DOCUMENT RESUME

ED 350 445 CE 062 127

TITLE	Heavy Equipment Mechanic Program Guide.
INSTITUTION	Georgia Univ., Athens. Dept. of Vocational Education.
SPONS AGENCY	Georgia State Dept. of Technical and Adult Education, Atlanta.
PUB DATE	88
CONTRACT	GA-89-110192
NOTE	130p.; For the program standards, see CE 062 128.
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052)
EDRS PRICE	MF01/PC06 Plus Postage.
DESCRIPTORS	*Behavioral Objectives; Competency Based Education; *Course Content; Course Descriptions; Employment Potential; Engines; Entry Workers; Hydraulics; Job Skills; *Maintenance; Mechanical Skills; *Mechanics (Process); Postsecondary Education; Power Technology; Program Guides; State Curriculum Guides; Technical Education; Technical Institutes; Two Year Colleges
IDENTIFIERS	Georgia; *Heavy Equipment Mechanics

ABSTRACT

Designed to train an entry-level mechanic, this heavy equipment mechanic program guide presents the standard curriculum for technical institutes in Georgia. The curriculum addresses the minimum competencies for a heavy equipment mechanic program. The general information section contains the following: purpose and objectives; program description, including admissions, typical job titles, and accreditation and certification; and the curriculum model, including standard curriculum sequence and lists of courses. The next four sections contain the courses: three general core courses (job acquisition and employability skills, basic mathematics, English); five fundamental technical courses (basic skills and laboratory safety, engines I, drive systems I, electrical I, hydraulics I); eight specific technical courses (air conditioning, engines II, drive systems II, hydraulics II, electrical II, engines III, drive systems III, drive systems IV), and two electives (diesel injection, engines IV). Each course consists of the following: course overview (description, competency areas, prerequisites, credit hours, contact hours); course outline with student objectives and class and lab hours; and resource list. Appendixes include an equipment list and addresses of organizations that are sources of additional training materials. (YLB)

GEORGIA DEPARTMENT OF TECHNICAL AND
ADULT EDUCATION
FY 89
CONTRACT # 89-110192

GEORGIA DEPARTMENT OF TECHNICAL AND ADULT EDUCATION

HEAVY EQUIPMENT MECHANIC PROGRAM GUIDE

HEAVY EQUIPMENT

MECHANIC

PROGRAM GUIDE

Developed and Produced
Under Contractual Agreement with

Division of Planning and Development
Department of
Technical and Adult Education

Suite 660, South Tower
One CNN Center
Atlanta, Georgia 30303-2705

1988

HEAVY EQUIPMENT

MECHANIC

PROGRAM GUIDE

Developed by

Mr. James D. Fowler, Project Director

Department of Vocational and Career Development
College of Education
Georgia State University
Atlanta, Georgia

Dr. John H. Preston, Department Chairman
Dr. John Collum, Project Coordinator

ACKNOWLEDGEMENTS

The project staff expresses its sincere appreciation to the Department of Technical and Adult Education, the heavy equipment industry, and the state's technical institutes for their tireless efforts which made the development of this program guide possible. Dr. Kenneth Breeden, Commissioner, and Mr. Bob Mabry, Assistant Commissioner, of the Department of Technical and Adult Education, provided initiative and direction for the project. Patt Stonehouse, Coordinator for Program Improvement for the Department of Technical and Adult Education, provided invaluable assistance in the planning and monitoring of the project.

Without the close cooperation of the heavy equipment industry in Georgia, this program guide would not have been possible. We would like to recognize each member of the State Technical Committee for Heavy Equipment below.

Robert E. Mason
Metrac

Ralph McElreath
Stith Equipment Company

Guy Taylor
Trico

Monroe Davis
Tri-State Tractor Company

Ken Billue
Yancey Brothers

Doug Guy
Georgia Cranes Inc.

Norm McGinnis
T & B Scottdale Contractors, Inc.

Brude Widener
Georgia Underground Contractors Assn.

Bobby E. Rider
Vulcan Materials Company

Gary Fowler
Associated General Contractors

Lee Lemke
Georgia Mining Association

Ernie Harris
Georgia Department of Transportation

The Occupational Working Committee, composed of educators from the technical institutes and personnel from industry, provided direct technical support and expertise in the development of the program guides. The members of this committee had an equal hand in making this endeavor possible. The individuals are:

Millard Shaw
Yancey Brothers

Rick Davis
South Georgia Technical Institute

Jack Teal
South Georgia Technical Institute

TABLE OF CONTENTS

HOW TO USE THIS MANUAL

Summary	This manual is divided into Tab - major divisions, physically separated by numbered tab dividers Sections - divisions within a tab Subjects - divisions within a section.
Numbering System	Each document (Subject) has a unique 6-digit number. This number is divided into 3 sets of 2 digits which are separated by dashes. Example: 04 - 02 - 03 Tab Section Subject
Locating a Document	Document numbers appear on the upper right hand corner of each page (see top of this page). To locate Subject: 1. Refer to the Table of Contents. 2. Note the Document Number for the subject. Example: 04-02-03 3. Turn to the tab divider marked 04 and within this tab find Section 02 and Subject 03.
Table of Contents	The table of contents (00-00-01) is intended to give a cover-to-cover overview of the manual contents and organization. It lists contents of a Tab to the Section and Subject level.
Amendments	Registered manual holders are instructed to keep their manuals up-to-date.
Manuals Document Transmittal	All new or revised documents are sent to the registered holder of the manual and are recorded on a Manuals Document Transmittal Form. Transmittals are numbered consecutively, and instructions for use are printed on the form.

GENERAL INFORMATION

Introduction

Overview

Heavy equipment has evolved from strictly mechanical/hydraulic machines to sophisticated equipment which integrates computer and electronic controls with the traditional hardware. As technology advances, maintenance personnel must broaden their base of knowledge to include the new integrated systems as well as the complex test equipment required to support them.

Training mechanics for the new generation of equipment is of paramount importance. The old adage, "he/she is good with his/her hands," simply is not apropo to today's situation. Today's heavy equipment mechanic does require good hand/eye skill; but, more importantly, he/she must be able to solve problems in highly complex electromechanical systems. The variety of manufacturers in the field, combined with the burgeoning technology, demands a mechanic who is well founded in electromechanical theory. Additionally, she/he must adapt that knowledge to a wide range of applications/types of machines. It is toward this end that the Heavy Equipment Mechanic Program has evolved.

GENERAL INFORMATION

Introduction

Standard Curriculum

The Heavy Equipment Mechanic Program Guide presents the standard curriculum for technical institutes in Georgia. The curriculum addresses the minimum competencies for a heavy equipment mechanic program. The competency areas included in a local Heavy Equipment Mechanic program may exceed what is contained in this program guide, but it must encompass the minimum competencies contained herein.

As changes occur in the heavy equipment field, this program guide will be revised to reflect those changes. Proposed changes are first evaluated and approved by the local program advisory committee and then forwarded to the state technical committee for approval and inclusion in the state standard program guide.

This program guide is designed to produce an entry-level mechanic. He/she will possess a solid background in basic mechanical and electrical theory, enhanced by hands-on training on heavy equipment. The graduate should progress toward journeyman status far faster than a comparable non-graduate.

GENERAL INFORMATION

Introduction

Developmental Process

The development of the Heavy Equipment Mechanic Program Guide was based on the premise that the people in the industry can best determine program needs. With this in mind, representatives from businesses which would employ program graduates were asked to serve on a state technical committee to help identify the technical content and to provide overall guidance to ensure that the resulting program would produce graduates qualified for entry level technical positions in the heavy equipment industry.

Technical institutes which would implement the curriculum were also included in the developmental effort. Representatives from the technical institutes provided the expertise in teaching methodology unique to the field and provided suggestions for integrating the program into the existing programmatic offerings. Additionally, training representatives from the heavy equipment field joined with personnel from the institutes to assure that technical content was appropriate and up to date.

Georgia State University coordinated and directed the development of the curriculum and produced the final program guide.

GENERAL INFORMATION

Introduction

Purpose and Objectives

Purpose

The purpose of the Heavy Equipment Mechanic Program is the provide educational opportunities which will enable students to obtain knowledge, skills, and attitudes necessary to succeed in the field of heavy equipment maintenance.

