuck drops. This will prevent damage to the ways.

B. Lathe Chuck Description

CONTENT	METHODS AND ACTIVITIES
<ol style="list-style-type: none"><li>1. Adjustable Jaws</li><li>2. Work is generally shorter than work held between centers</li><li>3. If work is longer than three times its diameter, the end should be supported.</li></ol>	
C. Mounting and Removing Chucks	
<ol style="list-style-type: none"><li>1. Mounting<ol style="list-style-type: none"><li>a. Depending on the machine, set lathe to slowest speed.</li><li>b. Shut off power</li><li>c. Remove drive plate and center if they are installed.</li><li>d. Clean surfaces</li><li>e. Place chuck cradle (or block of wood) in front of spindle</li><li>f. Slide cradle close to spindle nose and mount chuck</li><li>g. Three types of chuck attachment<ol style="list-style-type: none"><li>1) Threaded<ol style="list-style-type: none"><li>a) Don't jam or slam chuck into spindle, it could damage threads.</li></ol></li><li>2) Tapered<ol style="list-style-type: none"><li>a) Secure locking ring.</li></ol></li><li>3) Cam-Lock<ol style="list-style-type: none"><li>a) Pay attention to the registration lines on each of the cam-locks. They indicate whether the cam-lock is locked or unlocked.</li></ol></li></ol></li></ol></li></ol>	

CONTENT	METHODS AND ACTIVITIES
<ul style="list-style-type: none"><li>2. Removing a Chuck<ul style="list-style-type: none"><li>a. Set lathe at slowest speed</li><li>b. Stop the motor</li><li>c. Place cradle under chuck</li><li>d. Remove chuck onto cradle</li></ul></li></ul>	
II. THREE-JAW UNIVERSAL CHUCK	<i>Note: This is best demonstrated by the instructor for the first time.</i>
A. Assembling Jaws in a Three-Jaw Chuck	<i>Point out that the jaws are numbered for insertion into corresponding chuck grooves.</i>
<ul style="list-style-type: none"><li>1. Two sets of jaws usually supplied<ul style="list-style-type: none"><li>a. Outside gripping</li><li>b. Inside gripping</li><li>c. Not interchangeable between chucks</li></ul></li><li>2. Clean jaws and jaw slides</li><li>3. Turn the chuck key clockwise until the start of the scroll thread just shows on the back edge of Slide 1.</li><li>4. Insert Jaw 1 into Slide 1 and press down while turning chuck wrench clockwise</li><li>5. After scroll thread engages, continue to turn until scroll thread is back of Slide 2</li><li>6. Insert Jaw 2 and continue</li></ul>	<i>Typically jaws are installed numerically from 1., but there are exceptions</i>

**CONTENT**

**METHODS AND  
ACTIVITIES**

7. Insert Jaw 3 in the same manner
8. Some three-jaw chucks use jaws are fastened to master jaws with cap screws
9. Reverse for inside gripping
- B. Mounting Work
  1. Clean the chuck jaws
  2. Use the proper size chuck wrench and open jaws
  3. Place work in chuck
    - a. No more than three times diameter extending out
  4. Tighten jaws
    - a. All jaws move simultaneously
    - b. Do not over tighten

**EO: 1.2 Describe the methods of mounting and machining work in a four-jaw chuck****Main Idea**

<b>CONTENT</b>	<b>METHODS AND ACTIVITIES</b>
III. THE FOUR-JAW INDEPENDENT CHUCK	
A. Description	
1. All four jaws move independently 2. Holds odd-shaped work (square, rectangular)	
B. Mounting work	
1. Measure diameter of work 2. Adjust jaws to approximate size using index line on face of chuck 3. Set work in chuck and snug up jaws 4. True up work by one of following methods: a. Chalk method 1) Start lathe 2) Lightly touch chalk to diameter of work 3) Stop lathe and check chalk for high spots b. Surface Gage Method 1) Place surface gage on lathe bed and adjust point of scribe to just touch work 2) Revolve lathe by hand to find low spot 3) Loosen jaw nearest low spot and tighten opposite jaw 4) Repeat until work is true	

