PALO VERDE
NUCLEAR GENERATING STATION

Mechanical Maintenance Training
Safety and Introduction to Lathe Operations
Classroom Lesson

Mechanical Maintenance Training	**Date: 10/1/2010 12:03:46 PM**
LP Number: NMS60C000103	**Rev Author: MARK TAGUE**
Title: Safety and Introduction to Lathe Operations	**Technical Review:** Fredrickson, Rodney J(Z36022) Digitally signed by Fredrickson, Rodney J(Z36022) DN: cn=Fredrickson, Rodney J(Z36022) Date: 2010.10.28 08:17:27 -07'00'
Duration : 7 HOURS	**Teaching Approval:** Baker Sr, Lee E(Z07641) Digitally signed by Baker Sr, Lee E(Z07641) DN: cn=Baker Sr, Lee E(Z07641) Reason: I am approving this document Date: 2010.11.18 08:23:06 -07'00'

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

SCR P-1998-01727 Pickering Mechanic Injured while polishing project on lathe.

TCS 03-0414 Revise NMS60 to incorporate Prevent Events

OE 17845 HPI pump first stage impeller dislodged from lathe chuck.

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 Safety and Introduction to Lathe Operations :

Task or Topic Number*	Task Statement
Lesson:	Safety and Introduction to Lathe Operations
LATH001	Perform basic engine lathe operations and maintenance
LATH002	Perform precision engine lathe operations

Total task or topics: 2

LESSON TERMINAL OBJECTIVE:

1 Given a Lathe machining operation, the Maintenance Mechanic will explain the basic safety rules for the operation of the lathe and identify the component parts of the lathe. Mastery will be demonstrated by successfully completing a written examination with a score of 80% or better.

1.1 State the basic safety precautions for using a lathe

1.2 Describe the component parts of a lathe and their functions

1.3 Describe the various lathe accessories and their functions

1.4 Describe the types of lathe cutting tools

1.5 Identify the methods of determining the proper cutting speeds, feeds, and depth of cut

CONTENT	METHODS & ACTIVITIES
I. Motivation Provide knowledge and a start to using the lathe safely	Focus student attention on "What's In It For Me".
II. Pre-Job Brief	
A. Pre-job briefing on the day's activities modeling the use of the ***Palo Verde Standards & Expectations, Preventing Events***	
B. Focus On Five (Task Preview) Familiarize worker with the scope of work, task sequence, and critical steps.	
1. Critical Steps (**Course** Terminal Objective) Given various machine operations on the lathe, the Maintenance Mechanic will describe how to safely and properly operate the lathe applying Palo Verde standards and expectations. Mastery will be demonstrated by successfully completing a written examination with a score of 80% or better.	PVNGS Standards & Expectation book (Focus on five) Highlight the critical steps (Terminal Objectives) on the power point presentation.
2. Identify error likely situations (error traps) a. Discuss at least one specific error likely situation b. These topics are the subject of the class	Look at Error Precursors in S&E book
3. Identify the Worst thing that can happen. Someone get hurt, in class or later due to not learning the information in this course	Apply to the setting you're in. (Lab versus Classroom)
4. Identify specific error prevention defenses to be used. To be discussed and use throughout the course – questioning attitude & STOP if unsure	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. Schedule	
1. Length of class	
2. Break policy a. Two Minute Drill - After lunch at a minimum	Expected after lunch at a minimum

CONTENT	METHODS & ACTIVITIES
3. Evaluation	
4. Post training critique	Feedback (i.e.Class Climate)
D. Qualification No qualification until associated JQC is completed independent of this course	Identify what they will be qualified to do upon completion of the course
III. Lesson Introduction	
A. **Lesson** Terminal Objective Given a Lathe machining operation, the Maintenance Mechanic will explain the basic safety rules for the operation of the lathe and identify the component parts of the lathe. Mastery will be demonstrated by successfully completing a written examination with a score of 80% or better.	Read and/or discuss the lesson objectives
B. Lesson Enabling Objectives	
EO01 State the basic safety precautions for using a lathe	
EO02 Describe the component parts of a lathe and their functions	
EO03 Describe the various lathe accessories and their functions	
EO04 Describe the types of lathe cutting tools	
EO05 Identify the methods of determining the proper cutting speeds, feeds, and depth of cut	

TO: 1 Given a Lathe machining operation, the Maintenance Mechanic will explain the basic safety rules for the operation of the lathe and identify the component parts of the lathe. Mastery will be demonstrated by successfully completing a written examination with a score of 80% or better.

