A PLAN OF TRAINING

FOR

HEAVY DUTY EQUIPMENT TECHNICIAN

OCCUPATION

Approved by
Provincial Apprenticeship Board
June, 2000

Addendum # 1

1. Put in Block format.

Foreword

Apprenticeship training in the Province of Newfoundland and Labrador is undergoing considerable change. This change is prompted by the need to keep pace with technological changes in industry, the need to be competitive, and the desire to be efficient and effective in meeting the needs of the apprentice. We feel that this training plan will lay the groundwork to meet both the demands of industry and the needs of the apprentice.

The plan that follows is a comprehensive one. It recognizes that apprenticeship training begins when a student first registers at a training institution or signs a Contract of Apprenticeship with an employer, and continues until such time as the apprentice has completed all of the required technical training and has received the required industry experiences necessary to write an interprovincial examination. Passing this examination will result in the apprentice receiving Red Seal Certification which gives the tradesperson national mobility of trade qualifications. This plan also recognizes the need to provide flexible access to training based on the needs of the employer and the apprentice while at the same time recognizing the end goal is to complete the requirements for Red Seal Certification.

It is realized that change in all facets of education and industry is continuous and sometimes rapid. This change will necessitate the review of this document on a continuous basis to ensure that current needs of industry and apprentices are being satisfied. Through a process of accreditation, regular input from industry advisory committees, as well as input from those involved in the administration and delivery of the training, we are confident that residents of our province who elect to pursue an apprenticeable trade as a career choice will receive high quality training and thus will be prepared to compete for jobs worldwide.

Chair, Provincial Apprenticeship and Certification Board

Minister of Youth Services and Post-Secondary Education

TABLE OF CONTENTS

CONDITIONS GOVERNING APPRENTICESHIP TRAINING

1.0 GENERAL

The following general conditions will apply to all apprenticeship training programs approved by the Provincial Apprenticeship and Certification Board in accordance with the Apprenticeship Training and Certification Act. Where an occupation requires additional conditions, these will be noted in the specific plan of training for that occupation. In no case should there be a conflict between these conditions and the additional requirements specified in certain plans of training.

2.0 ENTRANCE REQUIREMENTS

2.1 Entry into the occupation as an apprentice requires:

Indenturing into the occupation by an employer who agrees to provide the appropriate training and work experiences as outlined in this plan of training.

2.2 Notwithstanding the above, each candidate must have successfully completed a high school program or equivalent and in addition may be required to have completed certain academic subjects as specified in particular plans of training. Mature students, at the discretion of the Director of Institutional and Industrial Education, may be registered. A mature student is defined as one who has reached the age of 19 and who can demonstrate the ability and the interest to complete the requirements for certification.

2.3 At the discretion of the Director of Institutional and Industrial Education, credit towards the apprenticeship program may be awarded to an apprentice for previous work experience and/or training as validated through prior learning assessment.

2.4 A Registration for Apprenticeship form must be duly completed.

3.0 PROBATIONARY PERIOD

The probationary period for each memorandum of understanding will be six months. Within that period the memorandum may be terminated by either party upon giving the other party and the Provincial Apprenticeship and Certification Board one week notice in writing.

4.0 TERMINATION OF A MEMORANDUM OF UNDERSTANDING

After the probationary period referred to in Section 3.0 herein, the memorandum of understanding may be terminated by the Board by mutual consent of the parties thereto or cancelled by the Board for proper and sufficient cause in the opinion of the Board.

5.0 APPRENTICESHIP PROGRESSION SCHEDULE AND WAGE RATES

5.1 Progression Schedule

7200 Hour Programs	Requirements for Progression	Progress To
First Year Apprentice	Completion of entry level (Block 1) courses, plus relevant work experience totaling a minimum of 1800 hours *	Second Year
Second Year Apprentice	Completion of advanced level (Block 2) courses, plus relevant work experience totaling a minimum of 3600 hours	Third Year
Third Year Apprentice	Completion of advanced level (Block 3) courses, plus relevant work experience totaling a minimum of 5400 hours	Fourth Year
Fourth Year Apprentice	Completion of advanced level (Block 4) courses and (Block 5) *if applicable,* plus sign-off of workplace skills required for certification totaling a minimum of 7200 hours**	Write Certification Examination
5400 Hour Programs	**Requirements for Progression**	**Progress To**
First Year Apprentice	Completion of entry level (Block 1) courses, plus relevant work experience totaling a minimum of 1800 hours *	Second Year
Second Year Apprentice	Completion of advanced level (Block 2) courses, plus relevant work experience totaling a minimum of 3600 hours	Third Year
Third Year Apprentice	Completion of advanced level (Block 3) courses, plus sign-off of workplace skills required for certification totaling a minimum of 5400 hours	Write Certification Examination

4800 Hour Programs	Requirements for Progression	Progress To
First Year Apprentice	Completion of entry level courses (Block 1) courses, plus relevant work experience totaling a minimum of 1600 hours *	Second Year
Second Year Apprentice	Completion of advanced level (Block 2) courses, plus relevant work experience totaling a minimum of 3200 hours	Third Year
Third Year Apprentice	Completion of advanced level (Block 3) courses, plus sign-off of workplace skills required for certification totaling a minimum of 4800 hours	Write Certification Examination

* All direct entry apprentices must meet the **Requirements for Progression** either through Prior Learning Assessment and Recognition or course completion before advancing to the next year.

** Apprentices in a 7200 hour program which incorporates more than four blocks of training are considered fourth year apprentices pending completion of 100% course credits and workplace skills requirements.

5.2 For the duration of each Apprenticeship Training Period, the apprentice, who is not covered by a collective agreement, shall be paid a progressively increased schedule of wages which shall not be less than:

Program Duration	Wage Rates		Comments
7200 Hours	1st Year	55%	These wage rates are percentages of the prevailing journeyperson's wage rate in the place of employment of the apprentice. No apprentice shall be paid less than the wage rate established by the Labour Standards Act (1988), as now in force or as hereafter amended, or by other Order, as amended from time to time replacing the first mentioned Order.
	2nd Year	65%	
	3rd Year	75%	
	4th Year	90%	
5400 Hours and 4800 Hours	1st Year	55%	
	2nd Year	70%	
	3rd Year	85%	
4000 Hours			(Hairstylist Program) - The apprentice shall be paid no less than the minimum wage for hours worked and a commission agreed upon between the apprentice and the employer.

6.0 TOOLS

Apprentices shall be required to obtain hand tools as and when specified by the Board.

7.0 PERIODIC EXAMINATIONS AND EVALUATION

7.1 Every apprentice shall submit to such occupational tests and examinations as the Board shall direct. If after such occupational tests and examinations the apprentice is found to be making unsatisfactory progress, his/her rate of wage shall not be advanced as provided in Section 5 until his/her progress is satisfactory to the Director of Institutional and Industrial Education and his/her date of completion shall be deferred accordingly. Persistent failure to pass required tests shall be a cause for revocation of his/her Memorandum of Understanding.

7.2 Upon receipt of reports of accelerated progress of the apprentice, the Board may shorten the term of apprenticeship and advance the date of completion accordingly.

7.3 For each and every course, a formal assessment is required for which 70% is the pass mark. At the discretion of the instructor, the summative mark may be for completion of a theory examination or a combination of the theory examination and an assigned practical project.

8.0 GRANTING OF CERTIFICATES OF APPRENTICESHIP

Upon the successful completion of apprenticeship, the Board shall issue a Certificate of Apprenticeship

9.0 HOURS OF WORK

Any hours employed in the performance of duties related to the designated occupation will be credited towards the completion of the term of apprenticeship. Appropriate documentation of these hours must be provided.

10.0 COPIES OF THE REGISTRATION FOR APPRENTICESHIP

The Director of Institutional and Industrial Education shall provide copies of the Registration for Apprenticeship form to all signatories to the document.

11.0 RATIO OF APPRENTICES TO JOURNEYPERSONS

The ratio of Apprentices to Journeypersons normally shall not exceed one apprentice to every one journeyperson employed. Exceptions for specific occupations may occur with the approval of the Provincial Apprenticeship and Certification Board.

12.0 RELATIONSHIP OF THE PLAN OF TRAINING TO A COLLECTIVE BARGAINING AGREEMENT

Collective agreements take precedence over the conditions outlined in the plan of training.

13.0 AMENDMENTS TO A PLAN OF APPRENTICESHIP TRAINING

A plan of training may be amended at any time by the Provincial Apprenticeship and Certification Board.

14.0 EMPLOYMENT, RE-EMPLOYMENT AND TRAINING REQUIREMENTS

14.1 The plan of training requires Apprentices to attend regularly their place of employment.

14.2 The plan of training requires Apprentices to regularly attend training programs for that occupation as prescribed by The Provincial Apprenticeship and Certification Board.

14.3 Failure to comply with Sections 14.1 and/or 14.2 will result in cancellation of the Memorandum of Understanding. Apprentices may have their M.O.U.'s reinstated by the Provincial Apprenticeship and Certification Board but would be subject to a commitment to complete the entire program as outlined in the General Conditions of Apprenticeship. Permanent cancellation in the said occupation is the result of non-compliance.

14.4 Cancellation of the Memorandum of Understanding to challenge journeyperson examinations, if unsuccessful, would require an apprentice to serve a time penalty of two (2) years before reinstatement as an apprentice or registering as a Trade Qualifier.

14.5 Under the plan of training the employer is required; to keep each apprentice employed as long as work is available, and if the apprentice is laid off due to lack of work, to give opportunity to be re-employed before another is hired.

14.6 The employer will permit each apprentice to attend regularly training programs as prescribed by the Provincial Apprenticeship and Certification Board.

14.7 Apprentices who cannot acquire all the workplace skills at their place of employment will have to be evaluated in a simulated work environment at a training institution and have sign-off done by instructors to meet the requirements for certification.

15.0 APPEALS TO DECISIONS BASED ON CONDITIONS GOVERNING APPRENTICESHIP TRAINING

Persons wishing to appeal any decisions based on the above conditions must do so in writing to the Minister of Education within 30 days of the decision.

REQUIREMENTS FOR RED SEAL CERTIFICATION IN THE HEAVY DUTY EQUIPMENT TECHNICIAN OCCUPATION

1. Evidence that the required work experiences outlined in this plan of training have been obtained. This evidence must be in a format that clearly outlines the experiences and must be signed by an appropriate person or persons attesting that these experiences have been obtained to the level required.

2. Successful completion of all required courses in program.

3. A combination of training from an approved training program and suitable work experience totalling 7200 hours

   OR

   A total of 9000 hours of suitable work experience in the occupation accompanied by sign-off of required work competencies.

4. Completion of a National Red Seal examination, to be set at a place and time determined by the Industrial Training Division.

5. Payment of the appropriate examination fee.

ROLES AND RESPONSIBILITIES OF STAKEHOLDERS IN THE APPRENTICESHIP PROCESS

The Apprenticeship process involves a number of stakeholders playing significant roles in the training of apprentices. This section captures, in a broad sense, these roles and the responsibilities that result from them.

The Apprentice

- to complete all required technical training courses as approved by the Provincial Apprenticeship and Certification Board.
- to find appropriate employment.
- to complete all required work experiences in combination with the required hours.
- to ensure that the work experiences are well documented.
- to approach apprenticeship training with an attitude and commitment that fosters the qualities necessary for a successful career as a qualified journeyperson.
- to obtain the required hand tools as specified by the Board for each period of training of the apprenticeship program.

The Employer

- to provide high quality work experiences in an environment that is conducive to learning.
- to remunerate apprentices as set out in this Plan of Training or Collective Agreements.
- to provide feedback to Training Institutions, Industrial Training Division and Apprentices in an effort to establish a process of continuous quality improvement.
- where appropriate, to release apprentices for the purpose of returning to a training institution to complete the necessary technical courses.
- to ensure that work experiences of the apprentices are documented.

The Training Institution

- to provide a high quality learning environment.
- to provide the necessary student support services that will enhance an apprentice's ability to be successful.
- to participate with other stakeholders in the continual updating of programs.

The Industrial Training Division

- to establish and maintain program advisory committees under the direction of the Provincial Apprenticeship and Certification Board.
- to promote apprenticeship training as a viable career option to prospective apprentices and other appropriate persons involved, such as career guidance counsellors, teachers, parents, etc.
- to establish and maintain a protocol with training institutions, employers and other appropriate stakeholders to ensure the quality of apprenticeship training programs.
- to ensure that all apprentices are appropriately registered and records are maintained as required.
- to schedule all necessary technical training periods for apprentices to complete requirements for certification.
- to administer provincial/interprovincial examinations.

The Provincial Apprenticeship and Certification Board

- to set policies to ensure that the provisions of the Apprenticeship Training and Certification Act are implemented.
- to ensure that advisory and examination committees are established and maintained.
- to accredit institutions to deliver apprenticeship training programs.
- to designate occupations for apprenticeship training and/or certification.

PREFACE

This document is intended to describe the curriculum content of the Heavy Duty Equipment Technician theory training program in the Atlantic Provinces.

It describes the suggested content of each of the courses required for completion of **apprenticeship**.

Through performance objectives, it identifies knowledge and practical skills that are required to master competencies under the scope of the occupation.

This Curriculum Standard will be amended periodically and suggestions for improvement should be directed to the Apprenticeship and Occupational Certification Branch.

ACKNOWLEDGMENT

Valuable input into the development of this Curriculum Standard has been made by Advisory Committees, instructional and support staff. Without their dedication to quality training, this document would not have been produced. A sincere thank you!

This document has been validated by the Provincial Advisory Committee at their ***APRIL, 1998*** meeting.

INTRODUCTION

OVERVIEW

This training service is designed to provide trainees with skills and knowledge required for employment in the field of Heavy Equipment Repair. Heavy Duty Equipment Technician diagnose problems, locate the cause of the malfunction, dismantle and overhaul components. They repair defects, reassemble existing parts or fit new parts, and make final adjustments.

Technicians use many specialized tools, including hand tools, gauges, jacks and hoists, welding equipment, hydraulic equipment, and complex electronic diagnostic testing devices.

