

Green Level Labs

- Hand and Power Tools Lab
- Rigging Lab
- Measurements Lab
- Lubrication Systems Lab
- Basic Mechanical Lab
- Advanced Mechanical Lab

Hand & Power Tools Lab

Introduction

In these lab exercises the student will use various hand and power tools such as wrenches, hammers, pliers power drills and saws and a drill press to perform a number of common tasks. The exercises will emphasize proper safety procedures and appropriate usage techniques. The student will be expected to perform all tasks in a careful and timely manner.

Key Learning/ Performance Objectives

- Use all tools with the proper safety procedures
- Properly select and use hand tools to:
 - Measure, mark and cut metal
 - Drill, tap and dress holes in metal
 - Remove and repair various fasteners and fittings
- Properly use torque wrench
- Properly select and use power tools for specific jobs

Success Measure

The student will perform all tasks to within 80% accuracy as determined by the lab instructor

Equipment and Special Requirements

- Wrenches, pliers, hammers, chisels, files, drill bits and taps, charts, saws
- Power drills, grinders, power saws, drill press

Prerequisite Labs

- None

Description of Procedure

The student will safely perform various common tasks using the appropriate hand and power tools.



Hand & Power Tools Lab Procedure and Worksheet

Name	Start Time
Date	Finish Time
Instructor's Signature	

In this lab, your objective is to complete various tasks which will be used to evaluate your mastery of the requisite skills. It is your responsibility to complete these tasks accurately in a timely manner complying with all appropriate safety measures and use of all required Personal Protective Equipment (PPE).

Task I - Hand Tools	Pass	Fail	Initials
1. Obtain a section of ½" bar stock from your lab instructor.			
2. Select one end of the bar stock. Determine if it is square by using a combination or engineer's square. Square the end if needed.			
3. Measure 2" from squared end and mark. Position the bar in the vise and cut it using a hack saw with the blade properly installed. (Ensure that the cut is square to minimize dressing.)			
4. Use a single cut file to smooth and square the cut edges.			

Task I - Hand Tools cont.

	Pass	Fail	Initials
5. Find the center of a 2" square block and center punch it for drilling. Using a hand drill, drill a hole and then tap the hole for the fastener provided by the lab instructor. NOTE: USE CUTTING FLUID WHEN DRILLING AND TAPING.			
6. Using the trainer provided by the lab instructor, perform the required tasks, using the provided hand tools.			

Task II - Power Tools

	Pass	Fail	Initials
1. Reciprocating Saw: Install the proper blade and make the cut required by the lab instructor.			
2. Power Band Saw: Install a blade, if necessary, and, using the print provided, mark and cut the material per print specifications.			
3. Power Grinders: With a bench grinder, grind at a 45° angle, 0.125" across the flat on one side of a piece of material provided by the lab instructor. Then, using a handheld power grinder, perform the same task on the opposite side of the material.			
4. Drill Press: Using the print and material provided, drill the required holes.			
5. Clean all machine tools and the work area. Put scrap material in the scrap bin.			

Rigging Lab

Introduction

In these lab exercises the student will use rigging equipment such as slings, chains, pulleys, hoists and a gantry chain to perform a number of common rigging and lifting tasks. The exercises will emphasize proper safety procedures and appropriate usage techniques, as well as tools for calculating load weight and distribution. The student will be expected to perform all tasks in a careful and timely manner.

Key Learning/ Performance Objectives

- Use all equipment with the proper safety procedures
- Identify the various parts of a rigging system
- Calculate load weight and distribution
- Properly select and use slings, chains, cables, hooks, hoists, pulleys, a compound block and tackle, and a gantry crane to rig and lift balanced and unbalanced objects

Success Measures

The student will calculate load lift weight and distribution to within 90% accuracy and rig and lift assigned loads with no error.

Equipment and Special Requirements

- Slings, chains, cables
- Hooks, pulleys, hoists, compound block and tackle
- Gantry crane

Prerequisite Labs

- None

Description of Procedure

The student will perform the assigned rigging and lifting tasks, making the appropriate weight and distribution calculations and safely using the appropriate rigging and lifting tools and techniques.