EO: 1.1 State the basic safety precautions for using a lathe

CONTENT	METHODS & ACTIVITIES
LATHE SAFETY	
A. General Shop Rules	**Prevent Events**
1. No horseplay	Stop when unsure of what controls do.
2. Understand the lathe controls.	Identify Error precursors like Unfamiliarity, Lack of knowledge, Inexperience
3. Not understanding what will happen when a lever or switch is turned can be extremely dangerous.	
Plant: Pickering	
Title: Machine Shop Accident on Lathe (Reference: SCR P-1998-01727)	
Summary: A Mechanical Maintainer assigned to a "Machining for Fitters" course was polishing the surface finish of a project he was completing. The project was a fireplace poker approximately 24 inches in length with a composite material laminated handle. After polishing the handle he noticed chuck marks on the ½-inch diameter shaft and decided to polish the shaft to remove the marks. The piece was re -chucked with approximately 19 inches extending from the chuck unsupported. The lathe was started with a speed of 840 RPM but the Maintainer decided that he should increase the speed to 1500 RPM to improve the polishing process. Following speed adjustment, the lathe was restarted and immediately the project piece became unbalanced and bent at approximately 45 degrees striking the Maintainer in the chest and jamming itself against the lathe bedway. The shaft began slipping in the jaws of the chuck producing a loud noise, which alerted the instructor who switched off the lathe.	*The Maintainer sustained an injury, which appeared to be a scrape on the upper chest with some bruising, and was in some pain. He was subsequently escorted to hospital for medical assessment and later allowed to return to normal duties without restrictions.*
4. Be sure that you can stop the machine immediately.	
B. Safety Guards	
1. Do not operate the machine unless the safety guards are installed properly.	

CONTENT	METHODS & ACTIVITIES
C. Stop the lathe when: 1. Measuring work 2. Cleaning, lubricating or adjusting the machine.	
D. Cleaning work 1. Do not use a rag to clean work in a lathe while the machine is operating. *Note: Explain that rags can get caught in the rotating parts, or that it can pick up sharp chips and cut the hand.*	
E. Stopping the lathe 1. Never attempt to stop a coasting lathe by hand as there are many projections (drive plate or chuck) that will injure your hand seriously.	*Reference OSHP Manual Article 7 Para.C.1*
F. Mounted work 1. Ensure that the chuck or faceplate is mounted securely before starting the lathe. 2. If an accessory comes off the machine during operation it will act like a missile. **OE17845** While attempting to machine a High Pressure Injection (HPI) Pump impeller in a lathe, the impeller dislodged from the jaws of the chuck, fell into the drip tray of the lathe, and sustained minor damage. The cause was insufficient clamping force applied to the impeller because of the method in which the impeller was chucked in the lathe.	

CONTENT	METHODS & ACTIVITIES
G. Chuck Wrench 1. Ensure the chuck wrench is removed from the chuck prior to starting the lathe. Keep your hand on the chuck wrench at all times when it is in the chuck. 2. If the wrench were in the chuck when the lathe was started it could either: a. Fly off like a missile b. Jam between the chuck and lathe bed damaging the chuck, lathe bed, spindle and wrench.	**Prevent Events** – Self-check/Peer-check
H. Prior to starting the Lathe 1. Move the carriage to the furthest position of the cut. 2. Turn the spindle by hand one complete revolution to ensure there are no obstructions.	
I. Working around a stopped lathe 1. Remove the tool bit to prevent serious cuts to hands and arms.	
II LATHE DESCRIPTION A. It operates on the basic principle of the work being held and rotated on its axis while the cutting tool is stationary and advanced along the lines of a desired cut	
B. Lathe Size and Capacity 1. Largest work diameter that can be swung over the lathe ways and generally the maximum distance between centers.	*Show how capacity is determined*