Product Objectives

1. To provide basic knowledge, skill, and attitude development based on a systematic analysis of the occupational area to be served.

2. To produce a technician capable of dealing with the complex electromechanical systems which characterize modern technological environments.

3. To provide program options that allow in-depth study in specialized areas beyond the basic skills level.

4. To provide instruction that focuses on the application of knowledge, skills, and attitudes to actual work situations.

5. To ensure that the Heavy Equipment Mechanic Program meets the needs of the industry by maintaining a cooperative relationship between schools and the heavy equipment industry.

6. To provide a program of instruction that is responsive to the rapid rate of technological changes in the heavy equipment industry.

Program Process Objectives

1. To provide well trained faculty who stay current with both technical and instructional technology.

2. To provide instructional materials, and equipment (in accordance with available funding) which teach knowledge, skills and attitudes appropriate to the needs of the heavy equipment industry.

3. To provide training facilities which foster learning and provide safe, healthy environments available and accessible to all students who can benefit from the program.

4. To provide academic, occupational, and employability skills training which promote technical competence, attitudes, and work habits that will enable graduates of the program to obtain and retain employment, and to advance in the industry.

5. To encourage the desire for learning so that graduates will pursue their own continuing education, as a lifelong endeavor.

6. To provide an environment which promotes a positive self image and a sense of personal well being.

7. To provide training that fosters development of good safety habits.

8. To provide admissions, educational, and placement services without regard to race, color, national origin, sex, age, or handicapping condition.

9. To provide information to the public regarding the program that will promote recruitment and enrollment of students.

10. To promote good public relations through contacts and regular communications with the heavy equipment industry and the public sector.

11. To promote faculty and student rapport and communications to enhance student success in the program.

Document
Number 01-02-01

GENERAL INFORMATION

Program Description

Program Defined

The Heavy Equipment Mechanic program is designed to address the needs of the companies in the industry. The program provides the occupational foundation which will enable graduates to become employed in occupations involving the maintenance and repair of heavy equipment.

GENERAL INFORMATION

Program Description

Admissions

Admissions Requirements

Admission of new students to the Heavy Equipment Mechanic Program is contingent upon their meeting all of the criteria listed below. To be admitted to the program, an applicant:

1. must be at least 16 years of age;

2. must achieve a th grade level in reading and math on a statistically validated test;

3. must have gone through the application process including a properly completed application; or

4. must have been previously admitted to another postsecondary vocational-technical Heavy Equipment Mechanic Technology program or another program which has equal admission requirements; and

Admission of transfer students is contingent upon their meeting the following:

1. regular admission to and good standing at a regionally accredited postsecondary diploma granting institution; and

2. completion of an application for admission.

Provisional Admission

A new student who does not meet the regular admission requirements of the program may be admitted on a provisional basis. The requirements for provisional admission are:

1. achievement of the th grade level in reading and math as shown on a statistically validated test;

2. interview with program faculty;

3. approval based on evaluation by admissions officers and program faculty; and

4. completion of an application for admission.

Document
Number 01-02-03

GENERAL INFORMATION

Program Description

Typical Job Titles

Job Titles

The Technical committee for the Heavy Equipment Mechanic Curriculum Development Project examined the technical occupational areas for the industry and identified one job title for which training is required: Heavy Equipment Mechanic.

The Heavy Equipment Mechanic Program is assigned the CIP code taxonomy number of 47.0302

Document
Number 01-02-04

GENERAL INFORMATION

Program Description

Accreditation and Certification

Currently, there are no accreditation or certification requirements for Heavy Equipment Mechanics.

GENERAL INFORMATION

Curriculum Model

Standard Curriculum

The standard curriculum for the Heavy Equipment Mechanic Program is set up on the quarter system. A suggested sequence for the program is given below.

Course	Hours Class	Lab	Contact	Credit
FIRST QUARTER				
HEM 100 - Basic Skills and Laboratory Safety	1	11	12	4
MAT 100 - Basic Mathematics	3	0	3	3
EMP 101 - Job Acquisition and Employability Skills	2	0	2	2
HEM 101 - Engines I	4	4	8	5
HEM 102 - Drive Systems I	5	0	5	5
	14	15	30	19
SECOND QUARTER				
Eng 100 - English	5	0	5	5
HEM 203 - Drive Systems II	3	3	6	4
HEM 103 - Electrical I	7	2	9	8
HEM 104 - Hydraulics I	6	4	10	8
	21	9	30	25

Course	Hours Class	Lab	Contact	Credit
THIRD QUARTER				
HEM 201 - Air Conditioning	2	4	6	3
HEM 202 - Engines II	2	4	6	3
HEM 207 - Drive Systens III	2	6	8	4
HEM 205 - Electrical II	1	9	10	5
	7	23	30	15
FOURTH QUARTER				
HEM 204 - Hydraulics II	8	4	12	9
HEM 206 - Engines III	1	5	6	2
HEM 208 - Drive Systems IV	2	4	6	3
HEM 22X - Elective	1	5	6	2
	12	18	30	16

Document
Number 01-03-02

GENERAL INFORMATION

Curriculum Model

General Core Courses

The general core courses provide students with a foundation in the basic skills which enable them to express themselves more clearly, both orally and in writing, and to perform the mathematical functions required in this occupation. The general core courses for the Heavy Equipment Mechanic program are listed below.

EMP 101-Job Acquisition and Employability Skills	2 hrs.
MAT 100-Basic Mathematics	3 hrs.
ENG 100-English	5 hrs.

Document
Number 01-03-03

GENERAL INFORMATION

Curriculum Model

Fundamental Technical Courses

The technical core courses provide the students with a foundation in the areas of basic shop skills and basic mechanical/hydraulic principles which are needed to progress to the more highly specialized courses in heavy equipment maintenance. The Technical core courses are listed below.

HEM 100 - Basic Skills and Laboratory Safety	4 hrs.
HEM 101- Engines I	5 hrs.
HEM 102 - Drives Systems I	4 hrs.
HEM 103 - Electrical I	8 hrs.
HEM 104 - Hydraulics I	8 hrs.

GENERAL INFORMATION

Curriculum Model

Specific Technical Courses

The specific technical courses build upon the technical core courses to provide students with the basic knowledge and skill required to work as a mechanic in the heavy equipment field. The specific technical courses offered in the Heavy Equipment Mechanic Program are listed below.

HEM 201- Air Conditioning	3 hrs.
HEM 202 - Engines II	3 hrs.
HEM 203 - Drive Systems II	4 hrs.
HEM 204 - Hydraulics II	9 hrs.
HEM 205 - Electrical II	5 hrs.
HEM 206 - Engines III	2 hrs.
HEM 207 - Drive Systems III	4 hrs.
HEM 208 - Drive Systems IV	3 hrs.

GENERAL INFORMATION

Curriculum Model

Electives

Elective courses are provided to allow for the different levels of prior knowledge and skills brought to the classroom by students with diverse backgrounds, educational attainment, and specialized interests. Electives for the Heavy Equipment Mechanic program are given below.

HEM 220 - Diesel Injection Systems	2 hrs.
HEM 221- Engines IV	2 hrs.

Document
Number 02-01-01

GENERAL CORE

EMP 101 - Job Acquisition and Employability Skills

Course Overview

Course Description
This course focuses on the behavioral aspects of people in business and industry. The course emphasizes the development of interpersonal skills and attitudes required to work effectively with others in a business or an industry environment.

Competency Areas
Identifying employment opportunities

Demonstrating appropriate work behavior

Communicating on the job

Maintaining working relationships with others

Maintaining good customer relations

Adapting to change

Prerequisites
Provisional admission

Credit Hours
2

Contact Hours Per Week
Class - 2

Lab - 0

Document
Number 02-01-02

GENERAL CORE

EMP 101 - Job Acquisition and Employability Skills

Course Outline

Recommended Outline	After competing this section, the student will:	Hours Class	Hours Lab
Identifying Employment Opportunities		**4**	**0**
Job requirements	Identify job requirement.		
Educational opportunities	Investigate educational opportunities.		
Occupational opportunities	Investigate occupational opportunities.		
Resources for employment	Locate resources for finding employment.		
Job application	Follow procedures for job application.		
Job interviewing	Practice job interviewing.		
Demonstrating Appropriate Work Behavior		**8**	**0**
Rules and regulations	Follow rules and regulations.		
Personal conduct	Exhibit dependability.		
	Demonstrate punctuality.		
	Exhibit pride and loyalty.		