GENERAL OBJECTIVES

Following successful completion of this program, the apprentice will be able to:

- Demonstrate good safety habits, proper use and maintain various tools and equipment used in an automotive repair shop.

- Demonstrate skills in recognizing, servicing, removing, overhauling, and installing the various related parts and systems on heavy equipments.

PROGRAM INFORMATION

DELIVERY

This training program will be delivered by an instructor holding a Certificate of Qualification recognized by Apprenticeship and Occupational Certification.

At this moment, three methods of delivery could be used:

One is an individualized system that is learner centered and self paced, where trainees are involved in a "modular" learning process. Trainees, through consultation with instructors, establish schedules, take tests, and exit each module when they have achieved the objectives of that module.

The second method of delivery is a conventional system that is instructor centered and group paced. This method involves lectures, demonstrations, practical and self study.

The third method of delivery is through distance education, that is, apprentices are provided learning material prior to the lesson with the instructor where he/she will teach on line the material that has been scheduled for that lesson. The apprentices are able to interchange with the instructor and with other students by way of the audio graphic technology. The practical is done on-the-job at the employer's place of business. Courses are scheduled at the beginning of the academic year, apprentices register and take their training at specified times.

PROGRAM INFORMATION

DURATION

Apprenticeship requires a combined total of 7200 hours of classroom and practical work experience.

EVALUATION

Theory

A pass mark of 70% is required for each course

Practical

A pass mark of 70% is required for each course.

Work experiences or competencies performed by the apprentice are recorded by the **employer** in the Progress Record Book.

GLOSSARY OF TERMS

The following is a brief explanation of the components of the courses found in this Curriculum Standard.

Outcome is a statement that summarizes the performance objectives of the unit of instruction.

Duration is the approximate length of time required for the apprentice to complete the course. The duration may vary for each apprentice as their background and experience will impact on the time required to meet the objectives.

Prerequisites are the courses that must be completed before the apprentice attempts the course at hand.

Objectives are statements that identify what the apprentices will learn and what they will be able to do, how well, and to what standards.

Content is a listing of the theoretical topics included in the courses material and required by the apprentice for the performance of the tasks/objectives.

Suggested Learning Activities are activities assigned in relationship to the objectives of the course. The suggested projects may be substituted by the instructor for other projects that will also enable the apprentice to meet the objectives of the course. There are activities that take place during a course that apprentices must participate in for them to be able to meet the objectives of that course. The suggested activities may be substituted by the instructor(s) by other activities as long as it does not interfere with the progress of the apprentice.

Suggested Resources includes any material required by the apprentice to complete that course. Written reference material may include text books, Manufacturer's Service Manuals, Learning Activity Package, or other appropriate publications or literature.

PROGRAM STRUCTURE

PROGRAM STRUCTURE

Entry Level Courses					
NL Course No.	**Atlantic Course No.**	**Course Name**	**Hours**	**Pre-Requisite**	**Page No.**
SV-1100		Safety in the Shop	15		24
TS-1510		Occupational Health and Safety	6		25
TS-1520		WHMIS	6		28
SV-1110		Ozone Depleting Substances	7		31
TS-1530		First Aid	14		32
SV-1120		Gasket, Seals and Sealers	8	SV-1100; SV-1110; TS-1510; TS-1520; TS-1530	33
WD-1300		Oxy-Fuel Welding	30	SV-1100; SV-1110; TS-1510; TS-1520; TS-1530	36
SV-1130		Electrical and Electronic Basic Principles	90	SV-1100; SV-1110; TS-1510; TS-1520	38
SV-1140		Hydraulic Basic Principles	30		45
SV-1150		Service Information Systems	30		47
SV-1160		Hand Tools	30	SV-1100; SV-1110; TS-1510; TS-1520; TS-1530	49
SV-1170		Shop Tools and Equipment	30	SV-1160	53
SV-1180		Fasteners, Tubing and Fittings	30	SV-1160	55
SV-1190		Lubrication and Fluid Services	30	TS-1510; TS-1530; SV-1100; SV-1110; SV-1120; SV-1150; SV-1180	58
SV-1200		Start, Move, Park Vehicle	30	SV-1100; SV-1150	64
SV-1210		Tires, Rims and Wheels	30	TS-1510; TS-1520; SV-1100; SV-1150; SV-1180	66
SV-1220		Manual Steering Systems	45	SV-1190	68
SV-1230		Power Steering Systems	30	SV-1220	70
SV-1240		Front End Alignment	15	TS-1510; TS-1530; SV-1100; SV-1150; SV-1180; SV-1230	72
SV-1250		Front and Rear Suspensions	45	SV-1240	76
SV-1260		Hydraulic Brakes	60	SV-1140; SV-1190	83

Entry Level Courses					
NL Course No.	**Atlantic Course No.**	**Course Name**	**Hours**	**Pre-Requisite**	**Page No.**
SV-1270		Air Brakes	60	SV-1260	87
SV-1280		Drive Lines	30	SV-1190	93
SV-1290		Differential Assemblies	30	SV-1280	159
SV-1300		Engine Principles	75	SV-1190	95
SV-1310		Cooling Systems	30	SV-2580	100
SV-1320		Lubrication Systems	15	SV-1300	104
SV-1330		Air Filtration and Exhaust Systems	30	SV-1300; WD-2320	106
SV-1340		Gasoline Fuel Systems	15	SV-1130; SV-1330	116
SV-1350		Alternative Fuel Systems	15	SV-1340	119
SV-1360		Diesel Fuel Supply Systems	15	SV-1340	121
SV-1370		Batteries	15	TS-1510; TS-1530; SV-1100; SV-1110; SV-1130; SV-1180	133
SV-1380		Starting Systems	30	SV-1370	136
SV-1390		Charging Systems Components	30	SV-1370	139
SV-1400		Lighting Gauges	30	SV-1300; SV-1340; SV-1350	165
SV-1410		Fire Suppression Units	15	SV-1100; SV-1110; SV-1150; SV-1170; SV-1180; TS-1510; TS-1530	197
OT-1170		Work Exposure	60		--
CM-2150		Workplace Communications	45		215
MR-1210		Customer Service	30		218
SP-2300		Quality Assurance / Quality Control	30		220
MC-1050		Introduction to Computers	30		222
SD-1700		Workplace Skills	30		227
SD-1710		Job Search Techniques	15		230
SD-1720		Entrepreneurial Awareness	15		232
Total Hours			**1301**		

REQUIRED WORK EXPERIENCE

Block #2					
NL Course No.	**Atlantic Course No.**	**Course Name**	**Hours**	**Pre-Requisite**	**Page No.**
WD-2330		Mig Welding	30	SV-1100; SV-1110; TS-1510; TS-1520; TS-1530	34
WD-2320		Arc Welding	30	TS-1510; TS-1530; SV-1100; SV-1110; SV-1180; WD-1300	61
SV-2680		Basic Motive Power Computers	60	SV-1130	41
SV-2320		Manual Transmission Removal and Installation	30	SV-1280	146
SV-2330		Clutches	30	SV-2320	148
SV-2670		Air Conditioning Systems	30	SV-1110; SV-1130; SV-1190; SV-1310	143
SV-2340		Manual Transmission Service and Repair	30	SV-2320	151
Total Hours			**240**		

REQUIRED WORK EXPERIENCE

Block #3					
NL Course No.	**Atlantic Course No.**	**Course Name**	**Hours**	**Pre-Requisite**	**Page No.**
SV-2570		Engine Brakes and Retarders	15	SV-1270	91
SV-2580		Engine Removal and Installation	30	SV-1110; SV-1190; SV-1300	98
SV-2590		Turbo Chargers, Blowers and Intercoolers	30	SV-1320	109
SV-2600		Diesel Engine Overhauling	90	SV-1310; SV-1330; SV-2590	111
SV-2610		Diesel Engine Problems Diagnosis	30	SV-2600	114
SV-2660		Ignition Systems and Tune-ups	15	SV-1300; SV-1340; SV-1350; SV-1370	141
SV-2310		Electric Brakes	15	SV-1130; SV-1270	145

NL Course No.	Atlantic Course No.	Course Name	Hours	Pre-Requisite	Page No.
SV-2550		Service and Repair Circle Bearings	15	SV-2410	210
Total Hours			**240**		

REQUIRED WORK EXPERIENCE

Block #4					
NL Course No.	**Atlantic Course No.**	**Course Name**	**Hours**	**Pre-Requisite**	**Page No.**
SV-2620		Injectors	30	SV-1360	124
SV-2630		Injection Pumps	30	SV-1360	126
SV-2640		Tune-ups and Diagnosis of Diesel Fuel Systems	30	SV-2570; SV-2630	128
SV-2650		Electronic Fuel Control Systems	60	SV-1130; SV-2620; SV-2640; SV-2680	131
SV-2350		Torque Converters	30	SV-1280	154
SV-2360		Powershift Transmissions	30	SV-1140; SV-2350	156
SV-2370		Drive Axles and Final Drives	15	SV-1280	162
SV-2510		Blades, Buckets and Cutting Edges	15	SV-2420; WD-2320	203
Total Hours			**240**		

REQUIRED WORK EXPERIENCE

Block #5					
NL Course No.	**Atlantic Course No.**	**Course Name**	**Hours**	**Pre-Requisite**	**Page No.**
SV-2380		Hydraulics	30	SV-1140; SV-1190	169
SV-2390		Reservoirs and Fluid Conditioners	15	SV-2380	172
SV-2400		Hydraulic Pumps and Motors	30	SV-2390	175
SV-2410		Hydraulic Control Valves	15	SV-2400	178
SV-2420		Hydraulic Cylinders	15	SV-2410	181

NL Course No.	Atlantic Course No.	Course Name	Hours	Pre-Requisite	Page No.
SV-2430		Hydraulic Accumulators	15	SV-2410	183
SV-2440		Hydraulic Steering Systems (Articulated)	15	SV-2420	185
SV-2450		Hydrostatic Transmissions	30	SV-1290; SV-2330; SV-2340; SV-2360; SV-2370; SV-2410	187
SV-2460		Diagnose and Test Hydraulic Systems	15	SV-2430; SV-2440; SV-2450	189
SV-2470		Winches, Wire Ropes and Accessories	15	SV-2410; WD-2320	192
SV-2480		Cabs and ROPS	15	SV-1100; SV-1110; SV-1150; TS-1510; TS-1530	195
SV-2490		Portable Air Compressors	15	SV-1130; SV-1190; SV-1400	199
SV-2500		Booms and Attachments	15	SV-1140; SV-2420; WD-2320	201
Total Hours			**240**		

REQUIRED WORK EXPERIENCE

Block #6					
NL Course No.	**Atlantic Course No.**	**Course Name**	**Hours**	**Pre-Requisite**	**Page No.**
SV-2290		Steering System (Tracked)	30	SV-1220	74
SV-2300		Track Type Undercarriage	90	WD-2320; SV-1210	78
SV-2520		Aprons, Bowls and Tailgates	30	SV-2510	206
SV-2530		Feller Heads	30	SV-2490	208
SV-2540		Delimber Mechanisms	30	SV-2490; SV-2500	209
SV-2560		Preventative Maintenance Inspections	15	Entire Program	212
Total Hours			**225**		

PROGRAM CONTENT

NAME AND NUMBER: SV1100 - Safety in the Shop

SUGGESTED DURATION: 15 hours

PREREQUISITES: None

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this course, the apprentice will be able to identify procedures related to the maintenance of a safe and clean work environment and how to extinguish fires.

OVERVIEW OF OBJECTIVES:
1. Identify fire hazards.
2. Identify safe working habits.
3. Identify explosion hazards.

CONTENT:
1. Identify fire hazards
    - Fire hazards: classification of fires, types, purpose and use of fire extinguishers.
    - Explosion hazards: spontaneous combustion, storage and handling of fuels
    - Ventilation and hazardous gases: carbon monoxide, storage batteries
2. Identify safe working habits
    - Personal hazards
    - Good housekeeping practices
    - Reporting injuries
3. Identify explosion hazards
    - Recognize and prevent explosion hazards

SUGGESTED LEARNING ACTIVITIES:
- Operate fire extinguishers.
- Locate exits, fire alarms.
- Locate shop ventilation systems.
- Prepare a floor plan showing fire exit routes.

SUGGESTED RESOURCES:

TS-1510 OCCUPATIONAL HEALTH AND SAFETY

Description:

This course is designed to give participants the knowledge and skills necessary to interpret the Occupational Health and Safety Act, laws and regulations; understand the designated responsibilities within the laws and regulations; the right to refuse dangerous work; and the importance of reporting accidents.

Course Outcomes:

Upon successful completion of this unit, the apprentice will be able to:
- prevent accidents and illnesses
- improve health and safety conditions in the workplace

Theory:

1. Interpret the Occupational Health and Safety Act laws and regulations
   - i) Explain the scope of the act
     - Application of the act
     - Federal/Provincial jurisdictions
     - Canada Labour Code
     - Rules and regulations
     - Private home application
     - Conformity of the Crown by the Act

2. Explain responsibilities under the Act & Regulations
   - i) Duties of employer, owner, contractors, sub-contractors, employees, and suppliers

3. Explain the purpose of joint health and safety committees
   - i) Formation of committee
   - ii) Functions of committee
   - iii) Legislated rights
   - iv) Health and safety representation
   - v) Reporting endangerment to health
   - vi) Appropriate remedial action
   - vii) Investigation of endangerment
   - viii) Committee recommendation
   - ix) Employer's responsibility in taking remedial action

4. Examine right to refuse dangerous work
   - i) Reasonable grounds for refusal
   - ii) Reporting endangerment to health
   - iii) Appropriate remedial action
   - iv) Investigation of endangerment
   - v) Committee recommendation
   - vi) Employer's responsibility to take appropriate remedial action
   - vii) Action taken when employee does not have reasonable grounds for refusing dangerous work
   - viii) Employee's rights
   - ix) Assigning another employee to perform duties
   - x) Temporary reassignment of employee to perform other duties
   - xi) Collective agreement influences
   - xii) Wages and benefits

5. State examples of work situations where one might refuse work.

6. Describe discriminatory action
   - i) Definition
   - ii) Filing a complaint procedure
   - iii) Allocated period of time a complaint can be filed with the Commission
   - iv) Duties of an arbitrator under the Industrial Relations Act
   - v) Order in writing inclusion
   - vi) Report to commission Allocated period of time to request Arbitrator to deal with the matter of the request
   - vii) Notice of application
   - viii) Failure to comply with the terms of an order
   - ix) Order filed in the court

7. Explain duties of commission officers
   - i) Powers and duties of officers
   - ii) Procedure for examinations and inspections
   - iii) Orders given by officers orally or in writing
   - iv) Specifications of an order given by an officer to owner of the place of employment, employer, contractor, sub-contractor, employee, or supplier
   - v) Service of an order
   - vi) Prohibition of persons towards an officer in the exercise of his/her power or duties
   - vii) Rescinding of an order
   - viii) Posting a copy of the order
   - ix) Illegal removal of an order

8. Interpret appeals of others
   - i) Allocated period of time for appeal of an order
   - ii) Person who may appeal order
   - iii) Action taken by Commission when person involved does not comply with the order
   - iv) Enforcement of the order
   - v) Notice of application
   - vi) Rules of court

9. Explain the process for reporting of accidents
   - i) Application of act
   - ii) Report procedure
   - iii) Reporting notification of injury
   - iv) Reporting accidental explosion or exposure
   - v) Posting of act and regulations

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Conduct an interview with someone in your occupation on two or more aspects of the act and report results.