CONTENT	METHODS AND ACTIVITIES
c. Dial Indicator Method (preferred)	
1) Mount work and true approximately	
2) Mount an indicator on a stationary part of lathe	<i>Instructor to demonstrate zeroing of a part.</i>
3) Bring indicator point against work until it registers	<i>Then the offsetting to a specific reading</i>
4) Turn lathe by hand and note highest and lowest readings	
5) Loosen at lowest and tighten at highest until work is moved halfway between	
6) Continue to adjust these two readings until the indicator registers the same	
7) Repeat with opposite set of jaws until indicator reads the same on any point	
8) Rotate lathe by hand and check readings	

**EO: 1.3 Describe the process of facing, grooving, and cutting off work held in a chuck**

**Main Idea**

**CONTENT**

**METHODS AND  
ACTIVITIES**

IV. Facing, Grooving, And Cutting Off In A Chuck

A. Facing

1. Purpose

- a. Obtain true, flat surface
- b. Cut the work to length

2. Process

- a. True up work in the chuck
- b. At least an amount equal to the diameter projecting from chuck jaws
- c. Set compound rest
  - 1) 90 degrees, if many shoulders to be cut
  - 2) 30 degrees to the right, for single surface
- d. Set facing tool bit to center height
  - 1) approx. 10 degrees to left
- e. Lock the carriage
- f. Set the depth of cut on the compound rest
  - 1) Twice the amount at 30 degrees
  - 2) The exact amount at 90 degrees
- g. Speed is normal cutting speed
- h. Feed tool by hand until it touches

**CONTENT****METHODS AND  
ACTIVITIES**

- i. Automatic feed to center of face
  - j. Make one or more rough cuts
  - k. Finish cut from middle out
  - l. If a projection is left in the middle of the work then the cutting tool is not set at center.
- B. Cutting Off Work
- 1. Mount work with cutoff point as close to jaws as possible
  - 2. Mount cut-off tool on left side of compound rest and center the cutting tool
  - 3. Place cutter as close to the tool post as possible to avoid chatter
    - a. Extend cutting blade half the diameter plus  $\frac{1}{8}$ "
  - 4. Set speed at one-half cutting speed
  - 5. Start lathe and feed tool by hand
    - a. Keep steady feed
    - b. Apply cutting fluid
      - 1) Do not use cutting fluid on cast iron
  - 6. When grooving or cutting off deeper than  $\frac{1}{4}$ ", slight sideways movement of cutting tool prevents jamming
  - 7. Just before cut is complete – remove burrs by light filing.
-

**EO: 1.4 Describe the process of drilling holes using a lathe****Main Idea**

<b>CONTENT</b>	<b>METHODS AND ACTIVITIES</b>
V. DRILLING ON A LATHE	
A. Center drilling	
1. V-shaped shallow hole 2. Guide for regular drill 3. Provides the proper hole at each end of a piece of work that will be turned between centers.	
B. Regular Drilling	
1. Mount work true in lathe 2. Set lathe to proper speed for material to be drilled 3. Align tailstock 4. Spot the hole with a center drill 5. Mount twist drill <ol style="list-style-type: none"><li>Tailstock spindle</li><li>Drill chuck</li><li>Drill holder</li></ol> 6. Start lathe and drill to desired depth - apply cutting fluid 7. Use graduations on tailstock or measuring instrument 8. Back drill out often to remove chips from the flutes of the drill.	<i>Instructor may discuss pilot drilling.</i>

**CONTENT**

**METHODS AND  
ACTIVITIES**

- a. Not clearing the chips will cause the flutes to clog and possibly break the drill bit. *Hazard Assessment*

**EO: 1.5 Describe the process of reaming and boring using a lathe**

**Main Idea**

<b>CONTENT</b>	<b>METHODS AND ACTIVITIES</b>
VI. REAMING AND BORING ON A LATHE	
A. Steps in making a true hole	
1. Drill	
2. Bore	
3. Ream	
B. Boring - The purpose of boring is to ensure that the hole is on location	<i>Pass a boring bar around the class</i>
1. Enlarging and truing a hole with a single point cutting tool	
2. Special diameter holes can be produced	
3. Process	
a. Mount work, face, center drill, and drill hole 1/16" undersized	
b. Select and mount boring bar	
c. Center tool bit	
d. Set speed (normal cutting) and medium feed	
e. Start lathe and touch work with tool bit	
f. Take light trial cut	
g. Stop lathe and measure for accuracy	
h. Determine amount to be removed	
1) Leave .010" -.020" for finishing cut	