	List consequences of dishonesty		
Responsibility to company	Complete assignments in accurate and timely manner.		
Problem solving skills	Demonstrate problem solving skills.		
Communicating on the Job		**1**	**0**
Listening	Demonstrate appropriate listening skills.		
Telephone etiquette	Demonstrate telephone etiquette.		
Terminology	Read and comprehend written communications.		
Maintaining Working Relationships with Others		**4**	**0**
Teamwork	Work productively with others.		
Supportiveness	Show empathy, respect, and support for others.		
Acting as a resource	Demonstrate work procedures and assist others when necessary.		
Emotional control	Channel emotional reaction constructively.		

Maintaining Good Customer Relations		**2**	**0**
Empathy	Empathize with a simulated customer's situation.		
Commitment	Show commitment in dealing with simulated customers.		
Tact	Use tact in dealing with simulated customers.		
Attitude	Maintain a positive attitude at all times when working with simulated customers.		
Adapting to Change		**1**	**0**
Education	Demonstrate a willingness to learn.		
	List benefits of participation in continuing education.		
Work	Seek work challenges.		
	Demonstrate flexibility in work assignments.		
Career goals	Demonstrate willingness to consider adjusting career goals to meet new situations.		

Document
Number 02-01-03

GENERAL CORE

EMP 101 - Job Acquisition and Employability Skills

Resources

Armine et al. *Manufacturing Organization and Management.* Englewood Cliffs, NJ: Prentice-Hall, 1982.

Everand and Shilt. *Business Principles and Management.* Southwestern Publishing, 1979.

Yoder and Standohar. *Personnel Management and Industrial Relations.* Englewood Cliffs, NJ: Prentice-Hall, 1982.

Document
Number 02-02-01

GENERAL CORE

MAT 100 - Basic Mathematics

Course Overview

Course Description
Mathematics for heavy equipment mechanics is based on the minimum requirements of the job; i.e., basic arithmetic functions and operations. The course begins with a review of basic arithmetic operations, such as addition, subtraction, multiplication and division of whole numbers. The course progresses to decimals, fractions and percents, and culminates with metric to U.S. conversions.

Competency Areas
Performing addition and subtraction

Performing multiplication and division

Converting numbers between forms expressed as fractions, decimals and percents

Converting between American units of measure

Measuring and expressing angular relationships

Converting between American units and metric units

Prerequisites
Program admission level math competency

Credit Hours
3

Contact Hours Per Week
Class - 3

Lab - 0

Document
Number 02-02-02

GENERAL CORE

MAT 100 - Basic Mathematics

Course Outline

Recommended Outline	After competing this section, the student will:	Hours Class	Hours Lab
Performing Addition and Subtraction		**5**	**0**
Whole numbers	Perform addition and subtraction of whole numbers, decimals and fractions.		
Decimals			
Fractions			
Performing Multiplication and Division		**5**	**0**
Whole numbers	Perform multiplication and division of whole numbers decimals and fractions.		
Decimals			
Fractions			

Converting Numbers Between Forms Expressed as Fractions, Decimals, and Percents		**5**	**0**
Mixed numbers	Convert numbers between forms expressed as mixed numbers, fractions, decimals and percents.		
Decimals			
Fractions			
Percents			
Measuring and Expressing Angular Relationships		**5**	**0**
Angular relationships	Measure and express basic angular relationships.		
Converting Between American Units of Measure		**5**	**0**
U.S. system	Convert between American units of measure.		

Converting Between American Units and Metric Units

5 0

U.S. to metric

Metric to U.S.

Convert between American units and metric units of measure.

Document
Number 02-02-03

GENERAL CORE

MAT 100 - Basic Mathematics

Resources

Shea, James T. *Working With Numbers.* Speck-Vaughn Publishers.

Stein, Edwin. *Refresher Math,* 8th Ed. Allen/ Bacon Publishing Co.

GENERAL CORE

ENG 100 - English

Course Overview

Course Description
This course emphasizes the development and improvement of written and oral communication abilities. Topics include: Communication skills improvement, writing skills improvement; and locating, using and organizing information.

Competency Areas
Using grammar and composition

Using oral communications

Demonstrating listening skills

Demonstrating reading skills

Demonstrating use of technical and other reference materials

Using basic sentence and paragraph construction

Prerequisites
Admission level English & reading competency

Credit Hours
5

Contact Hours Per Week
Class - 5

Lab - 0

GENERAL CORE

ENG 100 - English

Course Outline

Recommended Outline	After competing this section, the student will:	Hours Class	Hours Lab
Using Grammar and Composition		15	0
Identify good writing	Identify correct writing (does it sound right? Does it make sense?).		
Sentence development	Develop writing skills.		
Paragraph development			
Organization			
Spelling			
Using Oral Communications		5	0
Organizing	Developing oral communication skills (organizing and presenting skills).		
Presenting			

Demonstrating Listening Skills		5	0
Noting key points	Develop listening skills.		
Accurate translations			
Demonstrating Reading Skills		15	0
Gaining key points	Develop reading skills.		
Accurate reiterations, interpretations			
Demonstrating Use of Technical and other Reference Materials		10	0
Locating, cross-referencing of various sources	Develop skills in use of Reference materials.		
Use various spelling and word references			
Use of grammar and writing references			
Use of technical documents			

Document
Number 02-03-03

GENERAL CORE

ENG 100 - English

Resources

Chacler and Clark. *English the Easy Way.* Southwestern Publishing Co.

Bracy, Jane and McClintoc, Marian. *Read to Succeed.* McGraw-Hill Publishing Co.

De Fossard. *Reading in Focus.* Southwestern Publishing Co.

Document
Number 03-01-01

FUNDAMENTAL TECHNICAL

HEM 100 Basic Skills and Laboratory Safety

Course Overview

Course Description
This course introduces the student to basic shop skills, precision measurement, and general shop safety. Basic skills training includes precision measuring, use of hand and power tools, use of torque wrenches, tapping and threading, selection and use of files, welding, cutting, and other generic shop skills, shop and equipment safety rules, and the moving of equipment.

Competency Areas
Identifying and using standard hand tools

Identifying and using power tools

Selecting and installing fasteners

Performing basic shop skills

Performing presicion measurement

Moving equipment

Performing cutting and welding

Applying general shop safety

Corequisite
Mathematics 100

Credit Hours
4

Contact Hours Per Week
Class - 1

Lab - 11

Document
Number 03-01-02

FUNDAMENTAL TECHNICAL

HEM 100 - Basic Skills and Laboratory Safety

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Identifying and Using Standard Hand Tools		0	4
Identify and use basic hand tools	Identify and use basic hand tools.		
Use torque wrenches			
Selection and use of files			
Proper use of hack saw			
Identifying and Using Power Tools		1	8
Use hand-held electric drills	Identify and use power tools.		
Use body sander/grinder			
Use bench grinder/buffer			
Use drill press			
Use air/electric wrenches			
Use air for drying parts			

Selecting and Installing Fasteners		1	8
Discriminate between NC and NF threads	Select and install fasteners.		
Identify bolt and screw diameters			
Recognize (strength) class of fasteners			
Identify screw head types			
Match fastener to application			
Performing Basic Shop Skills		0	10
Perform layout and drill holes			
Grind drill bit			
Tapping and threading	Perform basic shop skills.		
Install Heli-coil inserts			
Packing of ball/roller bearings			
Remove broken stud			
Form single and double flare			
Safe handling of tires/wheels			

Performing Precision Measurement		5	10
Use standard and metric measurements	Use U.S. and metric measurements.		
Use steel rule and tape	Use steel rule and tape.		
Use caliper	Use caliper and micrometers.		
Use micrometers & depth gauges			
Use dial indicators	Use dial indicators.		
Use special gauges			
Measure threads			
Check tool calibration			
Clean and store tools	Care for precision measuring tools.		
Moving Equipment		0	10
Perform pre-start check			
Perform start/warm up procedures	Start and warm up equipment.		
Operate/back	Move/back vehicles equipment.		
Stop and park equipment	Stop/park equipment.		