2. Conduct a safety inspection of shop area.

TS-1520 WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)

Description:

This course is designed to give participants the knowledge and skills necessary to define WHMIS, examine hazard identification and ingredient disclosure, explain labeling and other forms of warning, and introduce material safety data sheets (MSDS).

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

– interpret and apply the Workplace Hazardous Materials Information System (WHMIS) Regulation under the Occupational Health & Safety Act.

Required Knowledge and Skills:

1. Define WHMIS safety
   - i) Rational and key elements
   - ii) History and development of WHMIS
   - iii) WHMIS legislation
   - iv) WHMIS implementation program
   - v) Definitions of legal and technical terms

2. Examine hazard identification and ingredient disclosure
   - i) Prohibited, restricted and controlled products
   - ii) Classification and the application of WHMIS information requirements
   - iii) Responsibilities for classification
     - the supplier
     - the employer
     - the worker - Classification: rules and criteria
     - information on classification
     - classes, divisions and subdivision in WHMIS
     - general rules for classification
     - class A - compressed gases
     - class B - flammable and combustible materials
     - class C - oxidizing material
     - class D - poisonous and infectious material
     - class E - corrosive material
     - class F - dangerously reactive material

iv) Products excluded form the application of WHMIS legislation
- consumer products
- explosives
- cosmetics, drugs, foods and devices
- pest control products
- radioactive prescribed substances
- wood or products made of wood
- manufactured articles
- tobacco or products of tobacco
- hazardous wastes
- products handled or transported pursuant to the Transportation of Dangerous Goods (TDG) Act

v) Comparison of classification systems - WHMIS and TDG

vi) General comparison of classification categories

vii) Detailed comparison of classified criteria

3. Explain labeling and other forms of warning

i) Definition of a WHMIS label
- supplier label
- workplace label
- other means of identification

ii) Responsibility for labels
- supplier responsibility
- employer responsibility
- worker responsibility

iii) Introduce label content, design and location
- supplier labels
- workplace labels
- other means of identification

4. Introduce material safety data sheets (MSDS)

i) Definition of a material safety data sheet

ii) Purpose of the data sheet

iii) Responsibility for the production and availability of data sheets
- supplier responsibility
- employer responsibility
- workers responsibility

Practical:

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

1. Locate WHMIS label and interpret the information displayed.

2. Locate a MSDS sheet for a product used in the workplace and determine what personal protective equipment and other precautions are required when handling this product.

SUGGESTED RESOURCES:

1. WHMIS Regulation

2. Sample MSDS sheets

NAME AND NUMBER: SV1110 - Ozone Depleting Substances

SUGGESTED DURATION: 7 hours

PREREQUISITES: None

EVALUATION: Theory and practical applications require a minimum pass mark of 70%
Test supplied by HRAI

OUTCOME:
Upon successful completion of this course, the apprentice will be able to legally handle ozone depleting substances (refrigerants) used in motor vehicles.

OVERVIEW OF OBJECTIVES:
1. Handle ozone depleting substances (refrigerants) used in motor vehicles as per regulations.

CONTENT:
1. Handle ozone depleting substances (refrigerants) used in motor vehicles as per regulations.
   - Curriculum and certification supplied by HRAI to be delivered by instructors certified to teach ODS courses for Motive Power Occupations

SUGGESTED LEARNING ACTIVITIES:

SUGGESTED RESOURCES:

TS-1530 FIRST AID

Description:

This course is designed to give the apprentice the ability to recognize situations requiring emergency action and to make appropriate decisions concerning first aid.

Complete a **St. John Ambulance** Standard First Aid Certificate course.

NAME AND NUMBER: SV1120 - Gaskets, Seals and Sealers

SUGGESTED DURATION: 8 hours

PREREQUISITES: SV1100 SV1110 TS1510 TS1520 TS1530

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this course, the student will be able to use gaskets, seals and sealing compounds.

OVERVIEW OF OBJECTIVES:
1. Identify types of gaskets, o-rings, seals and sealing compounds and their purposes.

CONTENT:
1. Identify types of gaskets, o-rings, seals and sealing compounds and their purposes
    - Gaskets
        - Type and construction
        - Purpose
        - Installation
    - O-rings
        - Types
        - Limitations
        - Installations
    - Seals
        - Types
        - Installation
    - Sealing compound
        - Room temperature vulcanizing (RTV)
        - Anaerobic

SUGGESTED LEARNING ACTIVITIES:

SUGGESTED RESOURCES:

NAME AND NUMBER: WD2330 - Mig Welding

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1100 SV1110 TS1510 TS1520 TS1530

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this course, the apprentice will be able to describe the basic MIG (GMAW) welding process and provide the trainee with the skills and knowledge needed to use MIG Welding equipment.

OVERVIEW OF OBJECTIVES:
1. Operate MIG welding equipment to industrial safety standards as needed for various motorized equipment.

CONTENT:
1. Operate MIG welding equipment to industrial safety standards as needed for various motorized equipment
    - Equipment used in MIG welding
    - Shielding gases used in MIG welding
    - Filler wire used in MIG welding
    - The basic MIG welding process
    - Advantages of MIG welding
    - Types of MIG welding
    - Proper penetration
    - Electrical system cautions when MIG welding
        - Location of ground cables
        - Possible bearing damage from welding
        - Possible computer and electrical accessory damage from welding
        - Procedures to prevent electrical and bearing damage
    - Set up and shut down procedures

SUGGESTED LEARNING ACTIVITIES:
- Identify the equipment used in MIG welding.
- Describe the shielding gases used in MIG welding.
- Describe the filler wire used in MIG welding.
- Describe the basic MIG welding process.
- List the advantages of MIG welding.
- List the types of MIG welding.

- Weld using MIG equipment.
- Perform set up and shut down procedures.

SUGGESTED RESOURCES:

NAME AND NUMBER: WD1300 - Oxy-Fuel Welding

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1100 SV1110 TS1510 TS1520 TS1530

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this course, the apprentice will be able to identify procedures for the safe and effective set up and operation of oxy-fuel equipment for heating, cutting and braze welding.

OVERVIEW OF OBJECTIVES:
1. Operate oxy-fuel heating and cutting equipment to industrial safety standards for the removal and/or installation of parts.
2. Perform braze welding using oxy-fuel equipment.
3. Perform flame cutting with oxy-fuel equipment.

CONTENT:
1. Operate oxy-fuel heating and cutting equipment to industrial safety standards for the removal and/or installation of parts.
    - Safety precautions
        - Safety apparel
        - Storage and handling of welding gases
        - Pre-operational inspection
    - Setting up equipment
        - Cylinders
        - Gauges
        - Regulators
        - Valves-flame arrestor
        - Torches and tips
        - Hoses
        - Testing for leaks
    - Operating the torch
        - Lighting procedures
        - Types of flame (adjustment)
        - Shutting down procedures

2. Perform braze welding using oxy-acetylene equipment
    - Braze welding

3. Perform flame cutting with oxy-acetylene equipment
    - Flame cutting
        - Cutting torch and tips
        - Use of cutting torch

SUGGESTED LEARNING ACTIVITIES:

- Assemble, test, light and adjust oxy-fuel welding and cutting equipment.
- Perform braze welding on sheet metal using oxy-fuel equipment.
- Perform flame cutting with oxy-fuel equipment.
- Perform proper shut down procedures.

SUGGESTED RESOURCES:

NAME AND NUMBER: SV1130 - Electrical & Electronic Basic Principles

SUGGESTED DURATION: 90 hours

PREREQUISITES: SV1100 SV1110 TS1510 TS1520

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to apply basic electrical and electronic principles.

OVERVIEW OF OBJECTIVES:
1. Demonstrate knowledge of basic electrical principles.
2. Apply electrical principles using Ohms Law to calculate volts, ohms and amperes.
3. Use instruments to test components of series, parallel and series parallel circuits to determine cause of malfunctions in an electrical circuit.
4. Identify electronic components.

CONTENT:
1. Demonstrate knowledge of basic electrical principles
    - Safety practices and procedures working with electrical equipment
    - Terminology - abbreviations and glossary of electrical terms
    - Sources of Electricity
        - generation of electricity
        - use of chemical, magnetism, heat, light and DC power supply
        - theory and laws of electricity
        - theory and laws of magnetism and inductance
    - Ohms Law - volts, Ohms and amperes
    - Symbols and schematics - common automotive symbols
        - read schematics/wiring diagrams

2. Apply electrical principles using Ohms Law to calculate volts, ohms and amperes
    - Application of Ohms Law to Electrical Circuits
        - series circuit
        - parallel circuit
        - series and parallel circuit

3. Use instruments to test components of series, parallel and series parallel circuits to determine cause of malfunctions in an electrical circuit
    - Circuit testing devices

- applications of volt, ohm and ammeters
- meter ranges
- correct hookup of meters
- test lights, circuit breakers

- Circuit problems and testing problems
  - short, open and grounds
  - diagnostic trouble shooting procedures
  - testing procedures and equipment

4. Identify electronic components
   - Wires and terminals
     - types and sizes
     - terminals and connectors
     - conductors, semi conductors and insulators
   - Fibre Optics
     - basics
   - Capacitors
     - construction
     - purpose
     - uses
   - Resistors
     - identification
     - purpose
     - uses
   - Transistors
     - identification
     - purpose
     - uses
   - Diodes
     - identification
     - purpose
     - uses

SUGGESTED LEARNING ACTIVITIES:

- Classroom Theory
- Read schematics and wiring diagrams
- Familiarize learner with circuit testing devices
- Use circuit testing devices.
  - ampmeter
  - ohmmeter
  - voltmeter

    - test lights
- Apply Ohms Law to Electrical Circuit
- Identify wires and terminals
    - demonstrate back probing
- Test electronic circuits

SUGGESTED RESOURCES:

NAME AND NUMBER: SV2680 - Basic Motive Power Computers

SUGGESTED DURATION: 60 hours

PREREQUISITES: SV1130

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to diagnose and/or repair/reprogram motive power computers.

OVERVIEW OF OBJECTIVES:
1. Explain the basic operation of computers.
2. Explain how and why computers are used to control vehicle systems.
3. Demonstrate ability to follow safety precautions associated with computers and electronic components.
4. Demonstrate understanding of scan tools and their operation.

CONTENT:
1. Explain the basic operation of computers
    - Rationale - reasons for using electronic controls
        - more accurate control
        - less change in emissions and performance with accumulated mileage
    - Basic computer systems
        - computers - compared to brain
        - inputs - information to brain
        - outputs - commands from brain
    - Computer operation
        - basic CPU
        - types of memory - RAM, ROM, PROM, EEPROM
        - input and output interfaces
        - clock speed
        - feeds (power) and grounds for computers
    - Input circuits
        - discreet inputs
        - analogue inputs
        - 2-wire sensor systems
        - 3-wire sensor systems
    - Output circuits
        - high side and low side control of circuits

- pulse width modulation (PWM)
- current limiting protection in newer computers versus burn-out of older units with no self-protection

- Sensing devices
  - switches
  - thermistors
  - potentiometers
  - pressure sensors
  - permanent magnet (PM) generators
  - hall effect switches
  - LED operated
  - knock sensors
- Feedback systems
  - open loop versus closed loop operation
  - oxygen sensors
- Adaptive learning
  - purpose for adaptive strategies of computer systems
  - short term versus long term memories
  - ways of describing variation - counts or percentages
  - conditions versus commands - what does 115 integrator counts or long-term fuel trim of 110% means
- Output systems
  - solenoids - on-off and PWM
  - relays
  - stepper motors
  - lights
  - trouble codes and diagnostic information

2. Explain how and why computers are used to control vehicle systems
   - Electrical and electronic fundamentals

3. Demonstrate ability to follow safety precautions associated with computers and electronic components
   - Construction and programmability of computers
   - Use of original PROMS and knock sensor calibrators
   - Programming of reprogrammable type before use

4. Demonstrate understanding of scan tools and their operation
   - Scan tools
     - test circuitry for operation and defects
     - clear codes

    - road test with scanners and data recorders
- Understand J 1930 technology
- Test computer output sensors
    - solenoids/on off and PWM
    - relays
    - stepper motors
    - lights
    - trouble codes and diagnostic information
- Sensing Devices
- Wiring Diagrams
    - power and ground wiring and connectors
    - proper procedure for testing
- Use of Logical Approach to Diagnosis
    - verify complaint
    - preliminary checks (visual, operational, and other systems)
    - diagnostic systems check (check operational of MIL)
    - check for service bulletins
    - check for diagnostic trouble codes (DTC's)
    - use symptoms diagnostic charts
    - repair and verify operation
- Diagnostic Tools
    - shop manuals and other printed or electronic service information
    - digital VOM
    - various test lights - 12 volt - noid
    - pressure gauges
    - injector testers
    - test connector sets (for testing weatherproof terminal circuits)
- Specific Tests
    - precautions with static electricity
    - diagnostic system check
    - computer feeds and grounds - voltage drops
    - use of scan tools to check inputs
    - use of VOM and oscilloscopes to check inputs
    - snap-shot functions in scan tools
    - fuel injector balance tests and current tests
    - fuel pump output tests

SUGGESTED LEARNING ACTIVITIES:

- Demonstrate ability to use diagnostic tools.
- Access trouble codes and analyze information received.