EO: 1.2 Describe the component parts of a lathe and their functions

CONTENT	METHODS & ACTIVITIES
Typical Lathe I Component parts of a lathe A. Bed 1. Top section has machined ways 2. Guide and align the major parts of a lathe B. Headstock 1. Clamped on left side of lathe bed C. Headstock spindle 1. Hollow, cylindrical shaft supported by bearings 2. Provides drive from motor to work-holding devices such as live center, faceplate, or chuck 3. Driven by belt and pulley or gearbox D. Quick change gearbox 1. Provides feed rod and lead screw with various rates of feeds E. Half-nut or Split-nut lever 1. Synchronous engagement for thread cutting F. Carriage - consists of: 1. Saddle 2. Crosslide 3. Apron G. Tailstock 1. Provides support for right end of work 2. Tailstock spindle has internal taper	*Show the components and describe their function*

CONTENT	METHODS & ACTIVITIES
H. Lathe Care and Maintenance 1. Clean and Lubricate 2. Oil on ways and other sliding surfaces 3. Grease in grease fittings 4. Cover ways with paper when filing, grinding, or polishing 5. Do not over tighten clamps 6. Use proper wrenches for adjustment 7. Ensure spindle is stopped if needed before changing gears 8. Check oil reservoirs 9. Machine must be level 10. Do not abuse machine by hammering or forcing mechanisms	*Point out all reservoirs and lubrication points.* HU Tool – Maintain a Questioning Attitude when performing lathe maintenance. Something out of place may indicate a bigger problem.

EO: 1.3 Describe the various lathe accessories and their functions

CONTENT	METHODS & ACTIVITIES
Lathe Accessories A. Work holding, supporting, and driving devices 1. Centers a. 60 degree with Morse taper shank 1) Needs lubrication b. Revolving dead center (Live Center) 1) No lubricant needed c. Microset adjustment. (these are for O.D. grinders) 1) Permits limited amount of adjustment to each side of center d. Self-driving live center 1) Grooves to provide drive 2) Used in head stock to enable on continuous cut.	*The instructor should have examples of these centers to pass around the class, if possible*
2. Chucks a. Three-jaw Universal b. Four-Jaw Independent 3. Spindle Noses a. Threaded 1) Clockwise b. Tapered 1) Lock Ring c. Cam-lock	*Show the students the chucks installed on the lathes.*

CONTENT	METHODS & ACTIVITIES
4. Spring collet chuck a. Accurate b. Limited range	
5. Jacobs Chuck a. Rubber-flex collets	
6. Magnetic a. Light cuts only	*Emphasize that a magnetic chuck is used for light non-forceful activities only.*
7. Faceplates a. Slots for bolts to secure workpiece	
8. Rests a. Steadyrest - supports long work b. Follower rest - prevents work springing away, mounted on carriage	
9. Mandrels a. Hold internally machined workpieces between centers	
10. Lathe Dogs a. Standard bent-tail dog b. Straight-tail dog c. Safety-clamp dog d. Clamp dog e. odd-shaped workpieces	
B. Cutting Tool Holding Devices	

CONTENT	METHODS & ACTIVITIES
1. Tool Holders - It is very important to use the proper tool holder for the job being performed. It is too easy to run a tool holder into the rotating work which creates more hazards like; breaking the tool off, damaging the equipment or throwing the rotating work out of the lathe. a. Left-hand offset 1) Machining close to chuck - right to left b. Right-hand offset 1) Machining close to tailstock - left to right - facing c. Straight 1) General machining operations d. Carbide Toolholder 1) little or no back rake e. Cut-off (Parting) f. Threading Toolholder g. Boring Bar holders	OE – Hazards associated with using the wrong tooling.
2. Tool Posts a. Standard b. Turret-type c. Quick-change/Dovetailed	*The Quick-Change tool post is very common and is what is used in the training lab.*

EO: 1.4 Describe the types of lathe cutting tools

CONTENT	METHODS & ACTIVITIES
LATHE CUTTING TOOLS	*Show examples of different types of cutting tools*
A. Materials	
1. High speed steel	
2. Cast alloys (stellite)(replaced by carbides	
3. Cemented carbides	
4. Ceramics	
B. Properties	
1. Hardness	
2. Wear-resistant	
3. Withstand high temperatures	
4. Withstand shock	
C. Cutting Tool Nomenclature	*Note: Examples of properly ground toolbits to pass around would provide excellent training aids*
1. Base	
2. Cutting edge	
3. Face	
4. Flank	
5. Nose	
6. Nose radius	
a. Small - for rough cuts	
b. Large - for finish cuts	
7. Point	
8. Shank	
D. Cutting Tool Shapes	
1. Rough cut	
2. Finish cut	