Performing Cutting and Welding		2	60
Oxy-fuel	Set up oxy-acetylene system.		
Cutting	Cut mild steel.		
Brazing	Braze mild steel.		
Shielded arc welding	Set up shielded arc welder.		
Welding	Arc weld in flat position.		
Applying General Shop Safety		2	*110
Apply shop and equipment safety rules	Demonstrate application of general shop safety.		
Apply first aid procedures	Demonstrate first-aid techniques.		
Complete an accident report	Follow accident reporting and emergency guidelines.		
Evaluate personnel safety violations			
Inspect the workplace for safe working environment			
Report shop safety violations			
Correct safety violation			
Participate in shop safety committee			

* To be demonstrated at all times in shop

Document
Number 03-01-03

FUNDAMENTAL TECHNICAL COURSES

HEM 100 - Basic Skills and Laboratory Safety

Resources

Fundamentals of Service - Shop Tools. Moline, Illinois: John Deere and Co., 1986.

Fundamentals of Service - Fasteners. Moline, Illinois: John Deere and Co., 1986.

Fundamentals of Service - Bearings and Seals. Moline, Illinois: John Deere and Co., 1986.

Heavy Duty Mechanics Apprenticeship Training, Module One, Vol I. Province of British Columbus.

Hand Tools. Peoria, Illinois: Caterpillar Tractor Co. 1980.

Document
Number 03-02-01

FUNDAMENTAL TECHNICAL

HEM 101 - Engines I

Course Overview

Course Description
Engines I introduces the student to the major components, engine systems, operating theory and servicing of diesel engines.

Competency Areas
Listing major engine components

Explaining operating principles of two and four cycle engines

Listing engine systems and describe their functions

Servicing engines.

Prerequisites
None

Credit Hours
5

Contact Hours Per Week
Class - 4

Lab - 4

FUNDAMENTAL TECHNICAL

HEM 101 - Engines I

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Introducing Engine Components		**6**	**5**
Block	List major engine components and explain their functions.		
Crankshaft			
Flywheel			
Pistons			
Connecting rods			
Valves/valve train			
Camshaft			
Intake manifolds			
Exhaust			
Explaining Operating Principles of Two and Four Cycle Engines	Explain two and four cycle engine operating principles.	**3**	**0**
Intake			

Compression			
Power			
Exhaust			
Introducing Engine Systems		**25**	**10**
Induction systems	List basic engine systems and describe their function and operation.		
Cooling systems			
Exhaust systems			
Lubrication systems			
Fuel systems			
Electrical systems			
Servicing Engines		**5**	**25**
Fuel filters	R. & R. fuel filters.		
Bleeding fuel system	Bleed fuel systems.		
Oil	Change oil.		
Filter	Change oil filter.		
Lubricate	Lubricate items on chart.		
Oil pressure	Check oil pressure.		
	Troubleshoot lubrication problems.		
Intercooler	Check/clean intercooler.		

Air filter	Check/change air filter.
Auxiliary start devices	Change auxiliary start cartridges.
Water filter	Change water filters.
Adjust Acidity/Alkilinity	Check/adjust coolant Ph.
Flush/winterize	Flush & winterize cooling system.
Pressure cap	Check/test pressure cap.
Change pressure cap	R. & R. pressure cap.

Applying shop/vehicle safety **1*(40)**

* Must be demonstrated at all times in shop.

FUNDAMENTAL TECHNICAL

HEM 101 - Engines I

Resources

Frank Thiessen and Davis Dales. *Diesel Fundation*. Reston, VA: Reston Publishing Co., 1982.

Richard L. Little and Garry C. Edmondson. *Diesel Mechanics* N. Scituate, Mass.: Brenton Publishers, 1982.

John F. Dagel. *Diesel Engine Repair*. John Wiley and Sons, Inc., 1982.

The Engine Book. Peoria, Illinois: Caterpillar Tractor Co., 1968.

Heavy Duty Mechaics Apprenticeship Training, Module One, Vol. II. Provience of British Columbia.

amentals of Service - Engines. Monline, Illinois: John Deere and Co., 1986.

Document
Number 03-03-01

FUNDAMENTAL TECHNICAL

HEM 102 - Drive Systems I

Course Overview

Course Description

Drive systems I introduces the student to bearings, seals, gears, couplings and u-joints, chain and belt drives, clutches and drive applications

Competency Areas
Identifying basic types of bearings

Identifying basic bearing applications

Identifying major types of seals

Identifying major types of couplings and U-joints

Identifying major types of belt drives

Identifying major types of chain drives

Identifying basic types of gears

Identifying basic types of gear train applications

Identifying basic types of clutch/shifting devices

Corequisites
Mathematics 100

Credit Hours
5

Contact Hours Per Week
Class - 5

Lab - 0

FUNDAMENTAL TECHNICAL

HEM 102 - Drive Systems I

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Introducing Bearings		**5**	**0**
Plain	Describe basic types of bearings.		
Ball			
Roller			
Classes of bearings			
Introducing Bearing Applications		**5**	**0**
Axial loads	List bearings designed for axial loads.		
Radial loads	List bearings designed for radial loads.		
Combination/alternating loads	List bearings designed for combined axial/ radial loads.		
Introducing Seals		**5**	**0**
Gaskets	List types of seals and describe typical applications.		
"O" rings, "D" rings			
Duo-cone seals (track drives)			

Chevron/lip seals			
V-bands			
Packings			
Introducing Couplings And U-Joints		**5**	**0**
Lovejoy	List common types of couplings and describe typical applications.		
Roller chain			
U-joints			
CV joints			
Chain Drives		**4**	**0**
Silent	List types of chain drives and describe typical applications.		
Roller			
Introducing Belt Drives		**5**	**0**
V-belts	List types of belt drives and describe typical applications.		
Flat, serpentine belts			
Cogged belts			
Introducing Gears		**7**	**0**
Gear types	Describe basic types of gears.		

Ratios/mechanical advantage	Calculate gear ratios.		
Speed/torque relationships	Identify speed/torque relationships.		
Idler gears			
Introducing Gear Train Applications		**10**	**0**
Pinion-driven gear	List basic types of gear applications.		
Ring and pinion			
Planetary gears			
Differential gears	Explain operation of basic types of gear trains.		
Worm gears			
Constant-mesh gears			
Introducing Clutches Shifting Devices		**3**	**0**
"Dog" clutches/synchronizers	List types of clutches and describe typical applications.		
Disc-type clutches			
Clutch packs			
Applying Shop/Vehicle Safety		**1**	**0**

Document
Number 03-03-03

FUNDAMENTAL TECHNICAL

HEM 102 - Drive Systems I

Resources

The Engine Book. Peoria, Illinois: Caterpillar Tractor Co., 1976.

Seals and Gaskets. Peoria, Illinois: Caterpillar Tractor Co., 1977.

Fundamentals of Service - Power Trains. Moline, Illinois: John Deere and Co., 1986.

Heavy Duty Mechanics Apprenticeship Training, Module One, Vol. II. Province of British Columbia.

Document
Number 03-04-01

FUNDAMENTAL TECHNICAL

HEM 103 - Electrical I

Course Overview

Course Description
Electrical I provides a foundation in basic electrical theory, including Ohm's law, series, parallel and combination series/parallel circuits, use of test instruments, starting and generating circuits.

Competency Areas
Explaining basic electrical theory

Calculating and measuring properties of series, parallel and combination circuits

Using test equipment and procedures

Explaining starter circuit operation

Explaining alternator circuit operation

Corequisite
Mathematics 100

Credit Hours
8

Contact Hours Per Week
Class - 7

Lab - 2

Document
Number 03-04-02

FUNDAMENTAL TECHNICAL

HEM 103 - Electrical I

Course Outline

Recommended outline	After completing this section, the student will:	Hours Class	Hours Lab
Introducing Electricity		15	0
Conductors	Define voltage, current resistance, power and conductance.		
Insulators			
Voltage			
Current			
Power			
Resistance			
Ohms law	Draw and define simple resistive circuits.		
Circuit symbols			
Batteries	Describe operation of a battery.		

Calculating and Measuring Properties of Series, Parallel and Combination Circuits		15	5
Series circuits	Measure the current, and resistance in DC series, parallel and combination circuits.		
Parallel circuits			
Combination circuits			
Using Test Equipment and Procedures		9	15
VOM	Set up and test DC Components and circuits for voltage, current and resistance.		
Ammeter			
Continuity tests			
Component resistance measurements			
"Live" circuit measurements			
Wiring diagrams	Interpret heavy equipment wiring diagrams.		