- Interpret service manuals for wiring diagrams, flow charts and trouble shooting guides.

SUGGESTED RESOURCES:

- Scanners
- Break out boxes
- Manufacturers specific scan tools
- Engine analyzers
- Lab-type oscilloscopes
- Portable scanners

NAME AND NUMBER: SV1140 - Hydraulic Basic Principles

SUGGESTED DURATION: 30 hours

PREREQUISITES: None

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon completion of this course, the apprentice will be able to apply basic hydraulic principles by using Pascal's Law to calculate force and fluid pressure as applied to Motive Powered Equipment.

OVERVIEW OF OBJECTIVES:
1. Apply basic hydraulic principles.
2. Identify basic hydraulic components and systems and their applications.
3. Interpret and use hydraulic symbols and diagrams.
4. Identify safety practices.

CONTENT:
1. Apply basic hydraulic principles
    - Definition of Pascal's Law
    - Multiplication of force
    - Using the formulas, calculate area, pressure, force
    - Bernoulli's principle
    - Advantages of hydraulic systems
    - Hydrodynamics
    - Hydrostatic
    - Types of properties of hydraulic fluid
        - viscosity
        - friction
        - flow
        - volume
        - velocity
        - laminar
    - Pressure
        - imperial
        - metric
    - Force
    - Energy
    - Work
    - Power

- Torque
- Pressure gauge
- Absolute pressure

2. Identify basic hydraulic components and systems and their applications
   - Basic hydraulic components
     - pump
     - hydraulic actuator
       - linear
       - rotary
     - pressure control valve
     - directional control valve
     - volume control valve
     - reservoir
     - hoses
   - Types of hydraulic systems
     - open-center
     - close-center
     - advantages and disadvantages of different systems

3. Interpret and use hydraulic symbols and diagrams
   - Recognize symbols commonly used in hydraulic diagrams
   - Interpretation of schematics and diagrams
     - pictorial drawing
     - cutaway drawing
     - symbol drawing
     - exploded views

4. Identify safety practices
   - Blocking prior to removal (procedures)
   - Releasing system pressure

SUGGESTED LEARNING ACTIVITIES:

SUGGESTED RESOURCES:

NAME AND NUMBER: SV1150 - Service Information Systems

SUGGESTED DURATION: 30 hours

PREREQUISITES: None

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to select and use different types of service manuals for heavy equipment and truck and transport.

OVERVIEW OF OBJECTIVES:
1. Use operator's manual.
2. Use maintenance and lubrication manual.
3. Use service manual.
4. Use parts manual.
5. Use special bulletins.
6. Use computerized information systems.

CONTENT:
1. Use operator's manual
   - Methods of using
   - Interpretation of sections

2. Use maintenance and lubrication manual
   - Methods of using
   - Interpretation of sections

3. Use service manual
   - Methods of using
   - Interpretation of sections

4. Use parts manual
   - Methods of using
   - Interpretation of sections

5. Use special bulletins
   - Methods of using
   - Purpose
   - Interpretation

- Introduction to computers
    - computerized parts information
    - computerized service and repair information

6. Use computerized information systems
    - Work order
    - Warranty claims
    - Time ticket
    - Tracking procedures
    - Computerized Info System
    - Electronic service

SUGGESTED LEARNING ACTIVITIES:

- Find serial number of a vehicle on the following items:
    - chassis
    - motor
    - transmission
- With the appropriate manual, find the type and amount of hydraulic oil recommended on a vehicle.
- With the appropriate manual find the step by step removal procedure of the engine and transmission of a vehicle.
- With the appropriate manual, make a parts list of a cylinder head.

SUGGESTED RESOURCES:

- Manufacturer's manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1160 - Hand Tools

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1100 SV1110 TS1510 TS1520 TS1530

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to use and maintain hand tools.

OVERVIEW OF OBJECTIVES:
1. Use and maintain hand tools.
2. Use and maintain cutting tools.
3. Use and maintain measuring tools.
4. Use and maintain miscellaneous tools.

CONTENT:
1. Use and maintain hand tools
    - Screwdrivers
        - standard
        - Phillips
        - Robertson
        - Torex
    - Reconditioning procedures
    - Correct use and care
        - reed and prince
        - offset
        - stubby
        - screw starters
    - Pliers
        - combination
        - gripping
        - cutting
        - vise-grips
        - snap ring
        - needle nose
    - Hose clamp
        - proper use and care
    - Wrenches
        - open-end

- box ends
- ratcheting box ends
- flex-head box ends
- obstruction wrenches
- striking wrenches
- special-purpose box wrenches
- adjustable wrenches
- pipe wrenches
- spanner wrenches
- allen & multispline wrenches
    - recognition of sizes (imperial and metric)
    - proper use and care

- Sockets and drives
    - drive sizes
    - sockets points
    - deep sockets
    - flexible sockets
    - impact socket
    - drive handle
    - ratchet
    - universal joint
    - adapters
    - extensions
    - speed handles
    - recognition of sizes (imperial and metric)
    - proper use and care
- Hammers
    - ball peen hammer
    - cross peen hammer
    - plastic tip hammer
    - brass-headed hammer
    - rubber mallet hammer
    - dead blow hammer
    - sledgehammer
- Hammer handles
    - installation procedures
    - proper use and care
- Punches
    - starting punch
    - pin punch
    - center punch

- aligning punch
- reconditioning procedures
- proper use and care

- Torque wrenches
  - types
  - sizes
  - purpose
  - proper use and care
- Torque multiplier
- Torque rods (stick)

2. Use and maintain cutting tools
   - Chisels
     - flat chisel
     - cape chisel
     - round nose cape chisel
     - diamond point chisel
     - rivet buster chisel
   - Chisel holder
   - Reconditioning procedures
   - Proper use and care
   - Hacksaws
     - types and designs
     - blades classification and selection
     - proper use and care
   - Files
     - types and designs
     - file handle
     - file card
     - proper use and care
   - Twist drills
     - types and designs
     - sharpen procedures
     - recognition of sizes (imperial and metric)
     - proper use and care
   - Taps
     - taper taps
     - plug taps
     - bottoming taps
     - recognition of sizes (imperial and metric)
     - tap handle

    - proper use and care
- Dies
    - types
    - recognition of sizes (imperial and metric)
    - dies stock
    - proper use and care
- Thread restorers
    - types and designs
    - proper use and care

3. Use and maintain measuring tools
    - Steel rules and squares
    - Calipers
    - Micrometers
    - Dial indicators
    - Small hole gage
    - Telescoping gage
    - Vernier caliper
    - Protractors
    - Dividers
    - Wire gage
    - Drill gage
    - Screw pitch gage
    - Feeler gage
    - Proper use and care

4. Use and maintain miscellaneous tools
    - Stud extractors
    - Bushing and seal drivers
    - Magnetic pickup tools
    - Mechanical pickup tools
    - Inspection Mirrors
    - Stamping sets
    - Stethoscope

SUGGESTED LEARNING ACTIVITIES:

- Bench work projects to include the use of common hand tools, metal cutting, filing, measuring, drilling, tapping, threading and broken stud removal.
- Sharpen a twist drill.

SUGGESTED RESOURCES:

NAME AND NUMBER: SV1170 - Shop Tools and Equipment

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1160

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the trainee will be able to use and maintain shop tools and equipment.

OVERVIEW OF OBJECTIVES:
1. Use and maintain shop tools.
2. Use and maintain shop equipment.

CONTENT:
1. Use and maintain shop tools
    - Power tools
        - impact wrenches
        - hand impact wrench
        - air ratchet
        - air chisels
        - air hammers
        - electric impact wrench
    - Electric drills
    - Air drills
    - Air lines
    - Air nozzles
    - Air regulators
    - Face shield
    - Safety goggles
    - Drill press
    - Hydraulic press
    - Floor jacks
    - Hand jack
    - Transmission jack
    - Portable crane
    - Overhead crane
    - Hoist crane safety standards
    - Chain hoist

- Hoists
- Safety stands
- Lifting cables, slings and chains
- Cleaning equipment
    - solvent washers
    - pressure washers

2. Use and maintain shop equipment
    - Bench grinders
    - Portable grinders
    - Grinding wheels
    - Grinder accessories
        - wire wheels
        - wheel dressers
        - eye shields
        - pedestal
    - Pullers
        - gear and bearing pullers
        - slide hammer pullers
        - steering pullers
        - blind hole pullers
        - puller attachments
        - bench vises
        - vise jaw covers
        - extension lights
        - creepers

SUGGESTED LEARNING ACTIVITIES:

- Raise a vehicle, blocking it using safety stand and cross blocking.
- Wash a vehicle or a component with pressure washer equipment.

SUGGESTED RESOURCES:

- Automotive Service and Repair Tools (Hill).
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1180 - Fasteners, Tubings and Fittings

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1160

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to select and use common fasteners, tubing and fittings found in heavy equipment and truck and transport.

OVERVIEW OF OBJECTIVES:
1. Select and use fasteners.
2. Select and use different types of tubing and hoses.
3. Select and use different types of fittings.
4. Select and use flaring tools.

CONTENT:
1. Select and use fasteners.
    - Bolts
    - Capscrews
    - Nuts
    - Studs
    - Threads classification
        - imperial and metric
    - Grade markings
    - Theory of torquing
    - Torquing pattern
    - Torque chart
    - Washers
        - flat washer
        - lock washer
        - external spring washer
        - internal spring washer
    - Machines screws
    - Sheet metal screws
    - Self tapping screws
    - Keys and pins
        - woodruff keys
        - square keys

    - cotter pins
    - spring pins
    - tapered pins
    - clevis pins
- Locking devices
    - functions
    - types
- Liquid compounds
    - lock-type compounds
    - antiseizure compounds

2. Select and use different types of tubing and hoses
    - Steel tubing
    - Copper tubing
    - Plastic tubing
    - Rubber tubing
    - Recognition of sizes

3. Select and use different types of fittings
    - Types of low pressure fittings
    - Types of flares
    - Types of threads
    - Torque limitation of fitting
    - Thread sealers

4. Select and use flaring tools
    - Flaring tool kit
    - ISO flaring
    - Tubing cutter
    - Deburring tool
    - Tubing bender
    - Tubing wrenches
    - Cutting, bending and flaring procedures

SUGGESTED LEARNING ACTIVITIES:

- Cut, flare, bend and connect copper and steel tubing.

SUGGESTED RESOURCES:

- Automotive Service and Repair Tools (Hill).
- Diesel Mechanics.
- FOS Fasteners (Deere).

- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1190 - Lubrication and Fluid Services

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1100 SV1110 SV1120 SV1150 SV1180 TS1510 TS1530

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to perform engine oil and filter changes, chassis lubrication and service automatic lubrication systems.

OVERVIEW OF OBJECTIVES:
1. Select and use different types of oil.
2. Change engine oil.
3. Change engine oil filter.
4. Start and run engine.
5. Select and use different types of grease.
6. Lubricate vehicles chassis.
7. Repair and service automatic lubrication systems.
8. Disposal of used lubricants.
9. Oil analysis.

CONTENT:
1. Select and use different types of oil
    - Oil classification
        - API
        - SAE
    - Oil viscosity
    - Oil additive
    - Function of the oil
    - Oil selection
    - Recognition of contaminated fluid
    - Hydraulic oil
        - function
        - classification
        - selection
    - Gear oil
        - function
        - classification
        - selection

2. Change engine oil
   - Procedures for draining the oil
   - Precautions with hot oil
   - Cleaning drain plug
   - Filling procedures
   - Importance of cleanliness
   - Checking oil level
   - Proper torque of drain plug
   - Storage of used oil

3. Change engine oil filter
   - Construction of filter
   - Types of filter
   - Selection of filter
   - Oil filter removal
   - Oil filter seals
   - Importance of cleanliness

4. Start and run engine
   - Check for oil leaks
   - Check engine oil pressure
   - Check oil level

5. Select and use different types of grease
   - Properties of grease
     - function
     - classification
     - selection
   - Type of grease
     - wheel bearing grease
     - universal joint grease
     - chassis grease
     - high temperature grease
     - multipurpose grease

6. Lubricate vehicles chassis
   - Grease gun (hand and air)
   - Lubrication lines
   - Grease fitting
   - Refilling the grease gun
   - Grease gun adapters

- Oilers
- Storage and handling grease
- Lubricating charts

7. Repair and service automatic lubrication systems
   - Types of systems
   - Purpose
   - Systems operations
     - reservoir
     - lubrication points
     - lubrication lines
     - regulator function
   - Warning malfunction
   - Reservoir refilling
   - Procedures to repair hoses and fittings

8. Disposal of used lubricants
   - Environmental issues
   - Health issues
   - Filter crushers

9. Oil analysis.
   - Contamination of sample
   - Interpretation of analysis
   - Identification of contaminants
   - Collection of specimen

SUGGESTED LEARNING ACTIVITIES:

- Change engine oil and filter on a vehicle.
- Perform a complete lubrication service on a vehicle.
- Check fluid level on vehicles components.

SUGGESTED RESOURCES:

- FOS - Fuels, Lubricants and Coolants (Deere).
- Diesel Mechanics.
- FOS - Hydraulics (Deere)
- Vehicle's service manual
- Use appropriate audio-visual material where available.

NAME AND NUMBER: WD2330 - Arc Welding

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1100 SV1110 SV1180 TS1510 TS1530 WD1300

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to set up and perform basic arc welding.