Rigging Lab Procedure and Worksheet

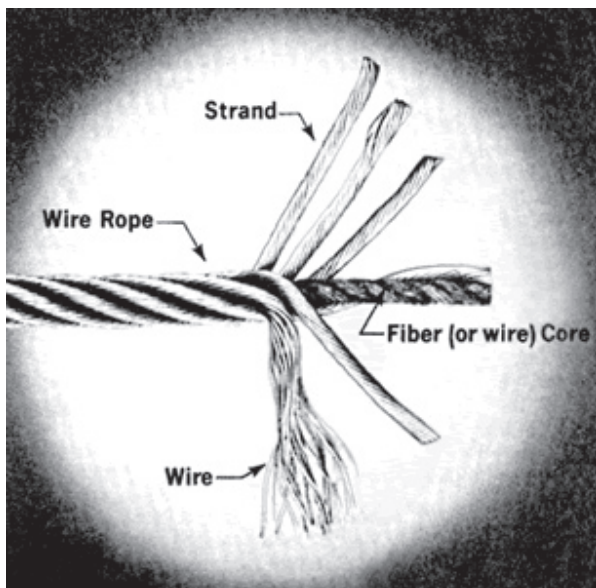
Name	Start Time
Date	Finish Time
Instructor's Signature	

In this lab, you will be required to complete various tasks which will be used to evaluate your mastery of the requisite skills. It is your responsibility to complete these tasks accurately in a timely manner complying with all appropriate safety measures and use of all required Personal Protective Equipment (PPE).

Task I - Identifying and using basic tools and materials

1. Identify different types of rope from a collection provided by the evaluator.
Synthetic, manila, nylon, and wire.

2.



Note: Identification of the parts of a wire rope.

Task I - Identifying and using basic tools and materials cont.

Possible answers for steps 3 thru 12. Record letter in proper identify box.

- A. Shackles
- B. Hooks
- C. Single and double synthetic web slings
- D. Eye splice thimbles
- E. Wire rope left lang lay
- F. 3-leg bridle hitch
- G. Choker hitch
- H. Basket hitch
- I. Wire rope right regular lay
- J. Wire rope clips
- K. Chain slings
- L. Chain hoist
- M. Ratchet jack
- N. Simple block and tackle
- O. Screw jack
- P. Compound block and tackle
- Q. Hydraulic jack
- R. Hydraulic jack with external pump

3. Identify wire rope lay

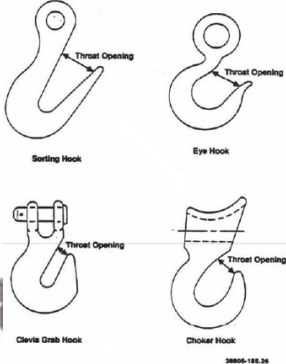
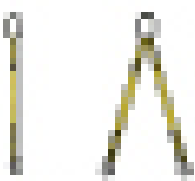
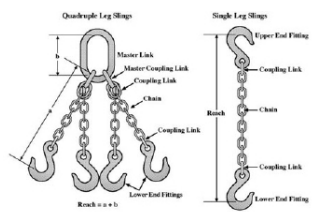




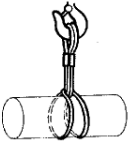
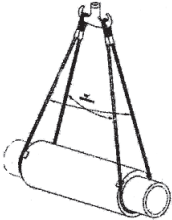
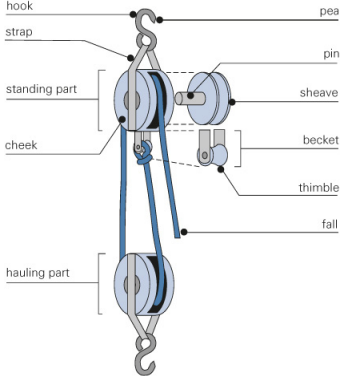
4.



Task I - Identifying and using basic tools and materials cont.

	Pass	Fail	Initials
5.  Sorting Hook Eye Hook Clevis Grab Hook Choker Hook 38905-182.36			
6. 			
7. 			
8. 			
9.  Quadruple Leg Slings Single Leg Slings Master Link Upper End Fitting Master Coupling Link Coupling Link Coupling Link Chain Hook Lower End Fitting Reach 38905-182.36			

Task I - Identifying and using basic tools and materials cont.

		Pass	Fail	Initials
10.	 _____			
11.	 _____			
12.	 _____			
13.	 _____			
14.	 _____			

Task I - Identifying and using basic tools and materials cont.

		Pass	Fail	Initials
15.	 _____			
16.	 _____			
17.	 _____			
18.	 _____			
19.	 _____			

Task II - Calculate load weight and rigging requirements

	Pass	Fail	Initials
1. You have to move an 8" diameter steel bar that is 8 foot long.			
a. Assuming steel weighs .284 pounds per cubic inch, how much does this piece weigh?			
b. Rig a choker hitch from the available slings that has adequate capacity to safely carry the load plus 10%.			