Introducing Starting Systems		15	0
Starter motor	Explain operation of a starter motor.		
Bendix	Explain operation of a Bendix.		
Solenoids	Describe operation of starting solenoids/relays.		
Series-parallel relay			
Starter circuit	Trace current flow in a starter circuit.		
Introducing AC Fundamentals		15	0
The sine wave	Identify frequency, time and amplitude of a sinusoidal waveform.		
Single phase AC			
Three phase AC			
Introducing Alternator Systems			
Delta alternator	Explain operation of Delta and Wye wound alternators.		
Wye alternator			
Diodes and rectifiers	Explain conversion of AC to DC through diodes.		
Voltage regulation	Explain alternator voltage regulation.		

Applying Shop/Vehicle Safety. 1 *(20)

* To be demonstrated at all times in shop.

Document
Number 03-04-03

FUNDAMENTAL TECHNICAL

HEM 103 - Electrical I

Resources

Fundamentals of Service - Electrical Systems. Moline, Illinois: John Deere and Co., 1986.

Basic Electricity. Peoria, Illinois: Caterpillar Tractor Co.

Heavy Duty Mechanics Apprnticeship Training, Module One, Vol. II. Province of British Columbia.

Document
Number 03-05-01

FUNDAMENTAL TECHNICAL

HEM 104 - Hydraulics I

Course Overview

Course Description

Hydraulic I introduces the student to basic hydraulics theory, symbols and schematics, system components, system servicing and removal and replacement of components.

Competency Areas
Explaining basic hydraulics theory

Defining PAV relationships

Identifying hydraulic system components

Servicing hydraulic systems

Maintaining/repairing hydraulic systems

Corequisites
Mathematics 100

Credit Hours
8

Contact Hours Per Week
Class - 6

Lab - 4

Document
Number 03-05-02

FUNDAMENTAL TECHNICAL

HEM 104 - Hydraulics I

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Introducing Properties of Fluids		**1**	**0**
Non-compressibility	Explain properties of (liquid) fluids.		
Pascal's law	Explain Pascal's law.		
Introducing PAV Relationships		**25**	**0**
Displacement	Define and calculate displacement.		
Area	Calculate forces from P x A.		
Pressure	Calculate areas from P and F.		
Flow			
Force/distance/time relationships (power)	Calculate pressures from forces and areas.		
Translation of force (mech. advantage)	Calculate response Times based on flow and displacements.		

Introducing Hydraulic System Components		**25**	**30**
Symbols	Draw simple circuit, using standard hydraulic symbols.		
Pumps	Describe basic types of pumps.		
Valves	Describe basic types of valves.		
Cylinders	Describe basic types of cylinders.		
Lines	Identify correct line sizing, bend radii and installation		
Hoses	Identify correct hose sizing and application.		
Reservoirs	Explain function and operation of reservoirs.		
Servicing Hydraulic Systems		**8**	**10**
Service information	Locate and use correct service information.		
Check fluids	Check hydraulic fluids for level, type and condition.		
Service hydraulic	Clean screens/filters, change filters.		
Hydraulic system operational check	Perform hydraulic system operational check.		

Applying Shop/Vehicle Safety **1*(40)**

* Must be demonstrated at all times in shop.

Document
Number 03-05-03

FUNDAMENTAL TECHNICAL

HEM 104 - Hydraulics I

Resources

Fundamentals of Service - Power Trains. Moline, Illinois: John Deere and Co., 1986.

Hydraulics, Basic Hydraulic Valves. Peoria, Illinois: Caterpillar Tractor Co., 1983.

Heavy Duty Mechanics Apprenticeship Training, Module One, Vol. II. Province of British Columbia.

Document
Number 04-01-01

SPECIFIC TECHNICAL

HEM 201 - Air Conditioning

Course Overview

Course Description

This course introduces the student to the properties of freons, freon system principles, system components, servicing and repair of air conditioning systems.

Compentency Areas
Describing properties of freon

Identifying freon system components

Explaining freon system components

Servicing/repairing air conditioning systems

Removing and replacing air conditioning system components

Prerequisites
Electrical I

Credit Hours
3

Contact Hours Per Week
Class - 2

Lab - 4

SPECIFIC TECHNICAL COURSES

HEM 201 - Air Conditioning

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
		2	0
Introducing Properties of Freon			
Boiling point	Describe properties of freon.		
Compressibility			
Types of freon			
Introducing Freon System Components		6	0
Compressor	Name major components of a freon system and describe their functions.		
Expansion devices			
Evaporator			
Electrical circuits			

Introducing Freon System Principles		**6**	**0**
System operation	Explain a freon system operational cycle.		
Temperature controls			
Servicing/Repairing Air Conditioning Systems		**5**	**16**
Air conditioning tools/equipment	Evacuate an air conditioning system.		
System evacuation	Service and Leak-test an air conditioning system.		
System charging			
Leak detection			
Removing and Rrplacing Air Conditioning Components	R. & R. air conditioning system components.	**0**	**24**
Compressor			
Expansion devices			
Evaporator			
Condenser			
Receiver/dryer			

Applying Shop/Vehicle Safety **1*(40)**

* To be demonstrated at all times in shop.

Document
Number 04-01-03

SPECIFIC TECHNICAL

HEM 201 - Air Conditioning

Resources

Fundamentals of Service - Air Conditioning. Moline, Illinois: John Deere and Co., 1986.

Document
Number 04-02-01

SPECIFIC TECHNICAL

HEM 202 - Engines II

Course Overview

Course Description
Engines II encompasses minor and major tuneups, maintenance and repair of fuel and exhaust systems and maintenance and repair of cooling systems

Competeny Areas
Performing minor tuneups

Performing major tuneups

Maintaining/repairing fuel and exhaust systems

Maintaining/repairing cooling systems

Prerequisites
Engines I

Credit Hours
3

Contact Hours Per week
Class - 2

Lab - 4

SPECIFIC TECHNICAL

HEM 202 - Engines II

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Performing Minor Tuneups		**5**	**10**
Valve clearance	Check/adjust valve clearance.		
Valve cover gaskets	R. & R. valve cover gaskets.		
Injectors	Adjust injectors.		
Performance	Check engine performance.		
Performing Major Tuneups		**5**	**10**
Injectors	R. & R. diesel injectors.		
Injection electronics	R. & R. injection system electronic components.		
Idle	Adjust engine idle speed.		
Governor	Adjust governor		
Supply pressure	Check fuel supply pressure.		
Rail pressure	Check rail pressure.		

Injector rack (Detroit)	Check/adjust injector rack.		
Troubleshoot fuel system	Troubleshoot fuel system problems.		
Troubleshoot turbocharger	Troubleshoot turbocharger problems.		
Troubleshoot supercharger	Troubleshoot supercharger problems.		
Performance	Troubleshoot engine performance problems.		
Troubleshoot engine noises			
Maintaining/Repairing Fuel & Exhaust Systems		**4**	**10**
Pump	R. & R. fuel injector pumps.		
Transfer pump	R. R. fuel transfer pump.		
Turbocharger	R. & R. turbochargers.		
Supercharger	R. & R. superchargers.		
Maintaining/Repairing Cooling Systems		**5**	**10**
Expansion plugs	R. &. R. expansion plugs.		
Sending unit	R. & R. Temperature sending units.		
Gauge			
R. & R. temperature gauge.			
Test temperature gauge	Check/test temperature gauge.		

Thermostats	R. & R. thermostats.
Test thermostats	Check/test thermostats.
Water pump	R. & R. water pump.
Radiator	R. & R. radiator.
Fan and belts	R. & R. fan & auxiliary belts.
Fan drive	Disassemble and replace components of fan drive.
Oil cooler	R. & R. oil cooler.
Test oil cooler	Pressure test oil cooler.
Troubleshooting	Troubleshoot cooling system problems.

Applying Shop/Vehicle Safety **1 *(40)**

* To be demonstrated at all times in shop

Document
Number 04-02-03

SPECIFIC TECHNICAL

HEM 202 - Engines II

Resources

Fundamentals of Service - Engines. Moline, Illinois: John Deere and Co., 1986.