CONTENT	METHODS AND ACTIVITIES
i. Set depth of cut	<i>The dial setting disengages the tool</i>
j. Start lathe and take rough cut	<i>Stop the lathe, move the boring bar out of the bore.</i>
k. Make finishing cut with fine feed	
C. Reaming	<i>It would be a good training aid to show the difference between a machine and a hand reamer</i>
1. Used to obtain an accurate sized hole	
2. Drill and bore prior to reaming	
3. Process	
a. Mount work in chuck, center drill, drill and bore to .010" undersize	
b. Mount machine reamer in drill chuck or drill holder	
c. Speed is one-half normal cutting speed	
d. Bring reamer close and lock tailstock	
e. Start lathe, apply cutting fluid, and slowly feed reamer into bore with tailstock hand wheel	<i>Discuss feed rates for reamers</i>
f. Occasionally pull reamer out to clear chips and allow cutting fluid access. <b><u>Never turn a reamer backwards for any reason</u></b>	
g. When hole is reamed, remove reamer from bore and stop the lathe.	
h. Clean and store reamer properly.	

**CONTENT**

**METHODS AND  
ACTIVITIES**

**OE 20099 Wolf Creek January 2005**

On January 21, 2005 a machinist at Wolf Creek Nuclear Plant sustained a hand injury while reaming a hole in a blind flange for a CO2 connection.

The worker was manually jogging the button on the lathe to back out the reamer and was steadying the wrench on the lathe compound.

The reamer cocked and forced the back-up wrench to slip off the step of the compound and, in the process, the worker's right little finger was pinched between the back-up wrench and the lathe compound.

The worker's finger was broken and required 14 stitches.

**EO: 1.6 Describe the process of tapping an internal thread using a lathe**

**Main Idea**

**CONTENT**

**METHODS AND  
ACTIVITIES**

VII. TAPPING A HOLE ON THE LATHE

A. Used to produce internal threads

1. Point of tailstock dead center on shank end of tap to guide it and provide support
2. Tap handle is always turned by hand
3. Process:
  - a. Mount work in chuck, face, and center drill
  - b. Select proper sized tap drill
  - c. Set lathe to proper speed
  - d. Drill hole to required depth
  - e. Chamfer edge of hole slightly
  - f. Stop lathe and lock spindle
  - g. Place tapered tap in hole and support tap shank with point of tailstock center
  - h. With the tap wrench handle, turn the tap, keeping the dead center snug against the shank by turning the tailstock hand wheel.
  - i. Back the tap out occasionally to break chip
    - 1) If the tap isn't reversed occasionally to break the chip, the flutes of the tap will load up with debris and break the tap.

*Discuss the need to ensure that the tap is properly aligned to the hole prior to starting tapping evolution*

**CONTENT**

**METHODS AND  
ACTIVITIES**

- j. Remove taper tap and finish tapping the hole with bottoming or plug tap
- k. Check thread.

## **SUMMARY OF MAIN PRINCIPLES**

The following items are things to consider in your lesson summary. They are not mandatory. You should develop your own summary.,

### **Objectives Review**

Review the Lesson Objectives

Topic Review

Restate the main principles or ideas covered in the lesson. Relate key points to the objectives. Use a question and answer session with the objectives.

### **Questions and Answers**

Oral questioning

Ask questions that implement the objectives. Discuss students answers as needed to ensure the objectives are being met.

### **Problem Areas**

Review any problem areas discovered during the oral questioning, quiz, or previous tests, if applicable. Use this opportunity to solicit final questions from the students (last chance).

### **Concluding Statement**

If not done in the previous step, review the motivational points that apply this lesson to students needs. If applicable, end with a statement leading to the next lesson.

You may also use this opportunity to address an impending exam or practical exercise.

Should be used as a transitional function to tie the relationship of this lesson to the next lesson. Should provide a note of finality.

## **Post Training (Job) Critique**

Use Standards & Expectations Book Why, When, & How (page 74)