OVERVIEW OF OBJECTIVES:
1. Apply safety rules with arc welding.
2. Use electric arc welding equipment.
3. Use different types of electrodes.
4. Use personal protective equipment to arc weld.
5. Set up welding equipment.
6. Strike an arc and run stringer beads.

CONTENT:
1. Apply safety rules with arc welding
    - Proper ventilation
    - Rays
        - ultraviolet
        - infrared
    - Danger of high voltage
    - Danger of damp areas

2. Use electric arc welding equipment.
    - Types of welding machines
        - generators
        - transformer
        - rectifiers
    - Electrodes holder
    - Ground clamp
    - Protective shield
    - Welder's clothing
    - Cables
    - Chipping hammer

3. Use different types of electrodes
    - AWS
    - ASTM
    - Classification
        - E-6011
        - E-7018
    - Selecting the electrode
        - quality of weld requirement
        - weld position
        - joint design
        - welding speed
        - composition of base metal
        - storing the electrodes

4. Use personal protective equipment to arc weld
    - Protective equipment
        - wear goggles
        - head shield or helmet
        - gloves
        - aprons
        - shoes

5. Set up welding equipment
    - Safety precautions
        - safety equipment
        - electrical connection
        - properly grounded machine
    - Procedures to set the current

6. Strike an arc and run stringer beads
    - Starting the arc
    - Length of arc
    - Travel speed
    - Forming the crater
    - Types of joints
    - Cleaning metals to be welded
    - Angle of electrode

SUGGESTED LEARNING ACTIVITIES:

- Strike and maintain an arc.
- Fillet weld flat position.

SUGGESTED RESOURCES:

- Learning activity package for unit IMP 1105.
- FOS - Welding (Deere)
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1200 - Start, Move, Park Vehicle

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1100 SV1150

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to start, move and park heavy equipment machinery and prepare a vehicle to be towed.

OVERVIEW OF OBJECTIVES:
1. Apply safety rules before starting a vehicle.
2. Perform pre-start checks.
3. Perform equipment start-up.
4. Operate the vehicle.
5. Perform equipment shut-down.
6. Prepare a vehicle to be towed or pushed.

CONTENT:
1. Apply safety rules before starting a vehicle
    - Importance of good ventilation
    - Fume hazard
    - Sign interpretation

2. Perform pre-start checks
    - Fluid levels checks
        - engine
        - cooling
        - hydraulic
        - transmission
        - fuel
        - check for lock out
        - visual inspection

3. Perform equipment start-up
    - Operator's manual interpretation
    - Gauges interpretation
    - Start-up procedures
    - Importance of warm-up period

- Emergency shut-down

4. Operate the vehicle
   - Parking brake release
   - Accelerator controls
   - Hydraulic controls
   - Speed selection
   - Check brakes operation
   - Emergency shut-down
   - Safety

5. Perform equipment shut-down
   - Cooling period before shut-down
   - Lower all attachments

6. Prepare a vehicle to be towed or pushed
   - Recognition of towing and pushing procedures
   - Steering operation
   - Parking brakes release
   - Brakes application methods
   - Free to rotate or disconnect drive shafts
   - Towing cables or chains and shackles
   - Attaching techniques
   - Towing capacity

SUGGESTED LEARNING ACTIVITIES:

- Start, move and park different types of vehicles where available.

SUGGESTED RESOURCES:

- Vehicle operator's manual.
- Diesel Equipment I (Schulz).
- Heavy Equipment Repair (Nash).

NAME AND NUMBER: SV1210 - Tires, Rims and Wheels

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1100 SV1150 SV1180 TS1510 TS1520

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove and install tires from a demountable rim flange used on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Demount and mount tire from rim.
2. Use and maintain tire tools.
3. Remove and install wheel from axle.
4. Maintain tires.

CONTENT:
1. Demount and mount tire from rim
    - Tires
        - types and designs
        - construction
        - interpretation of sizing
        - tread design
    - Rims
        - types and design
        - construction
        - two-piece rim
        - three-piece rim
        - five-piece rim
        - demounting procedures
        - inspecting tires
        - inspecting rims
        - mounting procedures
        - importance of using tire cage
        - inflation methods
        - safety rules to follow

2. Use and maintain tire tools
    - Tire gauges

- Air chuck
- Special bars
- Tire safety cage
- Tire lubrication

3. Remove and install wheel from axle
   - Removal and installation procedures
   - Inspection of rims
   - Types of wheels, studs and nuts
   - Importance of torque sequence
   - Cause and effects of wheel off

4. Maintain tires
   - Causes and effects of abnormal tire wear
     - overinflation
     - underinflation
   - Proper inflation
   - Tire rotation
   - Dual tires
     - advantages
     - disadvantages
     - matching
     - how to measure
   - Tire ballast
     - purpose
     - types
     - advantages
     - disadvantages
   - Tire chains
     - traction
     - protection

SUGGESTED LEARNING ACTIVITIES:

- Demount and mount a tire from removable rim flange.

SUGGESTED RESOURCES:

- FOS - Tires and tracks (Deere).
- Diesel Equipment I (Schulz).
- Automotive Technology (Nash).
- Service manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1220 - Manual Steering Systems

SUGGESTED DURATION: 45 hours

PREREQUISITES: SV1190

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to disassemble, repair, adjust and assemble manual steering gear box, steering linkage, steering wheel and shafts.

OVERVIEW OF OBJECTIVES:
1. Disassemble, repair, adjust and assemble manual steering gear boxes.
2. Remove and install steering wheel and shafts.
3. Diagnose problem in manual steering box.
4. Remove, repair and install steering linkage and components.
5. Remove, repair and replace kingpin.

CONTENT:
1. Disassemble, repair, adjust and assemble manual steering gear boxes
    - Types
        - recirculating ball
        - worm and roller
        - cam and lever
    - Functions of major components
    - Steering ratio
    - Identification of parts
    - Removal and installation procedures of steering box
    - Overhaul steering boxes
        - repair procedures
        - bearing adjustments
        - overcenter preload adjustments
        - steering gear lubricant

2. Remove and install steering wheel and shafts
    - Steering wheel removal and replacement
    - Shaft and coupling service
    - Steering wheel centering

3. Diagnose problem in manual steering box
    - Procedures in diagnosing problems in manual steering systems
        - problems related to improper adjustment
        - hard steering
        - wandering
        - noise

4. Remove, repair and install steering linkage and components
    - Steering linkage
        - steering knuckle
        - tie rods ends
        - center link
        - drag link
        - idler arm
        - pitman arm
        - steering column
        - king pin and bushing
    - Identification of component wear
    - Methods of inspection
    - Removal and installation procedures
    - Safety precautions

5. Remove, repair and replace kingpin
    - Inspection for wear
    - Removal and installation procedures
    - Type of lubricant used
    - Special tools

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, repair and assemble a manual steering box.
- Remove and install a steering wheel.
- Disassemble, inspect, reassemble and adjust steering linkage and components.

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- Auto Service and Repair (Stockel).
- Automotive Technology (Nash).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1230 - Power Steering Systems

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1220

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to disassemble, repair, adjust and assemble power steering gear box and components.

OVERVIEW OF OBJECTIVES:
1. Disassemble, repair, adjust and assemble power steering boxes.
2. Remove, repair and install power steering pump.
3. Remove and repair power steering lines.
4. Inspect, test and diagnose problems in power steering systems.

CONTENT:
1. Disassemble, repair, adjust and assemble power steering boxes
    - Types of power steering
        - linkage
        - integral
        - semi-integral
    - Function of major components
    - Ratio
    - Identification of parts
    - Removal and installation procedures of steering box
    - Overhaul power steering box
    - Repair procedures
    - Bearings adjustments
    - Overcenter preload adjustments

2. Remove, repair and install power steering pump
    - Types of pumps
        - vane
        - gear
        - rotor
    - Identification of parts and functions of major components
    - Types of control valves
    - Disassemble and assemble procedures

- Inspection of defective parts
- Importance of cleanliness

3. Remove and repair power steering lines
   - Types and constructions of lines
   - Removal and replacement procedures
   - Recognition of serviceability

4. Inspect, test and diagnose problems in power steering systems
   - Procedures in diagnosing problems in power steering systems
     - fluid level
     - pull to one side
     - hard to steer
     - jerky, erratic steering
     - power assisted on one side only
     - loose belt
   - Procedures to pressure and flow test power steering systems

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, repair and assemble a power steering box.
- Disassemble, repair and assemble a power steering pump.

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- Auto Service and Repair (Stockel).
- Automotive Technology (Nash).
- Service manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1240 - Front-End Alignment

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1100 SV1150 SV1180 SV1230 TS1510 TS1530

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to perform basic front-end alignment on heavy equipment vehicle.

OVERVIEW OF OBJECTIVES:
1. Perform basic wheel alignment.
2. Check condition of steering linkages and components.
3. Diagnose wheel alignment problems.
4. Service electronically controlled steering.

CONTENT:
1. Perform basic wheel alignment
    - Steering geometry
        - caster
        - camber
        - steering axis inclination
        - included angles
        - toe-in
        - toe-out on turns
    - Procedures to check and adjust toe-in

2. Check condition of steering linkages and components
    - Check condition of:
        - steering box
        - tie rod ends
        - center link
        - idler arms
        - pitman arms
        - king pins

3. Diagnose wheel alignment problems
    - Pull to one side
    - Tire wear

- Improper wheel track

4. Service electronically controlled steering
   - Inspection for wear
   - Removal and installation procedures
   - Type of lubricant used

SUGGESTED LEARNING ACTIVITIES:

- Perform toe-in adjustment on a vehicle.

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- Auto Technology (Nash).
- Service manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2290 - Steering Systems (Tracked)

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1220

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service, repair and adjust track type steering systems.

OVERVIEW OF OBJECTIVES:
1. Remove, repair, install and adjust steering clutches.
2. Remove, repair, install and adjust planetary steering systems.
3. Diagnose steering clutch problems.

CONTENT:
1. Remove, repair, install and adjust steering clutches
    - Types of steering clutches
        - dry
        - wet
        - mechanically applied and released
        - hydraulically applied and released
        - location
    - Major components of steering clutches
        - drums
        - brake band
        - clutches
        - linkages
        - seals
        - bearings
    - Removal procedures
    - Inspection of parts for wear
    - Installation procedures
    - Adjustment procedures
        - brake band
        - free play
        - hydraulic pressure

2. Remove, repair, install and adjust planetary steering systems
    - Types of planetary steering
    - Advantages

3. Diagnose steering clutch problems
    - Hard steering
    - No steering on both sides
    - Steering on one side only
    - Steering clutch slippage
    - Dragging clutches

SUGGESTED LEARNING ACTIVITIES:

- Check, repair and adjust steering clutches on a crawler tractor.

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- Heavy Equipment Repair (Nichols).
- Service manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1250 - Front and Rear Suspension

SUGGESTED DURATION: 45 hours

PREREQUISITES: SV1240

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, inspect, repair and install heavy equipment front and rear suspension.

OVERVIEW OF OBJECTIVES:
1. Remove, inspect, repair and replace front and rear suspension.
2. Diagnose front and rear suspension problems.

CONTENT:
1. Remove, inspect, repair and replace front and rear suspension
    - Independent
    - Solid axle
    - Twin I Beam
    - Single axle
    - Tandem axles
    - Suspension components
        - spring
            - coil, leaf and torsion bar
        - shackles
        - insulators
        - rebound clips
        - center bolt
        - U bolt
        - saddle assembly
        - walking beam
        - torque rod
        - equalizer beam
    - Sprung and unsprung weight
    - Spring helper
    - Air ride suspension
    - Nitrogen charged suspension
    - Shock absorbers
        - types

- functions
- principle of operation
- Removal and installation procedures of components

- Repair procedures
- Spring removal and replacement procedures
- Shock absorber removal and installation
- Safety rules to follow

2. Diagnose front and rear suspension problems
   - Procedures to diagnose front and rear axles and suspension problems
   - Problems
     - broken leaf spring
     - broken center bolt
     - loose or broken spring bracket
     - bend or twist housing
     - mistracking of wheels

SUGGESTED LEARNING ACTIVITIES:

- Remove, inspect and install front or rear suspension from a vehicle.

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- Heavy Equipment Repair (Nichols).
- Automotive Technology (Nash).
- Service manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2300 - Track Type Undercarriage

SUGGESTED DURATION: 90 hours

PREREQUISITES: SV1210 WD2320

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, disassemble, repair, assemble and install a track type undercarriage from a crawler tractor or excavator.

OVERVIEW OF OBJECTIVES:
1. Remove, repair and replace track frame.
2. Remove, repair and replace track rollers, carrier rollers and front idlers.
3. Remove, repair and replace track adjusters.
4. Remove, repair and replace recoil mechanism.
5. Remove, repair and replace sprockets.
6. Remove, inspect and replace track chain.
7. Remove and replace track shoes.
8. Perform track maintenance.
9. Diagnose undercarriage problems.