Heavy Duty Mechanics Apprenticeship Training, Module One, Vol. II. Province of British Columbus.

Rober N. Brady. *Diesel Fuel Systems.* Reston, VA.: Reston Publishing Co., 1981.

Fuel System. 1515 W. 6th Ave., Stillwater, Oklahoma, Mid-American Vocational Curriculum Consortium, Inc., 1987.

Frank Thiessen and Davis Dales. *Diesel Fundamentals.* Reston, VA.: Reston Publishing Co., 1982.

Document
Number 04-03-01

SPECIFIC TECHNICAL

HEM 203 - Drive Systems II

Course Overview

Course Description
Drives II includes, maintenance and repair of torque converters, and power shift transmissions.

Competency Areas
Introducing torque converters

Maintaining/repairing torque converters

Introducing power shift transmissions

Maintaining/repairing power shift transmissions

Prerequisites
None

Credit Hours
4

Contact Hours Per week
Class - 3

Lab - 3

Document
Number 04-03-02

SPECIFIC TECHNICAL

HEM 203 - Drives II

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Introducing Torque Converters		**4**	**0**
Driven members	List the major parts of a torque convertor.		
Stators			
Drive members	Explain the operation of a torque converter.		
Maintaining/Repairing Torque Converters		**0**	**8**
Remove and replace	R. & R. torque converters		
Recondition	Remove, disassemble and replace components of torque converter.		
Operational check	Perform operational check of torque converter.		

Introducing Power Shift Transmissions		**25**	**0**
Gear train	Name the major parts of a power shift transmission.		
Hydraulics	Explain hydraulic operation of a power shift transmission.		
Clutches	Explain operation of shift clutches in a power shift transmission.		
Maintaining/Repairing Power Shift Transmission		**0**	**22**
Remove and replace	R. & R. power shift transmission.		
Recondition	Remove, disassemble and replace components of a power shift transmission.		
Operational check	Perform operational check on a power shift transmission.		
Applying Shop/Vehicle Safety		**1*(30)**	

* To be demonstrated at all times in shop

Document
Number 04-03-03

SPECIFIC TECHNICAL

HEM 203 - Drives Systems II

Resources

Fundamentals of Service - Power Trains. Moline, Illinois: John Deere and Co., 1986.

Manufacturers' shop manuals and bulletins, as appropriate (see Appendix for sources).

Document
Number 04-04-01

SPECIFIC TECHNICAL

HEM 204 - Hydraulics II

Course Overview

Course Description
Hydraulics II is an advanced course in hydraulics which deals in actual machine applications, such as hydrostatic drive, differential steering, dozer and loader systems, and other hydraulically driven systems.

Competency Areas
Introducing hydrostatic drive systems

Servicing and operational check of hydrostatic drive systems

Introducing heavy equipment hydraulic systems

Maintaining/repairing heavy equipment hydraulic systems

Prerequisites
Hydraulics I

Credit Hours
9

Contact Hours per week
Class - 8

Lab - 4

Document
Number 04-04-02

SPECIFIC TECHNICAL

HEM 204 - Hydraulics II

Course Outline

Recommended Outline	After completing this section, the student will:	Hour Class	Hour Lab
Introducing Hydrostatic Drive Systems		**29**	**0**
Pump	Explain operation of hydrostatic system components.		
Motor			
Control components	Explain operation of hydrostatic drive systems.		
Servicing & Operational Check of Hydrostatic Drive Systems		**0**	**10**
Servicing	Service hydrostatic drive systems per appropriate publication.		
Operational check	Perform hydrostatic drive operational checks.		

Introducing Heavy Equipment Hydraulic Systems		**50**	**0**
Backhoe/end-loader	List typical hydraulic systems on backhoe/end-loaders.		
Articulated end-loader.	List typical hydraulic systems on articulated end-loaders.		
Excavator	List typical hydraulic systems on excavators.		
Bulldozer	List typical hydraulic systems on bulldozers.		
Operational checks	Perform operational checks on heavy equipment hydraulic systems.		
Maintaining/Repairing Heavy Equipment Hydraulic Systems		**0**	**30**
Pumps	Disassemble and reassemble hydraulic pump.		
Cylinders	Disassemble and reassemble cylinder components.		
Rotary actuator	Disassemble and reassemble rotary actuator components.		
Valves (non-control)	Disassemble and reasseble non-control valve components.		

Valves (control)	Disassemble and reassemble control valve components.
Failure analysis	Determine cause(s) of hydraulic system component failures.
Troubleshooting	Troubleshoot typical heavy equipment hydraulic systems.
Evaluate condition of hydraulic system components	Evaluate hydraulic system components for repair/rebuilding.

Applying Shop/Vehicle Safety **1*(40)**

*To be demonstrated at all times in shop

Document
Number 04-04-03

SPECIFIC TECHNICAL

HEM 204 - Hydraulics II

Resources

Manufacturers shop manual and bulletins, as appropriate (see appendix for sources).

Document
Number 04-05-01

SPECIFIC TECHNICAL

HEM 205 - Electrical II

Course Overview

Course Description
Electrical II includes ectrical system maintenance, alternator testing, an introduction to electronic systems and the maintenance and repair of electronic systems on heavy equipment

Competency Areas
Maintaining/repairing electrical systems

Testing alternators and regulators

Explaining the operation of electronic systems

Maintaining /repairing electronic systems

Prerequisites
Electrical I

Credit Hours
5

Contact Hours per week
Class - 1

Lab - 9

Document
Number 04-05-02

SPECIFIC TECHNICAL

HEM 205 - Electrical II

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Maintaining/Repairing Electrical Systems		**0**	**25**
Battery tests	Check battery specific gravity.		
	Check battery cells.		
Battery maint.	R. & R. battery.		
	Clean battery & treat for corrosion.		
Battery cables	Clean battery cables.		
	R. & R. cables.		
R. & R. Starter	R. & R. starter		
Recondition starter	Remove, disassemble, test, & replace components of starter motors.		
R. & R. Bendix	R. & R. Bendix.		
Solenoids/relays	R. & R. starter solenoids/relays.		
Test Instrument panel components	Test instrument panel switches, gauges, and indicators.		

R. & R. instrument panel components	R. & R. instrument panel switches, gauges, and indicators.		
Troubleshoot	Troubleshoot heavy equipment electrical systems.		
Testing Alternators and Regulators		**0**	**25**
Alternator tests	Perform in-frame tests of alternator systems.		
Regulator tests	Perform in-frame tests of voltage regulators.		
Bench tests	Bench test alternators and regulators.		
Introducing Electronic Systems		**9**	**0**
Engines	Explain operation of electronic engine systems.		
Drives	Explain operation of electronic drive systems.		
Hydraulics	Explain operation of electronic hydraulic systems.		
Accessories	Explain operation of electronic accessories systems.		

Maintaining/Repairing Electronic Systems

0 40

Test equipment checks	Perform electronic system tests, using test equipment.
Non-test equipment checks	Using VOM, check harnesses terminal blocks & other components.
Remove and replace units	R. & R. electronic control components.
Operational checks	Perform electronic systems operational checks.

APPLYING SHOP/VEHICLE SAFETY

1*(90)

* To be demonstrated at all times in shop.

Document
Number 04-05-03

SPECIFIC TECHNICAL

HEM 205 - Electrical II

Resources

Manufacturers shop manuals and bulletins, as appropriate (see appendix for sources).

Document
Number 04-06-01

SPECIFIC TECHNICAL COURSES

HEM 206 - Engines III

Course Overview

Course Description
Engines III encompasses frame overhaul and maintenance and repair of discrete engine components

Competency Areas
Performing frame overhaul

Maintaining/repairing engines

Prerequisites
Engines I & II

Credit Hours
2

Contact Hours Per Week
Class - 1

Lab - 5

Document
Number 04-06-02

SPECIFIC TECHNICAL

HEM 206 - Engines III

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Performing Engine Frame Overhaul		**9**	**25**
Disassembly	Perform engine frame overhaul.		
Cleaning	Evaluate engine components for serviceability.		
Component evaluation			
Reassembly	Assemble engines.		
Testing	Run-in/test engine.		
Maintaining/Repairing Engines		**0**	**25**
Cylinder head	R. & R. cylinder head.		
Dry cylinder sleeves	R. & R. dry cylinder sleeves.		
Wet cylinder sleeves	R. & R. wet cylinder sleeves.		
Front oil seals	R. & R. front oil seals.		
Rear oil seals	R. & R. rear oil seals.		