CONTENT	METHODS & ACTIVITIES
E. Toolbit Angles and Clearances 1. Side cutting edge angle 2. End cutting edge angle 3. Side relief angle (clearance) 4. End relief angle (clearance) 5. Side rake 6. Angle of keenness 7. Back (top) rake	*Discuss tool bit geometry and what type of chips will be produced by different tools.*
F. Grinding a General-Purpose Toolbit	
HU Tools – Questioning Attitude, Stop when unsure. When grinding lathe tools ensure the gap on the tool rest for the grinder is set properly. If this gap is too large the tool can be sucked down into the wheel along with the fingers of the person grinding it causing personal injury and equipment damage. While grinding the tool be aware of the fact that the tool can get hot while grinding. The heat isn't good for the tool, and it can heat up so suddenly it can cause the person holding it to loose control of the tool causing it to become ejected from the grinder. Dip the tool in water often while grinding to keep it cool.	*Note: The instructor should demonstrate the process* Do not proceed in the face of uncertainty
1. Grip toolbit firmly 2. Grind the side cutting edge angle and the side relief angle 3. Keep the toolbit moving across the grinding wheel a. Keep it cool 4. Grind end cutting edge and end relief angle 5. Grind side rake 6. Grind nose radius 7. Hone cutting edge slightly	

EO: 1.5 Identify the methods of determining the proper cutting speeds, feeds, and depth of cut

Main Idea

CONTENT	METHODS & ACTIVITIES
CUTTING SPEEDS AND FEEDS	*Have students calculate and set the RPM on the lathe. Point out that the second one can be figured in your head*
A. Speeds	
1. Lathe work cutting speed (CS) is defined as the RATE at which a point on the work circumference passes the cutting tool.	
For example if the metal being cut has a CS of 80ft/min, it means the spindle speed must be set so that 80 ft of the work circumference will pass the cutting tool in One minute.	
a. CS is expressed in Feet per minute	
b. DO NOT confuse the CS of a metal with the number of turns a work piece will make in one minute	
c. To calculate the lathe spindle speed in revolutions per minute (rpm) the CS of the metal must be known. Most machinist handbooks have a standard chart for cutting speeds of materials.	*Page 369 of Technology of Machine tools. Table 47.1*
d. The proper spindle speed can be set by dividing the CS in inches per minute by the circumference of the work in inches.	

CONTENT	METHODS & ACTIVITIES
e. The formula is as follows: $RPM = \frac{CS \times 12}{\pi D}$	
Where CS is the cutting speed listed from the chart for the material being cut. Multiply the CS by twelve in order to convert it to inches. πD is the part of the formula where the circumference of the work is expressed in inches. π or Pi = 3.1416 and D = Diameter of the work piece.	*3.1416 or Pi is a standard. It is the circumference of a one inch diameter piece of round stock.*
f. This formula doesn't work very well for lathes though because they have a very limited selection of speeds. So the following is a simpler and more effective formula for spindle speed.	
g. $RPM = \frac{CS \times 4}{D}$	
B. Feed - Definition	
1. The distance a cutting tool advances along the length of the work for each revolution of the work piece. For example if the lathe is set for a 0.015 inch feed, it means the cutting tool will travel 0.015 inches along the length of the work for every revolution of the spindle. The feed of the lathe is dependent on the speed of the lead screw and is controlled by the change gears.	
a. Roughing cut - Coarse Feed means the tool travels a larger distance along the work per revolution of spindle.	
b. Finishing cut - Fine Feed means the tool travels a very short distance along the work per revolution of the spindle.	

CONTENT	METHODS & ACTIVITIES
C. General Guidelines 1. Speed and feed are inversely related 2. Lower speeds for harder materials 3. Higher speeds for harder toolbit materials 4. Lower speeds for roughing cuts 5. Higher speeds for finishing cuts 6. Lower speeds for long cutting edges 7. Lower speeds for castings	
D. Cutting Fluids 1. Purpose a. Cools the toolbit and work b. Lubricates chip bearing surface of toolbit c. Better surface finish d. Aids removal of chips e. Protects equipment f. Protects operator from dust 2. Types a. Soluble oil and water emulsions b. Straight cutting oils c. Chemical cutting oils(Synthetics)	*Point out that heat is a toolbits worst enemy. Discuss the need to keep the floor around the lathe dry when using a coolant system.* **Prevent Events**: 2-minute drill during and on regular intervals – ensure hazards not created

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.