CONTENT:
1. Remove, repair and replace track frame
    - Types of track frame
        - rigid frame
        - oscillating frame
    - Cross members
    - Stabilizer bar
    - Diagonal bar
    - Track guards
    - Removal and installation procedures
    - Repair procedures

2. Remove, repair and replace track rollers, carrier rollers and front idlers
    - Types of rollers
        - track rollers
        - carrier rollers
        - front idlers
        - single flange

        - double flange
    - Rollers components
        - shaft
        - bearing
        - bushings
        - seals
    - Lubrication recommendation
    - Removal and installation procedures
    - Recognition of wear limits
    - Repair procedures

3. Remove, repair and replace track adjusters
    - Types of track adjusters
        - mechanical
        - hydraulic
    - Components
        - seals
        - piston
        - rod
        - cylinder
        - grease fitting
        - bleed valve
    - Removal and installation procedures
    - Repair procedures

4. Remove, repair and replace recoil mechanism
    - Types of recoil mechanism
        - recoil spring
        - nitrogen gas
        - dual spring
        - staked cone spring plate
    - Removal and installation procedures
    - Repair procedures

5. Remove, repair and replace sprockets
    - Types of sprockets
        - hunting sprocket
        - non hunting sprocket
        - one piece sprocket
        - segments sprocket
        - ring type sprocket

- Method of attaching to final drive shaft
- Removal and installation procedures
- Recognition of wear limits
- Repair procedures

6. Remove, inspect and replace track chain
   - Types of track chain
     - flush
     - counterboard
     - sealed track
     - lubricated track
     - links
     - pins
     - bushings
     - high sprocket track
   - Master pins
     - identification
     - purpose
   - Split master link
   - Removal and installation procedures
   - Recognition of wear limits
   - Pin and bushings rotation
     - purpose
     - advantages
     - disadvantages

7. Remove and replace track shoes
   - Types of track shoes
     - standard grouser shoe
     - semi grouser shoe
     - cut-out grouser shoe
     - snow and ice shoe
     - flat shoe
     - shoe bolt and nuts
   - Removal and installation procedures
   - Recognition of wear limits

8. Perform track maintenance
   - Recognize undercarriage wear
   - Elements of wear
     - contact

- motion
- load

- Causes of wear
  - undercarriage works and wear
  - forward and reverse drive side wear
  - sprocket wear
  - roller wear
  - idler wear
  - pin and bushing wear
  - shoe wear
- General track inspection
- Roller and idler lubricant level
- Track alignment
  - camber toe
  - tighten hardware
  - track tension (sag)
  - importance of removing trash and mud
  - measure track pitch
  - measure sprocket pitch
  - measure roller wear
  - measure idler wear
  - measure link wear
  - measure pin and bushing wear
  - measure grouser (shoe) wear

9. Diagnose undercarriage problems
   - Procedures to diagnose undercarriage problems
   - Inspection
     - track misalignment
     - track too loose or too tight
     - leaking track adjuster
     - abnormal wear rate
     - loose hardware
     - missing parts
     - bent or damaged equalizer bar
     - bent or damaged diagonal bar

SUGGESTED LEARNING ACTIVITIES:

- Remove, disassemble, repair, assemble and install a track frame and all components.
- With special wear gauges and tools, check pin, bushing, roller and sprocket wear.
- Make track alignment and track sag adjustments to the manufacturer's specifications.

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- FOS - Tires and Tracks (Deere).
- Heavy Equipment Repair (Nichols).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1260 - Hydraulic Brakes

SUGGESTED DURATION: 60 hours

PREREQUISITES: SV1140 SV1190

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:

Upon successful completion of this unit, the apprentice will be able to remove, disassemble, repair, assemble and install hydraulic brake systems and components used in heavy equipment and truck and transport.

OVERVIEW OF OBJECTIVES:

1. Remove, repair and replace a master cylinder.
2. Remove, repair and replace drum type brakes.
3. Remove, repair and replace wheel cylinders.
4. Remove, repair and replace disc type brakes.
5. Remove, repair and replace parking brakes.
6. Remove, repair and replace brake lines.
7. Bleed brake systems.
8. Diagnose hydraulic brake problems.

CONTENT:

1. Remove, repair and replace a master cylinder
    - Fundamentals of brake systems
        - kinetic energy
        - heat
        - friction
        - coefficient of friction
        - heat dissipation
        - hydraulic principles
        - action of primary and secondary shoe
        - servo brakes
    - Types of master cylinders
    - Removal and installation procedures
    - Identifications of parts
    - Cleaning procedures
    - Repair procedures
    - Bleeding of the master cylinder

- Adjust brake pedal free play
- Types and function of hydraulic valves
    - proportional valve
    - metering valve
    - brake warning switch
    - combination valve

2. Remove, repair and replace drum type brakes
    - Removal and installation of brake drum
    - Removal of brake shoes
    - Lining condition and wear
    - Brake shoe arc
    - Method of attaching lining to shoe
    - Lubrication
    - Adjustments
        - minor and major
    - Measure drum for wear
    - Machine drum
    - Self-adjusting brakes
    - Automatic star wheels
    - Return springs
    - Identification of primary and secondary shoe
    - Backing plate

3. Remove, repair and replace wheel cylinders
    - Types of wheel cylinders
    - Removal and installation procedures
    - Identification of parts
    - Cleaning procedures
    - Repair procedures
    - Bleeding the system

4. Remove, repair and replace disc type brakes
    - Operating principle
    - Types
    - Component identification
    - Removal and installation of brake disc
    - Removal and installation of caliper
    - Recondition caliper
    - Check brake pad wear and contamination
    - Measure disc wear

- Machine brake disc

5. Remove, repair and replace parking brakes
   - Lever and fulcrum theory
   - Mechanical advantage
   - Application
   - Types and designs
     - external band
     - internal shoe
     - drive shaft type
     - wheel type
   - Parking brake lock mechanism
   - Adjustment

6. Remove, repair and replace brake lines
   - Brake lines
   - Fittings
   - Repair and replacement procedures
   - Safety rules to follow

7. Bleed brake systems
   - Types of fluids
   - Properties of fluids
   - Replacement of fluids
   - Bleeding methods
     - pressure
     - gravity
     - procedures for bleeding
   - Power boosters
     - hydraulic boost
     - vacuum

8. Diagnose hydraulic brake problems
   - Procedures to diagnose hydraulic brakes problems
     - brake pedal goes to floorboard
     - one brake drag
     - all brake drag
     - vehicle pulls to one side
     - soft or spongy pedal
     - poor braking action
     - brakes too sensitive

- noisy brakes
- air in system
- loss of brake fluid
- brakes do not self-adjust
- warning light comes on

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, repair and assemble a master cylinder.
- Disassemble, repair and assemble drum brakes.
- Disassemble, repair and assemble disc brakes.
- Machine drum and rotor.

SUGGESTED RESOURCES:

- Diesel Equipment I (Schulz).
- Auto Technology (Nash).
- Auto Service and Repair (Stockel).
- Heavy Equipment Repair (Nichols).
- Service manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1270 - Air Brakes

SUGGESTED DURATION: 60 hours

PREREQUISITES: SV1260

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, disassemble, repair, assemble and install air brake systems and components used in heavy equipment and truck and transport.

OVERVIEW OF OBJECTIVES:
1. Remove, repair and replace air compressors.
2. Remove, service and install reservoir.
3. Disassemble, repair and assemble air valves.
4. Inspect, repair or replace air chambers.
5. Remove, repair and install drum type brake.
6. Remove, service and install slack adjuster.
7. Service air dryer.
8. Remove, repair and install air over hydraulic chamber.
9. Diagnose air brake problems.

CONTENT:
1. Remove, repair and replace air compressors
    - Fundamentals of air brake systems
    - Air as a force multiplier
    - Major components of air brakes systems and functions
        - compressor
        - reservoir
        - valves
        - brake chamber
        - brake shoes and drums
        - indicator and warning devices
    - Compressors
        - types
        - classifications
        - operating principles
    - Removal and replacement procedures
    - Repair procedures

- Maintenance
- Troubleshooting

2. Remove, service and install reservoir
   - Types
     - dry
     - wet
   - Purpose
   - Classification
   - Safety valves
   - Repair procedures and caution

3. Disassemble, repair and assemble air valves
   - Operating principles of the following valves
     - foot valve
     - quick release valve
     - relay valve
     - hand valve
     - limiting valve
     - tractor protection valve
     - automatic reservoir drain valve
     - check valve (single and double)
   - Repair procedures

4. Inspect, repair or replace air chambers
   - Brake chamber
     - types and designs
     - functions
     - inter-relationship of mechanical components
     - principle of operations
     - adjustment methods and limitations
     - reconditioning procedures and precautions

5. Remove, repair and install drum type brake
   - Types
     - cam
     - wedge
   - Removal and installation procedures of brake drum
   - Removal of brake shoes
   - Check lining condition and wear
   - Sequence of bolting the brake lining to shoe

- Installation procedures of brake shoe to backing plate
- Lubrication

6. Remove, service and install slack adjuster
   - Types
     - manual
     - automatic
   - Operation
   - Servicing
   - Adjustment procedures

7. Service air dryer
   - Types
     - air dryer
     - alcohol evaporators
   - Purpose
   - Service procedures

8. Remove, repair and install air over hydraulic chamber
   - Air over hydraulic brakes
     - types and designs
     - principles of operation
     - recognition and function of major components
     - service procedures
     - cylinder reconditioning precautions
     - relationship to other hydraulic systems
     - repair procedures and caution
     - adjustments
   - Brake accumulator
     - purpose
     - types
     - precautions

9. Diagnose air brake problems
   - Procedures to diagnose air brakes problems
   - Reservoir leaking or water accumulation
   - Low or high air pressure
   - Frozen air lines
   - Camshaft and bushing wear
   - Poor braking performance, etc

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, repair and assemble air compressors.
- Disassemble, repair and assemble air valves.
- Disassemble, repair and assemble drum and disc brakes.
- Disassemble, repair and assemble air-packed (air over hydraulic unit).

SUGGESTED RESOURCES:

- Diesel Equipment I (Schulz).
- Air Brake Manual (Province of NB).
- Heavy Equipment Repair (Nichols).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2570 - Engine Brakes and Retarders

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1270

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service, repair and adjust engine brakes and retarders.

OVERVIEW OF OBJECTIVES:
1. Inspect, repair and adjust engine brakes.
2. Inspect, repair and adjust retarders.
3. Diagnose engine brakes and retarder problems.

CONTENT:
1. Inspect, repair and adjust engine brakes
    - Purpose of engine brakes
        - types
        - operation
        - components
        - electric circuit
    - Exhaust system compression brakes
        - types
        - operation
        - components
    - Maintenance recommendations
        - testing procedures
        - adjustment procedures
        - troubleshooting

2. Inspect, repair and adjust retarders
    - Types
    - Operation
    - Components
    - Hydraulic and electric circuits

3. Diagnose engine brakes and retarder problems
    - Maintenance recommendations

- Testing procedures
- Troubleshooting

SUGGESTED LEARNING ACTIVITIES:

- Service and adjust engine brakes.

SUGGESTED RESOURCES:

- Diesel Equipment I (Schulz).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1280 - Drive Lines

SUGGESTED DURATION: 30 hours

PREREQUISITES: IMP-1105

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, repair and install drive lines used on heavy equipment and truck and transport.

OVERVIEW OF OBJECTIVES:
1. Remove, repair and install drive lines.
2. Remove and install universal joints.
3. Remove and install center support bearing.
4. Diagnose drive shaft problems.

CONTENT:
1. Remove, repair and install drive lines
    - Purpose of drive lines
    - Types of drive lines
        - hotchkiss
        - rubber element
        - two-piece
    - Construction details
        - provision for balance
        - provision for variation in length
    - Removal and installation procedures

2. Remove and install universal joints
    - Purpose of universal joints
    - Types
        - cross and roller
        - constant-velocity
    - Limitations of U-joints
    - Removal and installation procedures
    - Provision for lubrication
    - Journal cross phasing
    - Shaft alignment
    - Shaft balancing

3. Remove and install center support bearing
    - Purpose
    - Types

4. Diagnose drive shaft problems
    - Procedures to diagnose faulty drive lines
        - vibrations
        - out of phasing
        - out of balance
        - angles limitations
        - common failures
        - manufacturer's specifications

SUGGESTED LEARNING ACTIVITIES:

- Remove and replace drive shaft, check phasing, alignment and shaft angle.
- Remove, service and install universal joint.

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- Automotive Service and Repair (Stockel).
- FOS Power Trains (Deere).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1300 - Engine Principles

SUGGESTED DURATION: 75 hours

PREREQUISITES: SV1190

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to be familiar with internal combustion engines and components.

OVERVIEW OF OBJECTIVES:
1. Identify and describe the components of engines.
2. Describe the operation of all major parts and their purpose within the engines.

CONTENT:
1. Identify and describe the components of engines
    - Engine operating theory
        - matter
        - mass
        - energy
        - inertia
        - force
        - momentum
        - torque
        - work
        - mechanical power
        - friction
        - combustion
        - atmospheric pressure
        - vacuum
        - laws of gases
            - Boyle's law
            - Charlie's law

2. Describe the operation of all major parts and their purpose within the engines
    - Principle of engine operation
        - stroke
        - bore
        - throw

- top dead center
- bottom dead center
- valve timing (diagram)
- firing order
- compression ratio
- volumetric efficiency
- mechanical efficiency
- reciprocating and rotating movement
- piston displacement
- clearance volume
- total volume
- scavenging
- engine clutches
- 2 strokes
- 4 strokes

- Horsepower
  - indicated HP
  - friction HP
  - flywheel or brake HP
  - drawbar HP
  - power take-off HP
  - rated HP
- Engine support system
  - cooling
  - lubrication
  - fuel
  - air intake
  - exhaust
- Cylinder head
- Valves
- Valve train
- Camshaft
- Cylinder block
- Sleeves
  - dry and wet
- Pistons
- Rings
- Connecting rod
- Crankshaft
- Bearings
- Lubrication pump

- Oil cooler
- Water pump
- Flywheel
- Intake manifold
- Exhaust manifold
- Valve arrangements
    - I head
    - H head
    - F head
    - L head
    - T head
- In line engine
- V-engine
- Overhead camshaft
- Cooling system
    - air
    - liquid
- Gasoline engine
- Diesel engine
- Combustion chambers design
    - open combustion
    - pre-combustion
    - turbulence combustion
    - energy cells
- Disassembly procedures of engine
- Procedures to measure engine dimensions
- Procedures to assemble engine
- Importance of following manufacturer's recommendations and specifications

SUGGESTED LEARNING ACTIVITIES:

SUGGESTED RESOURCES:

- FOS - Engines (Deere).
- Automotive Technology (Nash).
- Diesel Mechanics (Schulz).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2580 - Engine Removal and Installation

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1110 SV1190 SV1300

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove and reinstall engines according to manufacturer's recommended procedures.

OVERVIEW OF OBJECTIVES:
1. Remove an engine.
2. Inspect parts for wear.
3. Install engine.
4. Test engine operation.