Task III - Identify various slings provided by instructor

	Pass	Fail	Initials
1. List weights for:			
a. Vertical lift			
i. Demonstrate how to rig.			
b. Choker			
i. Demonstrate how to rig.			

Task III - Identify various slings provided by instructor cont.

	Pass	Fail	Initials
c. Basket			
i. Demonstrate how to rig.			
2. Set up lift using Double Choker hitch with chains.			
3. Why would you use a spreader bar?			
4. Set up a lift using a spreader bar.			

Task IV - Knots, tag lines and cables

	Pass	Fail	Initials
1. Tie a clove hitch.			
2. Tie a lineman's hitch.			
3. Where would you use a tagline?			

Task V - Ladder usage

	Pass	Fail	Initials
1. To change out the chain hoist on the mezzanine beam, what kind of ladder would you use to get to it?			
2. How would you set this ladder up?			
3. What will keep it from slipping away?			
4. Would you be required to use a safety harness performing this task?			
5. Please inspect this harness and lanyard set for suitability and serviceability.			
6. How would you get your tools up to the job?			
7. Demonstrate the above.			

Measurements Lab

Introduction

In these lab exercises the student will use engineering measuring instruments such as micrometers, vernier calipers, scales, gage blocks, and V blocks to measure various parts. The exercises will emphasize the relationship of drawing dimensions to the measurement of parts. The student will be expected to make precise and accurate measurements and make detailed recordings of those measurements.

Key Learning/ Performance Objectives

- Measure with a line graduated rule
- Measure with fixed gages
- Measure with dial calipers
- Measure with vernier calipers
- Measure with vernier micrometers
- Translate between English and metric measurements
- Use gage blocks to check calibration on measurement instruments

Success Measure

The student will perform all measurements and calculations to within 80% accuracy as determined by the lab instructor

Equipment and Special Requirements

- Six-inch steel rule
- Dial and vernier calipers
- Inch and metric vernier micrometers
- Telescoping gage
- Gage blocks
- Feeler gages
- V blocks
- Instructor-assigned parts

Prerequisite Labs

- None

Description of Procedure

The student will perform the assigned measurements and other tasks using the appropriate tools and techniques.



Measurements Lab Procedure and Worksheet

Name	Start Time
Date	Finish Time
Instructor's Signature	

In this lab, you will be required to complete various tasks which will be used to evaluate your mastery of the requisite skills. It is your responsibility to complete these tasks accurately in a timely manner complying with all appropriate safety measures and use of all required Personal Protective Equipment (PPE).

Task I - Basic Measurements

1. Using a 6" steel rule measure the length, width, and depth of the part provided.

L _____ W _____ D _____

2. Zero a Dial Caliper.

3. Using a gage block, check the inch micrometer for Zero.

4. Using inch and metric calipers and micrometers, measure the five lands on the shaft provided.

CALIPER		MICROMETER	
INCH	METRIC	INCH	METRIC

Task I - Basic Measurements cont.

	Pass	Fail	Initials
5. Measure the inside diameter of cylinder #1 at two points with the telescoping gage. 1st _____ 2nd _____			
6. Measure the inside diameter of cylinder # 2 at two points with the inch caliper. 1st _____ 2nd _____			
7. Measure the clearance at the coupling mounted in the V-blocks with feeler gages, at two points 180° apart. 1st _____ 2nd _____			
8. Take a depth reading at two points on the part provided using the inch caliper. 1st _____ 2nd _____			
9. Measure the misalignment of the shaft mounted in the V-blocks with feeler gages, at two points 180° apart. 1st _____ 2nd _____			

Lubrication Systems Lab

Introduction

In these lab exercises the student will identify the various types and proper uses of industrial lubricants in order to perform the lubrication of industrial machinery. The exercises will emphasize basic chemical safety, safe handling of chemicals and lubricants, and proper lubricating techniques. The student will be also identify and properly remove and replace seals and gaskets on industrial components.

Key Learning/ Performance Objectives

- Identify various types of industrial lubricants, grease and oils
- Identify lubrication points on various types of machinery
- Perform lubrication using proper procedures
- Locate proper Material Safety Data Sheets (MSDS)
- Read and apply MSDS rules and procedures to perform assign tasks
- Identify various seals and gaskets
- Remove and replace seals and gaskets

Success Measures

The student will select appropriate lubricants with no error, lubricate machines per manufacturer's specifications and reassemble components with no leaks.