Oil pan & gasket	R. & R. oil pan & gasket.
Cylinder pistons	R. & R. cylinder pistons.
Piston rings	R. & R. piston rings.
Timing chain	R. & R. timing chain.
Timing gears	R. & R. timing gears.
Camshaft bearings	R. & R. camshaft bearings.
Connecting rods	R. & R. connecting rod
Connecting rods bearings	R. & R. connecting rod bearings.
Main bearings	R. & R. main bearings.
Oil pump	R. & R. oil pump.
Recondition oil pump	Recondition oil pump.
Oil pressure regulating valve	R. & R. oil pressure regulating valve.
Flywheel	R. & R. flywheel.
Flywheel housing	R. & R. flywheel housing.
Intake manifold	R. & R. intake manifold.
Exhaust manifold	R. & R. exhaust manifold.
Muffler	R. & R. muffler.
Tailpipe/stack	R. & R. tailpipe/stack.

Applying shop/vehicle safety. **1 (50)**

* To be demonstrated at all times in shop

Document
Number 04-06-03

SPECIFIC TECHNICAL

HEM 206 - ENGINES III

Resources

Manufacturers' manuals and shop bulletins, as appropriate(See Appendix for sources

Document
Number 04-07-01

SPECIFIC TECHNICAL

HEM 207 - Drive Systems III

Course Overview

Course Description
Drives III is concerned with various types of final drives. The student is introduced to various types of final drives and performs disassembly/reassembly functions on the drives.

Competency Areas
Explaining operation of major types of final drives

Maintaining/repairing final drives

Prerequisites
Drives I & II

Credit Hours
4

Contract Hours Per week
Class - 2

Lab -6

Document
Number 04-07-02

SPECIFIC TECHNICAL

HEM 207 - Drives III

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Introducing Final Drive Systems		**19**	**0**
Differentials	List major types of wheeled vehicle differentials.		
	Explain operation of major types of differentials.		
Planetary axles	Explain operation of wheeled planetary axles.		
Tracked vehicle final drives	List major types of tracked vehicle final drives.		
	Explain operation of major types of final drives.		
Brakes	List major types of wheeled vehicle brakes.		
	Explain operation of major types of wheeled vehicle brakes.		
Steering	List major types of wheeled vehicle steering.		

Maintaining/Repairing Final Drives

0 60

Differentials	Disassemble and reassemble wheeled vehicle conventional, high traction and no-slip differentials
Planetary axles	Disassemble and reasseemble planetary drive axles
Bevel gear set	Remove, disassemble and replace components of bevel gear set
Steering clutches/brakes	Remove, disassemble and replace components of steering clutches/brakes
Differential/planetary steering	Remove, disassemble and replace components of differential/planetary steering.
Wet brakes	Disassemble and reassemble wet brake systems.
Dry brakes	Disassemble and reassemble dry brake systems.
Conventional steering	R & R components in conventional steering systems.
Hydraulic steering	R & R components in wheeled vehicle hydraulic steering systems.

Applying Shop/Vehicle Safety

1*(60)

Document
Number 04-07-03

SPECIFIC TECHNICAL

HEM 207 - Drives III

Resources

Manufacturers' manuals and shop bulletins, as appropriate (See Appendix for sources)

Document
Number 04-08-01

SPECIFIC TECHNICAL

HEM 208 - Drive Systems IV

Course Overview

Course Description
Drive Systems IV introduces the student to track system undercarriages. Subjects include theory of operation, removal and replacement of components, track tensioning, and track alignment.

Competency Areas
Listing major parts of a tracked vehicle undercarriage

Explaining the operation of tracked vehicle undercarriage

Maintaining/repairing tracked vehicle undercarriage

Prerequisites
Drives III

Credit Hours
3

Contact Hours Per Week
Class - 2

Lab - 4

Document
Number 04-08-02

SPECIFIC TECHNICAL

HEM 208 - Drive Systems IV

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Introducing Tracked Vehicle Undercarriages		**9**	**0**
Track frame	List major parts of a tracked vehicle undercarriage.		
Track/chain			
Idlers	Explain the operation of vehicle undercarriages.		
Rollers	Identify wear points on undercarriages.		
Sprockets	Explain general undercarriage evaluation techniques.		
Maintaining/Repairing Tracked Vehicle Undercarriages		**10**	**40**
Track	Remove and replace tracks.		
Track frame	Remove and replace track frame.		
Pins and Bushings	Inspect and evaluate pins and bushings.		

Shoes	Remove and replace track shoes.
Idlers/rollers	Remove and replace idlers/rollers.
Sprockets	Remove and replace drive sprockets.
Align	Align tracks.
Adjust	Adjust track tension.

Applying Shop/Vehicle Safety **1*(40)**

* Must be demonstrated at all times in shop.

Document
Number 04-08-03

SPECIFIC TECHNICAL

HEM 208 - Drive Systems IV

Resources

Heavy Duty Mechanics Apprenticeship Training, Module One, Vol. I Province of British Columbia.

Manufacturers' shop manuals and bulletins, as appropriate (See Appendix for sources).

Document
Number 05-01-01

ELECTIVE

HEM 220 - Diesel Injection Systems

Course Overview

Course Description
Diesel Injection Systems is designed to famiarize the student with the calibration of diesel injection systems, and includes pump calibration and the cleaning and testing/calibration of injectors

Competency Areas
Performing diesel injection pump calibration

Changing diesel injectors

Testing/calibrating injectors

Prerequisites
Engines I, II, & III

Credit Hours
2

Contact Hours Per Week
Class - 1

Lab - 5

ELECTIVE

HEM 220 - Diesel Injection Systems

Course Outline

Recommended Outline	After completing this section, the student will:	Hours Class	Hours Lab
Performing Diesel Injection Pump Calibration		**6**	**34**
Determine correct flow rate			
Calibrate pump to proper flow rate	Calibrate diesel injection pumps.		
Cleaning Diesel Injectors		**0**	**4**
Disassemble injectors	Clean diesel injectors.		
Clean injectors			
Assemble injectors			

Testing/Calibrating Diesel Injectors **3 12**

Determine test parameters Test/calibrate diesel injectors.

Test/calibrate

Applying Shop/Vehicle Safety **1 *(50)**

* To be demonstrated at all times in shop.

Document
Number 05-01-03

SPECIFIC TECHNICAL

HEM 220 - Diesel Injection Systems

Resources

Manufacturers' manuals and shop bulletins, as appropriate (See Appendix for sources)

Document
Number 05-02-01

ELECTIVE

HEM 221 - Engines IV

Course Overview

Course Description
Engines IV is designed to prepare a student for engine rebuilding, and includes disassembly and cleaning, parts evaluation, parts reconditioning and reassembly and testing.

Competency Areas
Disassembling and Cleaning engines

Evaluating parts

Reconditioning parts

Assembling engines

Testing engines

Prerequisites
Engines I-III

Credit Hours
2

Contact Hours Per week
Class - 1

Lab - 5

ELECTIVE

HEM 221 - Engines IV

Course Outline

Recommended Outline	After completing this section, the student	Hours Class	Hours Lab
Disassembling and Cleaning Engines		**0**	**3**
Clean exterior	Disassemble and clean engines.		
Hot vat			
Cold vat			
Evaluating Parts		**2**	**5**
Check for wear	Evaluate/measure engine parts for serviceability.		
Check for scoring, galling and fractures			
Check for warpage			
Reconditioning Parts		**3**	**7**
Rebush rocker arms	Recondition cylinder heads.		
Rebush rocker boxes			

Grind valves/rework cylinder heads			
Change wrist pins/pistons	Change wrist pins/pistons.		
Install cam bearings	Install cam bearings.		
Assembling Engines		**3**	**25**
Install liners			
Install crankshaft	Rebuild engine.		
Install pistons			
Install overhead			
Install miscellaneous parts and accessories			
Time engine			
Testing Engines		**1**	**10**
Install on run stand/dynamometer	Run-in engines.		
Make run stand connection	Make engine dynamometer checks.		
Connect manometer(s)			
Test engine			
Applying Shop Safety		**1**	***(50)**

* To be demonstrated at all times in shop.