CONTENT:
1. Remove an engine
    - Systems drainage
        - oil
        - coolant
        - hydraulic fluid (if applicable)
    - Disconnect and identify
        - electrical wires
        - hydraulic lines
    - Disconnecting engine from transmission
    - Supporting the transmission
    - Suitable engine hoist
    - Removing engine from chassis
    - Precautions
    - Following service manual recommendations

2. Inspect parts for wear
    - Inspect engine mounts
    - Check for loose or worn parts
    - Check linkages operation

3. Install engine
    - Installation procedures

- Importance of proper alignments of parts
- Torque attaching bolts
- Reconnect all attaching components
- Refill systems

4. Test engine operation
   - Start engine
   - Check oil pressure
   - Check for leaks
   - Check for abnormal noise
   - Check linkage operation
   - Follow manufacturer's recommendations

SUGGESTED LEARNING ACTIVITIES:

- Remove and reinstall an engine.

SUGGESTED RESOURCES:

- Diesel Mechanics (Schulz).
- Auto Service and Repair (Stoccel).
- Service Manual.
- Use appropriate audio-visual material where available.
- Reverse fan (Heavy Equipment only).

NAME AND NUMBER: SV1310 - Cooling Systems

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV2580

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service and repair engine cooling systems and components.

OVERVIEW OF OBJECTIVES:
1. Remove, repair and replace cooling systems.
2. Remove, service and replace radiators.
3. Remove, repair and replace water pump.
4. Remove, service and install thermostat.
5. Remove, service and install fans.
6. Drain, flush and refill the cooling systems.
7. Remove, repair and replace air cooling systems.
8. Service and repair cab heating systems.
9. Engine heater.
10. Diagnose cooling system problems.

CONTENT:
1. Remove, repair and replace cooling systems
    - Types of cooling systems
        - liquid cooled
        - air cooled
    - Purposes of cooling systems
    - Heat dissipation
        - convection
        - radiation
        - conduction
    - Cooling system components and functions
        - water pump
        - radiator
        - pressure caps
        - auxiliary tank
        - thermostat
        - fan

- fan drive
- water jackets
- shutterstat and control
- connecting pipes and hoses
- liquid or coolant
- filters and conditioners

2. Remove, service and replace radiators
   - Types of radiators
   - Construction
   - Removal procedures
   - Cleaning procedures
   - Installation procedures
   - Pressurizing the system using pressure tester
   - Construction of radiator caps

3. Remove, repair and replace water pump
   - Types of pumps
   - Construction
   - Removal procedures
   - Repair procedures
   - Installation procedures
   - Adjustment of belts

4. Remove, service and install thermostat
   - Types of thermostats
   - Construction
   - Opening temperature interpretation
   - Removal procedures
   - Testing procedures
   - Installation procedures

5. Remove, service and install fans
   - Types of fans
     - pusher
     - suction
     - application
     - viscous fan drive
     - thermatic fan drive
   - Removal procedures
   - Inspection

- Installation procedures

6. Drain, flush and refill the cooling systems
   - Drainage procedures
   - Flushing procedures
   - Refilling procedures
   - Antifreeze ratio mixtures
   - Recycling, storage, etc antifreeze
   - Methods of testing
     - ph
     - density
   - Conditioners

7. Remove, repair and replace air cooling systems
   - Shrouds
   - Fan
   - Thermostat application
   - Fan drive
   - Removal and installation procedures

8. Service and repair cab heating systems
   - Cab heating systems
     - types
     - principles of operation
     - recognition of components
     - heater controls
     - installation procedures
     - bleeding procedures

9. Engine heater
   - Types
     - block heaters
     - in line heaters
     - external sources
     - oil based heaters
   - Function
   - Installation procedures

10. Diagnose cooling system problems
    - Cooling system troubleshooting
      - overheating

- under heating
- external leakage
- internal leakage
- exhaust gas leakage
- restricted air flow
- defective thermostat
- rust and scale accumulation
- air in coolant
- worn or loose fan belt
- defective pressure cap

SUGGESTED LEARNING ACTIVITIES:

- Drain, flush and pressure test a cooling system.
- Remove, service and install a thermostat.
- Remove, repair and install a water pump.
- Check antifreeze strength in cooling systems.

SUGGESTED RESOURCES:

- FOS - Engines (Deere).
- Diesel Mechanics (Schulz).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1320 - Lubrication Systems

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1300

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service and repair engine lubrication system and components.

OVERVIEW OF OBJECTIVES:
1. Service and repair engine lubrication systems.
2. Service and repair engine oil pump.
3. Service and repair engine oil cooler.
4. Check engine oil pressure.
5. Diagnose lubrication system problems.

CONTENT:
1. Service and repair engine lubrication systems
    - Purpose of lubrication systems
    - Types of lubrication systems
        - splash
        - pressurized
        - by-pass
        - full flow
        - combination
    - Components of lubricating systems
        - oil pump
        - oil filter
        - oil cooler
        - oil pans
        - pressure regulating valve
        - oil filter by pass valve
        - oil cooler by pass valve
        - relief valve

2. Service and repair engine oil pump
    - Types of oil pumps
        - gears

        - rotor
    - Scavenging
    - Disassembly procedures
    - Inspecting and measuring pump wear
    - Following manufacturer's specifications
    - Reassembly procedures

3. Service and repair engine oil cooler
    - Disassembly procedures
    - Inspecting and testing oil cooler
    - Reassembly procedures

4. Check engine oil pressure
    - Installation of pressure gauge
    - Importance of engine operating temperature
    - Checking pressure at low and high speed
    - Following manufacturer's recommendations

5. Diagnose lubrication system problems
    - Lubrication system troubleshooting
        - low oil pressure
        - high oil pressure
        - interpretation of oil contaminants
        - excessive oil consumption
        - oil leakage

SUGGESTED LEARNING ACTIVITIES:

- Repair and install an engine oil pump.
- Check engine oil pressure on an engine.

SUGGESTED RESOURCES:

- FOS - Engines (Deere).
- Diesel Mechanics (Schulz).
- Auto Service and Repair (Stockel).
- Service Manual.

NAME AND NUMBER: SV1330 - Air Filtration and Exhaust Systems

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1300 WD2320

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, service and install engine air cleaners and exhaust systems used on heavy equipment and truck and transport.

OVERVIEW OF OBJECTIVES:
1. Remove, service and replace air filtration systems.
2. Remove, service and install air cleaners.
3. Service and repair exhaust systems.
4. Test for and diagnose problems in air filtration and exhaust systems.

CONTENT:
1. Remove, service and replace air filtration systems
    - Construction of air cleaning systems
    - Purpose of air cleaning systems
    - Types and designs
        - dry types
        - wet types
    - Air cleaner system components
        - air filter
        - safety filter
        - spiral rotor air cleaner (Donaclone)
        - air silencers
        - pre-cleaner
        - restriction indicator
        - crankcase ventilation system

2. Remove, service and install air cleaners
    - Dry type
        - element removal procedures
        - applicable cleaning procedures
        - inspection
        - importance of following manufacturer's specifications
        - importance of cleanliness

    - installation procedures
- Wet type
    - removal procedures
    - cleaning procedures
    - importance of using proper grade of oil
    - installation procedures

3. Service and repair exhaust systems
    - Exhaust system components
        - muffler
        - rain trap
        - spark arrestors
        - manifold
        - pipes
        - clamps and hangers
        - heat control valves
        - catalytic converters
    - Removal procedures of components
        - muffler
        - rain trap
        - exhaust manifold
    - Proper alignment of mating parts
    - Check operation of heat control valve (if applicable)
    - Installation procedures

4. Test for and diagnose problems in air filtration and exhaust systems
    - Air flow restricted
    - Air intake leaks
    - Too much crankcase pressure
    - Exhaust system leaks and restriction
    - Abnormal exhaust noise
    - Check intake restriction
    - Pressure measurement methods

SUGGESTED LEARNING ACTIVITIES:

- Service dry and wet type air cleaner.
- Inspect, repair or replace exhaust system and related components.
- Check intake restrictions using manometers.

SUGGESTED RESOURCES:

- FOS - Engines (Deere).

- Diesel Mechanics (Schulz).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2590 - Turbochargers, Blowers and Intercoolers

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1320

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, service or repair and install engine turbochargers, blowers and intercoolers used on Diesel engines.

OVERVIEW OF OBJECTIVES:
1. Remove, service and install turbochargers.
2. Remove, service and install blowers.
3. Remove, service and install intercoolers.

CONTENT:
1. Remove, service and install turbochargers.
    - Construction of turbochargers
    - Purpose of turbocharger
    - Types and designs
        - single stage
        - two stage
        - altitude compensators
    - Action in turbochargers
    - Components of turbochargers
        - turbine
        - compressor
        - shaft
        - bearings
        - seals
        - housing
    - Removal procedures
    - Inspection and tolerance checks
    - Installation procedures
    - Diagnosing turbochargers problems

2. Remove, service and install blowers.
    - Construction of blowers
    - Purpose of the blower

- Types and designs
  - centrifugal type
  - roots type
- Action in blower
- Removal procedures
- Inspection and tolerance checks
- Installation procedures
- Diagnosing blower problems

3. Remove, service and install intercoolers
   - Construction of intercoolers
   - Purpose of the intercoolers
   - Types and designs
     - air to coolant
     - air to air
   - Removal procedures
   - Service checks
   - Installation procedures
   - Diagnosing intercoolers problems

SUGGESTED LEARNING ACTIVITIES:

- Remove, inspect and install a turbocharger.
- Disassemble, repair and assemble a blower.

SUGGESTED RESOURCES:

- Diesel Mechanics (Schulz).
- FOS - Engines (Deere).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2600 - Diesel Engine Overhauling

SUGGESTED DURATION: 90 hours

PREREQUISITES: SV1310 SV1330 SV2590

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to disassemble, inspect, repair and assemble Diesel engines.

OVERVIEW OF OBJECTIVES:
1. Disassemble, inspect, repair and assemble Diesel engines.
2. Start and run engine.

CONTENT:
1. Disassemble, inspect, repair and assemble Diesel engines
    - Engine disassembly procedures
    - Disassembly, checking and repair of the following components
    - Cylinder head service
        - valves
        - valves protrusion
        - injector tube service
    - Pre-combustion chamber service
    - Fuel galleries
        - seats
        - guides
        - springs
        - rotators
        - pressure testing cylinder head
        - warpage
        - crack detection
    - Valve train service
        - rocker arm
        - rocker arm shaft
        - valve bridge
        - push rods
        - cam follower
        - gear train
    - Cylinder block service

- cleaning and inspection
- removal procedures of dry and wet sleeves
- check sleeve wear
- ridge removal
- de-glazing cylinder walls
- honing cylinder walls
- checking sleeve protrusion
- checking main bearing caps and bores
- checking camshaft bores

- Crankshaft and bearing service
  - inspecting and measuring for wear
  - remove and install crankshaft, bearing and bushing
- Camshaft and bearing service
  - inspecting and measuring for wear
- Piston and connecting rod service
  - piston wear or damage
  - rings wear
  - piston pin wear
  - connecting rod bend or damage
  - rebuilt connecting rods
- Engine assembly procedures
  - torque
  - valve timing
- Oil pump service
  - measuring all parts for wear and repairing to manufacturer's specifications

2. Start and run engine
   - Reconnecting all components
   - Refilling systems with oil and coolant
   - Pre-start check points
     - fluid level
     - fluid leaks
     - belt tension
     - emergency shut-off
     - safety
   - Starting engine and checking
     - oil pressure
     - water temperature
     - fluid leaks
     - abnormal noise
   - Disassembly procedures of engine

- Procedures to measure engine dimensions
- Procedures to assemble engine
- Importance of following manufacturer's recommendations and specifications
- Fitting Bearings
  - main
  - thrust
  - connecting rods
- Replace camshaft bushings
- Cylinder block boring
- Re-condition cylinder head
  - check for straightness
  - check for cracks
  - replace injector tubes
  - reface valves
- Check crankshaft
- Recondition connecting rods

SUGGESTED LEARNING ACTIVITIES:

- Overhaul Diesel engine.

SUGGESTED RESOURCES:

- Diesel Mechanics (Schulz).
- FOS - Engines (Deere).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2610 - Diesel Engine Problems Diagnosis

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV2600

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to evaluate and diagnose Diesel engine problems and conditions.

OVERVIEW OF OBJECTIVES:
1. Diagnose Diesel engine problems and conditions.

CONTENT:
1. Diagnose Diesel engine problems and conditions
    - Basic steps in diagnosing engine problems
        - know the system
        - ask the operator
        - inspect the engine
        - operate the engine
        - list the possible causes
        - reach a conclusion
        - test your conclusion
    - Leak down test
        - compression test
        - cranking speed test
    - Engine noise and knock interpretations
        - rod bearings
        - main bearings
        - piston noises
        - valves
        - timing gears
        - wrist pin
    - Lack of power
    - Excessive vibration
    - Engine starting problems
    - Oil pressure too low
    - Oil pressure too high
    - High oil consumption

- Crankcase oil dilution
- Engine overheating
- Exhaust smoke interpretations
    - black smoke
    - blue smoke
    - white smoke

SUGGESTED LEARNING ACTIVITIES:

- With appropriate test equipment, check the following items on diesel engine
    - Cylinder compression
    - Exhaust back pressure
    - Crankcase pressure
    - Air intake pressure

SUGGESTED RESOURCES:

- Diesel Mechanics (Schulz).
- FOS - Engines (Deere).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1340 - Gasoline Fuel Systems

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1130 SV1330

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this course, the apprentice will be able to diagnose, service and repair gasoline fuel supply system and carburetors used on gasoline engines.

OVERVIEW OF OBJECTIVES:
1. Service and repair reservoir and fuel lines.
2. Service and repair fuel transfer pump.
3. Test fuel pump performance.
4. Remove, repair and replace carburetors.
5. Diagnose problem in gasoline fuel systems.
6. Describe the operation of governors and service them.