Equipment and Special Requirements

- Lubricants and various industrial chemicals
- Lubrication equipment (grease gun, funnel, etc.)
- Machinery to be lubricated
- Various seals and gaskets
- MSDS for lubricants and chemicals on hand

Prerequisite Labs

- None

Description of Procedure

The student will identify various lubricants and chemicals, and properly and safely select and lubricate industrial machinery with the correct lubricants. The student will properly remove and replace seals and gaskets on industrial components.



Lubrication Systems Lab Procedure and Worksheet

Name	Start Time
Date	Finish Time
Instructor's Signature	

In this lab, your objective is to complete various tasks which will be used to evaluate your mastery of the requisite skills. It is your responsibility to complete these tasks accurately in a timely manner complying with all appropriate safety measures and use of all required Personal Protective Equipment (PPE).

Task I - Identify the following by sight, smell and feel and explain their applications and operations

	Pass	Fail	Initials
1. Oil			
2. Grease			
3. Synthetic lubricants			

Task I - Identify the following by sight, smell and feel and explain their applications and operations cont.

	Pass	Fail	Initials
4. Absorbent dams			
5. Absorbent powder			
6. Waste oil receptacles			

Task II - Inspect and repair or replace seals and gaskets on designated machinery

	Pass	Fail	Initials
1. Check seals and gaskets for leakage.			
2. Remove and replace an oil seal.			
3. Replace a paper gasket.			

Task II - Inspect and repair or replace seals and gaskets on designated machinery cont.

	Pass	Fail	Initials
4. Use a silicone gasket.			
5. Replace a mechanical seal.			

Task III - Inspect and lubricate various components as directed by lab instructor

	Pass	Fail	Initials
Ensure area is clean prior to working to avoid any unnecessary contamination. Upon completion, clean up area and tools, return tools to tool box locations.			

Task IV - Find appropriate MSDS and answer the questions for the small spill identified to you by lab instructor

	Pass	Fail	Initials
1. What is CAS number for the product?			
2. Is this substance reactive?			
3. How would you fight a fire involving this product?			

Task IV - Find appropriate MSDS and answer the questions for the small spill identified to you by lab instructor cont.

	Pass	Fail	Initials
4. What steps would you take to clean up this spill?			
5. How would you treat a person that ingested this substance?			

Basic Mechanical Lab

Introduction

In these lab exercises the student will explore mechanical systems, performing various exercises designed to give an understanding of mechanical advantage and power transmission, using levers, gears, pulleys, couplings, motors and shafts. The student will study bearings and develop techniques to collect and analyze vibration data and then correct vibration problems accordingly. The exercises will emphasize proper and safe usage of all components and systems.

Key Learning/ Performance Objectives

- Identify mechanical power train components
- Define mechanical advantage
- Define various types of levers and shafts
- Identify the various types, uses and failure modes of bearings
- Analyze power transmission in a mechanical assembly
- Inspect and correct a pillow block bearing assembly
- Explain the effects of vibration on a drive system
- Prepare, collect and analyze vibration data from an industrial machine

Success Measure

The student will perform all tasks to within 90% accuracy, as defined by the lab instructor.

Equipment and Special Requirements

- Motor, shaft and bearing assemblies
- Digital thermometer
- Various drive systems
- Vibration analysis meter and probes

Prerequisite Labs

- Hand and Power Tools Lab
- Measurements Lab
- Lubrication Systems Lab

Description of Procedure

The student will identify various mechanical drive components, disassemble and re-assemble various bearings, couplings and shafts, and simple drive units. The student will operate a drive assembly and check for excessive temperature and vibration using the digital thermometer and vibration analysis meter and probes.



Basic Mechanical Lab Procedure and Worksheet

Name	Start Time
Date	Finish Time
Instructor's Signature	

In this lab, your objective is to complete various tasks which will be used to evaluate your mastery of the requisite skills. It is your responsibility to complete these tasks accurately in a timely manner complying with all appropriate safety measures and use of all required Personal Protective Equipment (PPE).

Task I - Explain the mechanical advantage of the following:

	Pass	Fail	Initials
1. Levers and screws			
2. Pulleys and block and tackle			
3. Inclined plane			

Task I - Explain the mechanical advantage of the following: cont.

	Pass	Fail	Initials
4. Coefficient of friction and the effects of lubrication			

Task II - Bearings maintenance

	Pass	Fail	Initials
1. Identify and describe failure modes for:			
a. Bushings			
b. Sealed ball bearing			
c. Needle bearing			

Task II - Bearings maintenance cont.
Pass
Fail
Initials

d. Roller bearing

e. Linear bearing

f. Plain bearing

g. Pillow block and flange bearing

h. Tapered bearing

Task II - Bearings maintenance cont.