Document
Number 05-02-03

ELECTIVE

HEM 221 - Engines IV

Resources

Manufacturers shop manual and bulletins, as appropriate (see appendix for sources).

APPENDIX A

EQUIPMENT LIST

HEAVY EQUIPMENT MECHANIC

EQUIPMENT LIST

WHEELS, DRIVES LINES, BRAKES

Jack

2 ton, floor jack

4 ton, floor jack

20 ton, axle jack

30 ton ram

50 ton ram

100 ton Porta-power for track repair

transmission jack (heavy)

Stands

2 ton adjustable

4 ton adjustable

20 ton fixed (approx. 24")

Wheel balancer (static)

Wheel balancer (dynamic)

Axle nut wrenches (drive axle)

Lug nut wrenches, small

Brake lathe (drum and disc)

Arbor press (large), axel brg. accessories

Inclinometer (drive angle gauge)

U-Joint press kit

Bushing/seal knocker set (large and small)

Differential stands

1" drive impact wrench

Set 1" drive impact sockets

Transmission stands

Brake cylinder hones

Wheel bearing packer

Portable gear lube dispenser

Large grease gun (on 5 gal. can)

Hand grease gun

Automatic transmission funnel

Brake bleeder kit

Minimum final drive tools (generic, if possible)

Minimum track tools (generic, if possible)

ENGINES

Drain pans, oil water

Drain barrel, oils

Oil filter wrenches

Mercury manometer (induction tester)

Water manometer (induction tester)

Radiator pressure tester

Temeperature tester

Ph tester

Antifreeze tester

Radiator flush kit

Pressure gauge and adapter

Cam bearing knockers (large and small)

Torque wrenches

in. lb.

0-300 ft. lb.

0-600 ft. lb.

0-1500 ft. lb.

Sleeve puller set

Valve grinder (large)

Hard seat set (large)

Valve pocket cleaning brushes

Valve spring tester

Valve spring compressor

Engine rebuild stands

Hot tank

Cold tank (alum. and brass cleaning)

High-pressure washer

Cylinder hone

Glaze breaker

Ring compressors (large and small)

Ridge reamer

Minimum set John Deere tools

Minimum set Caterpillar tools

Minimum set Kamatsu tools

Vibration damber puller

Large shop floor crane

Diesel compression, cylinder leakage test kit

Gas compression, cylinder leakage test kit

Engine analyzer test set(s)

ELECTRICAL

Sun alternator test set (or equivalent)

Hydrometers

Hand-held cell testers

Volt-ohm meters (Simpson 260 or equivalent)

Volt-ohm meters, digital (ranges comparable to @subtopic = Simpson 260)

Basic DC breadboard trainers

Soldering guns

Heavy duty soldering iron

GRT machine

Battery carriers

Battery terminal puller

Battery terminal cleaners

Electronic test sets (Drive, hydraulic systems)

AIR CONDITIONING

Electronic leak detectors

Halide leak detectors

Set air conditioning tools (services, several vendor models)

Set air condition test gauges

Vacuum pump

Set of combs (for straightening fins on coils)

STEERING AND SUSPENSION

Power Steering Test Kit

Tie-rod puller

Pitman arm puller (small)

Pitman arm puller (large)

Toe-in gauge

Steering wheel puller

Small U.S. tap and die set

Large U.S. tap and die set

Small metric tap and die set

Large metric tap and die set

Heli-coil insert set, U.S.

Heli-coil insert set, metric

Heli-coil inset sparkplug set

15" drill press

Large twist drill set

Set reamers 6mm - 19 mm, metric

3/8" VSR drill motors

1/2" heavy duty drill motors

7" heavy duty sander-grinder

Hand held die grinder (cut off wheels)

Wire 'cup" brushes (for 7" sander-grinder)

Bench grinder (1 wire wheel, 1 grinding wheel

Pedestal grinder

Acetylene welding - cutting set, with rosebud torch

Acetylene welding cart

300 AMP AC-DC open arc welder

Electric welding helmet

Electric shop benches

8" shop vises (1 per each 2 benches)

Set combination wrenches to 3 1/2"

3/4" socket wrench set to 3 1/2"

3/4" air wrenches

1/2" air wrenches

3/8" air wrenches

Set outside gear pullers

Set inside gear pullers

Set exhaust pipe tools (cutter, expander, etc)

Pipe threading set manual

18" pipe wrench

24" pipe wrench

24" pipe wrench

36" pipe wrench

Pipe cutter (manual)

Set each major type high-press hose tools

High pressure hose cutter (for wire braid)

8 lb. sledge hammer

16 lb. sledge hammer

6'pry bars

Standard crow bar

Large water pump pliers

Large vise - grip

Large funnel for fuel, with strainer

Medium funnel

Small funnel

Transmission funnel (flex)

Tubing cutting/flaring set

Double - flare flaring set

Small safety cans

Large safety cans

Shop rag safety container

Shop brooms

Heavy duty mops

Heavy duty mop bucket, with wringer

O.D. micrometer set, through 6"

O.D. micrometer set, metric equivalent of above

Depth micrometer, U.S.

Depth micrometer, metric

Dial indicator kit, U.S.

Dial indicator kit, metric

Precision I.D./O.D. caliper, U.S.

Precision I.D./O.D. caliper, metric

3" precision steel rule, U.S.

1 meter steel rule

6" steel rules, calibrated in hundreths

Steel rules, metric equivalent of above

25' steel tape

Carbide - tipped scribes

Impact screw removers

Small stud remover

Large stud remover

Bushing driver set (small)

Bushing driver set (large)

Set mill bastard files 6" - 18", flat

Set mill bastard files 8" - 12", flat

Set mill bastard files 6" - 18",
rattail

Set smooth files 6" - 18", flat

Set smooth files 6" - 12",
traingular

Set rotary files, assorted shapes

Large glass blast cabinet

Large parts washer

APPENDIX B

ADDITIONAL RESOURCES

APPENDIX B

ADDITIONAL RESOURCES

The following addresses of organizations are provided as a source for obtaining additional training materials.

J. I. Case Company

Manuals

C. D. S.
P. O. Box 09359
Milwaukee, WI 53209-0359
Request Technical Publications Catalog #RAC 8-27491

Videotapes

Technical Publications Department
2317 Howe Street
Racine, WI 53403

Other Traing Materials

J. I. Case Company
Technical Training Center
ATTN: Manager of Training, Construction Equipment
700 State Street
Racine, WI 53404
(414) 636-6069

Caterpillar

Manuals and Training Materials

Yancey Brothers Company
ATTN: Training
P. O. Box 43326
Atlanta, GA 30378
(404) 941-2300

Dresser (International-Hough)

Manuals

Dresser Industries
Industry Publications
P. O. Box 457
Galion, OH 44833
(419) 468-4321
Request Index Price Book # 1019104 R24

Training Materials

Dresser Industries
P. O. Box 457
Galion, OH 44833
(419) 468-4321
Request CET Price List, 1988.

Euclid (and Michigan and Hitachi)

Manuals and Training Materials

Trax, Inc.
ATTN: Parts Department
1340 S. Perimeter Highway
Atlanta, GA 30349
(404) 996-6800

Ford

Manuals

Helm, Inc.
P. O. Box 07130
Detroit, MI 48207
(303) 865-5000

Ponce de Leon Ford Tractor Company
2928 Ponce de Leon Avenue
Decatur, GA
(404) 378-4557

Training Materials

Ford New-Holland, Inc.
500 Diller Avenue
Mail Station 500
New Holland, PA 17557
(717) 354-1546

Fiat-Allis

Manuals

Peach State Machinery
ATTN: Parts Department
3512 Oakcliff Road
Atlanta, GA 30362
(404) 451-6341

Training Materials

Contact Regional Representative
(813) 684-5616

John Deere

Manuals and Training Materials

Metrac
ATTN: Product Support
4500 Wendell Drive, S.W.
Atlanta, GA 30336
(404) 691-9445

Kawasaki (and Liebherr)

Manuals and Training Materials

Trico
ATTN: Parts and Service
P. O. Box 18197
Atlanta, GA 30316
(404) 363-9201

Komatsu

Manuals and Training Materials

Stith Equipment Company
ATTN: Operations
P. O. Box 20677
I-75 South at Morrow Road
Atlanta, GA 30320
(404) 366-0693