	Pass	Fail	Initials
2. Remove and replace bearings as assigned from shaft.			
a. Ball bearing			
b. Tapered ball bearing			

Task III - Mechanical drive systems

	Pass	Fail	Initials
1. Chain drive systems			
a. Describe the advantages and disadvantages of chain drive systems.			

Task III - Mechanical drive systems cont.

Pass

Fail

Initials

b. Identify and define:

i. Drive sprocket

ii. Driven sprocket

iii. Chain size

iv. Master link

Task III - Mechanical drive systems cont.

Pass

Fail

Initials

c. Define correct tension.

d. Describe how to check for wear and damage.

2. Belt drive systems

a. Describe the advantages and disadvantages of belt drive systems.

b. Identify and define:

i. Drive sheaves

Task III - Mechanical drive systems cont.	Pass	Fail	Initials
ii. Driven sheaves			
iii. Types of belts			
c. Describe how to adjust for tension.			
3. Gear drive systems			
a. Describe the advantages and disadvantages of gear drive systems.			
b. Identify and define:			
i. Circular pitch			

Task III - Mechanical drive systems cont.	Pass	Fail	Initials
ii. Diametral pitch			
iii. Lash			
iv. Spur gears			
v. Bevel gears			
vi. Worm gears			
vii. Helical gears			

Task III - Mechanical drive systems cont.
Pass
Fail
Initials

c. Describe how to adjust and lubricate gears.

Task IV - Drive system analysis – Instructor will assign a machine for your use
Pass
Fail
Initials

1. Inspect the machine for slop and play, including end play.

2. Using the thermometer, measure and record the temperature of the various components of the drive system.

3. Vibration analysis

a. Become familiar with setting up and using the vibration meter.

b. Make a baseline recording of the system vibration.

c. Adjust the system components accordingly to reduce the vibration.

d. Record the system vibration again.

e. Repeat adjustments and recordings until the system meets the lab instructor's requirements.

4. Measure the final temperature of the system components.

Advanced Mechanical Lab

Introduction

In these lab exercises the student will make an in-depth exploration into gears and gearbox assemblies, identifying the different types of gear drives and performing a disassembly and reassembly of a particular gearbox. The exercises will emphasize tools and techniques developed in prior lab experiences as well as introduce the student to laser shaft alignment tools and techniques. The student will learn how to use the shaft alignment equipment to properly align the test set up and the reassembled gearbox.

Key Learning/ Performance Objectives

- Identify various types of gearbox drives, including worm reducer, variable speed and right angle.
- Disassemble, inspect and reassemble various gearbox assemblies.
- Perform gear/shaft alignment using the appropriate tools and procedures
- Install and align motors, gearboxes and couplings

Success Measures

The student will remove, disassemble, inspect, repair and reassemble a gearbox assembly without error, and re-install and align the gearbox to within 95% accuracy as defined by the lab instructor.

Equipment and Special Requirements

- Various gear sets and gearboxes
- Dial indicators and stands
- Motor shim pack
- Shaft Hog Laser Alignment system
- Assorted wrenches and hand tools
- Lubrication tools and lubricants

Prerequisite Labs

- Hand and Power Tools Lab
- Measurements Lab
- Lubrication Systems Lab
- Basic Mechanical Lab

Description of Procedure

The student will diagnose, disassemble, inspect, repair and reassemble a gearbox assembly and then re-install the repaired gearbox and align its shaft using the proper alignment tools.



Advanced Mechanical Lab Procedure and Worksheet

Name	Start Time
Date	Finish Time
Instructor's Signature	

In this lab, your objective is to complete various tasks which will be used to evaluate your mastery of the requisite skills. It is your responsibility to complete these tasks accurately in a timely manner complying with all appropriate safety measures and use of all required Personal Protective Equipment (PPE).

Task I - Repairing a gearbox	Pass	Fail	Initials
1. Remove the gearbox from the drive system provided by the lab instructor.			
2. Disassemble the gearbox.			
3. Clean and inspect the gears and gearbox.			
4. Repair and/or replace gears as directed.			
5. Reassemble the gearbox.			

Task II - Re-install the gearbox into drive system
Pass
Fail
Initials

1. Install the coupling.

2. Install the base bolts and tighten to the specified torque.

3. Rough align the motor and the gearbox.

Task III - Shaft Alignment
Pass
Fail
Initials

1. Perform a basic alignment using a straight edge, a level and your eye.

2. Perform a precision alignment using a dial indicator.

3. Perform a laser alignment with the Shaft Hog Laser Alignment system.

a. View the Shaft Hog video clip.

b. Set up the Shaft Hog unit.

c. Perform the laser alignment.



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