CONTENT:
1. Service and repair reservoir and fuel lines
    - Properties of gasoline
        - volatility
        - antiknock value
        - combustion process
        - octane rating
        - chemical control of detonation
        - fuel additives
    - Safety precautions when handling gasoline
        - danger of explosion
        - storage
    - Reservoir
        - location and arrangement
        - removal and replacement
        - repair procedures and precautions
        - inspect tank for leaks
    - Fuel lines
        - types
        - fittings
        - removal and installation procedures

- repair procedures

2. Service and repair fuel transfer pump
   - Types of transfer pumps
     - mechanical
     - electric
   - Removal procedures from engine
   - Disassembly of pump (if applicable)
   - Identification of parts
   - Reassembly procedures

3. Test fuel pump performance
   - Pressure
   - Vacuum
   - Volume
   - Removal procedures
   - Importance of cleanliness
   - Installation procedures

4. Remove, repair and replace carburetors
   - Principles of carburation
     - effect of venturi
     - atomization
     - evaporation
     - vaporization
   - Types of carburetors
     - single barrel
     - two barrel
     - four barrel
     - down draft carburetor
     - updraft carburetor
     - side draft carburetor
   - Carburetor circuits
     - float circuit
     - idle circuit
     - low-speed circuit
     - high-speed circuit or main metering circuit
     - acceleration circuit
     - choke circuit

5. Diagnose problem in gasoline fuel systems
    - Low fuel pump pressure
    - Low fuel pump volume
    - Flooding
    - Choke malfunctioning
    - Hard starting
    - Loss of power
    - Poor economy
    - Poor idling
    - Poor acceleration
    - Fuel lines restriction or leaking
    - Clogged fuel filters
    - Defective speed control linkage

6. Describe the operation of governors and service them
    - Purpose
    - Type
        - mechanical
        - electronic
        - pneumatic
    - Adjustment

SUGGESTED LEARNING ACTIVITIES:

- Check transfer pump performance
    - pressure
    - vacuum
    - delivery
- Disassemble, repair and assemble carburetors

SUGGESTED RESOURCES:

- Auto Technology (Nash).
- Auto Service and Repair (Stockel).
- FOS - Engines - (Deere)
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1350 - Alternative Fuel Systems

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1340

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service, inspect and perform minor repairs on LPG systems.

OVERVIEW OF OBJECTIVES:
1. Service and repair LPG systems.
2. Diagnose LPG system problems.
3. Identify regulations related to fuel systems.

CONTENT:
1. Service and repair LPG systems
    - Special type of fuel
        - combustion temperature
    - Principles of operation of LPG systems
    - Advantages and disadvantages of LPG
    - Relationship to engine timing
    - Safety rules in handling LPG
    - Liquid withdrawal system
    - Vapor withdrawal system
    - LPG components
        - tank
        - filter
        - converter
        - carburetor
        - safety valve
        - filler valve
        - liquid level gauge
        - fuel lines and fittings
    - Repair or service
        - converter
        - carburetor
        - safety valves
    - Check system for leaks

- Adjust engine timing
- Importance of following manufacturer's recommendations

2. Diagnose LPG system problems
   - LPG troubleshooting
     - hard starting
     - loss of power
     - poor economy
     - freeze-up of converter
     - frost on fuel strainer
     - rough idling
     - overheating

3. Identify regulations related to fuel systems
   - Location of tanks
   - Manufacturing hoses
   - Provincial
   - Federal

SUGGESTED LEARNING ACTIVITIES:

- Check and service the convertor and carburetor of a LPG engine.
- Adjust timing of a LPG engine.
- Check system for leak.

SUGGESTED RESOURCES:

- FOS - Engines (Deere).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1360 - Diesel Fuel Supply Systems

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1340

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this course, the apprentice will be able to service, inspect and repair Diesel fuel supply systems.

OVERVIEW OF OBJECTIVES:
1. Service and repair fuel tank and fuel lines.
2. Use proper fuel storage and handling techniques.
3. Remove, service and install fuel filter.
4. Service and repair fuel transfer pump.
5. Test fuel pump performance.

CONTENT:
1. Service and repair fuel tank and fuel lines
    - Properties of diesel fuel
    - Fuel classification
        - certain number
        - specific gravity testing
        - viscosity
        - flash point
        - pour point
        - sulfur
        - volatility
        - carbon residue
        - fuel additives
        - interpretation of fuel specifications
        - summer and winter fuel
    - Tank
        - location and arrangement
        - removal and replacement procedures
        - repair procedures and precautions
        - inspecting tank for leaks
        - design and material

- Fuel lines
  - types
  - fittings
  - removal and installation procedures
  - repair procedures

2. Use proper fuel storage and handling techniques
   - Storage practices to prevent fuel contamination
   - Precautions
   - Safety measures

3. Remove, service and install fuel filter
   - Filters
     - types
     - functions
     - restriction indicator
     - water indicator
     - water separators
     - limitations of filters
     - location
     - service procedures
     - filling and bleeding procedures
   - Fuel heater and filter
     - removal procedures
     - design
     - testing
   - Importance of cleanliness
   - Installation procedures
   - Bleeding the system

4. Service and repair fuel transfer pump
   - Fuel transfer pump
     - type
       - mechanical
       - electrical
     - location
     - testing
     - removal
   - Disassembly of pump (if applicable)
   - Identification of parts
   - Reassembly procedures

5. Test fuel pump performance
    - Procedures to test pump performance
        - pressure
        - vacuum
        - delivery volume

SUGGESTED LEARNING ACTIVITIES:

- Check transfer pump performance
    - pressure
    - vacuum
    - delivery
- Change fuel filters, bleed system and start engine.

SUGGESTED RESOURCES:

- Diesel Mechanics (Schulz).
- FOS - Engines (Deere).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2620 - Injectors

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1360

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, test, rebuild, service and install injectors used on Diesel engine.

OVERVIEW OF OBJECTIVES:
1. Remove, rebuild and install injectors.
2. Test injector operation.
3. Remove and install fuel injection lines and connections.

CONTENT:
1. Remove, rebuild and install injectors
    - Related safety precautions
        - fuel impregnates skin
    - Principles of operation of injectors
        - timing
            - mechanical
            - electronic
        - atomization
        - metering
    - Types
        - electronic unit injectors
        - hydraulic actuated
        - unit injectors
        - pressure timed injectors
    - Nozzle holder
    - Types of injection nozzles
        - purpose
    - Injector action
    - Removal and installation procedures of injectors
    - Methods of timing
        - pressure timed injectors
        - style of injectors
            - unit

- Adjustment

2. Test injector operation
   - Testing the injector
     - opening pressure
     - closing pressure
     - valve seat test
     - back leakage test
     - spray pattern test
     - needle valve lift test
     - adjustment procedures
     - importance of cleanliness
   - Locating faulty injector

3. Remove and install fuel injection lines and connections
   - Types
   - Tensile strength
   - Bend radius recommendations
   - Removal and installation procedures
   - Connectors
   - Flares

SUGGESTED LEARNING ACTIVITIES:

- Remove and install injectors on a Diesel engine.
- With an injector tester, check and adjust the following on the injector
  - opening and closing pressure
  - valve seat test
  - back leakage test
  - spray pattern

SUGGESTED RESOURCES:

- Diesel Mechanics (Schulz).
- FOS - Engines (Deere).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2630 - Injection Pumps

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1360

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, install, time and adjust low and high idle on Diesel fuel injection pump.

OVERVIEW OF OBJECTIVES:
1. Remove and install fuel injection pump and perform timing.
2. Adjust engine low and high idle speed.

CONTENT:
1. Remove and install fuel injection pump and perform timing
    - Related safety precautions
        - fuel impregnating skin
        - cleanliness
        - manufacturer's specifications
    - Basic principal of operation of the following injection systems
        - in-line pump
        - distributor pump
        - unit injection system
        - pressure time pump
    - Metering principles
        - port and helix design
        - sleeves metering design
    - Governors (diesel application)
        - types and designs
            - mechanical
            - hydraulic
            - pneumatic
            - servo
            - electronic
    - Limiting speed governor
    - Variable speed governor
    - Knowledge of phasing calibrating

- Timing procedures
  - electronic
  - static
  - skill
- Bleeding the system
- Governor terminology
  - low-idle speed
  - high-idle speed
  - droop speed
  - maximum torque speed
  - torque range speed
  - overspeed
  - governor cut-off speed
  - sensitivity
  - momentary speed
  - hunting
  - stability
  - hysterisis
  - speed regulation
- Minor repair and adjustment procedures
- Lubrication recommendation
- Shut-off
  - mechanical
  - electrical
- Removal and installation procedures for fuel injection pumps

2. Adjust engine low and high idle speed
   - Adjusting low and high idle speed procedures

SUGGESTED RESOURCES:

- Diesel Mechanics (Schulz).
- FOS - Engines (Deere).
- Service Manual.
- Use appropriate audio-visual material where available.

SUGGESTED LEARNING ACTIVITIES:

- Remove and install an injection pump and start engine.
- Check/adjust low and high idle speed on a Diesel engine.

NAME AND NUMBER: SV2640 - Tune Ups and Diagnosis of Diesel Fuel Systems

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV2570 SV2630

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to perform a complete tune-up and diagnose problems on Diesel fuel systems.

OVERVIEW OF OBJECTIVES:
1. Perform tune-up on Diesel engine.
2. Check engine system pressure.
3. Diagnose fuel system problems.

CONTENT:
1. Perform tune-up on Diesel engine
    - Tune-up procedures
    - Tune-up intervals
    - Visual inspection of the engine
    - Preliminary check
        - air cleaner condition
        - belt tension
        - battery condition
        - oil and coolant level
    - Check following systems
        - air restriction
        - exhaust restriction
        - crankcase blow-by
        - boost pressure
    - Procedures to adjust the following components
        - valve bridge
        - valve lash
        - injectors timing
        - governor gap
        - injector racks
        - no load speed
        - idle speed
        - buffer screw

- injector
    - timing
    - pressure timing

2. Check engine system pressure
    - Checking system pressure with manometer
        - air restriction
        - exhaust restriction
        - crankcase blow-by
        - boost pressure
        - air box pressure

3. Diagnose fuel system problems
    - Evaluation of engine performance
        - trouble first noticeable
        - similar problems recorded
        - unusual noise
        - trouble noticeable at all speed
        - respond to acceleration or deceleration
        - poor idling
        - hard starting
        - excessive fuel consumption
    - Checking fuel lines for leaks or restrictions
    - Checking condition of fuel filters
    - Checking speed control linkage
    - Testing fuel transfer pump performance
        - pressure
        - vacuum
        - delivery
    - Diesel exhaust smoke analysis
        - black
        - white
        - blue

SUGGESTED LEARNING ACTIVITIES:

- Perform a complete tune-up.
- With appropriate test equipment, check
    - air restriction
    - exhaust restriction
    - crankcase blow-by
    - boost pressure

SUGGESTED RESOURCES:

- Diesel Mechanics (Schulz).
- FOS - Engines (Deere).
- Service Manual.
- Use appropriate audio-visual where available.

NAME AND NUMBER: SV2650 - Electronic Fuel Control Systems

SUGGESTED DURATION: 60 hours

PREREQUISITES: SV1130 SV2620 SV2640 SV2680

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service, inspect and repair electronic fuel control system on Diesel engines.

OVERVIEW OF OBJECTIVES:
1. Service, inspect and repair or replace electronic engine control systems.

CONTENT:
1. Service, inspect and repair or replace electronic engine control systems\
    - Types of electronic control systems
    - Advantages of electronic engine control systems
    - Electronic engine control components
        - control module
        - throttle sensor
        - fuel rack sensor
        - fuel rack actuator
        - variable timing sensor
        - variable timing actuator
        - vehicle speed sensor
        - clutch and brake switch
        - electronic unit injectors
        - electronic distributor unit
        - Huei systems
    - Procedures for using electronic control analyzer programmer
    - Importance of following manufacturer's recommendations

SUGGESTED LEARNING ACTIVITIES:
- With appropriate test equipment, service electronic engine control system to manufacturer's specification.

SUGGESTED RESOURCES:
- Diesel Mechanics (Schulz).
- Service Manual.

- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1370 - Batteries

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1100 SV1110 SV1130 SV1180 TS1510 TS1530

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, service, charge and install batteries used on heavy equipment and truck and transport.

OVERVIEW OF OBJECTIVES:
1. Remove and install batteries.
2. Identify battery connections.
3. Perform battery test.
4. Recharge battery.
5. Replace battery cable and/or terminals.
6. Start engine with booster battery.
7. Diagnose battery problems.

CONTENT:
1. Remove and install batteries
    - Safety rules when working with battery
    - Storage of Batteries
    - Battery construction
        - positive plates
        - negatives plates
        - separators
        - electrolyte
        - chemical action
        - terminals
    - Chemical action when discharging
    - Chemical action when charging
    - Sulfated battery
    - Maintenance free battery
    - Temperature effects on battery
    - Battery polarity
    - Battery ratings
        - cold power rating
        - reserve capacity rating

- Battery selection
- Procedures to remove and install battery cables
- Terminal pullers
- Hold down clamp
- Battery maintenance
    - procedures to clean battery
    - battery inspection
    - electrolyte level
    - cell replacement

2. Identify battery connections
    - Battery circuit connections
        - parallel circuits
        - series circuits
        - series parallel circuits

3. Perform battery test
    - Battery test
        - hydrometer test
        - electrolyte - Integrohydrometer
            - specific gravity variation
        - parasytic draw
        - light-load test
        - high-discharge test
        - cold cranking test
        - reserve capacity test
    - Correcting specific gravity readings to allow for temperature

4. Recharge battery
    - Types of chargers
        - slow charge method
        - fast charge method
        - trickle charging
        - battery temperature precautions
        - importance of good ventilation
        - safety precautions with highly explosive gases

5. Replace battery cable and/or terminals
    - Types of cable terminals
    - Cable size selection
    - Methods of fastening terminals to cable (soldered and crimped)

- Importance of installing corrosive inhibitor over terminals
- Voltage drop test

6. Start engine with booster battery
   - Importance of proper booster cables
   - Proper polarity and connections
   - Parallel connections
   - Series connections
   - Protective glasses
   - Safety precautions

7. Diagnose battery problems
   - Affects on battery life
     - electrolyte level
     - overcharging
     - undercharging
     - cycling
   - Battery hold-down loose or too tight
   - Corroded terminals
   - Frayed or broken cables
   - Cracked case
   - Voltage drop test

SUGGESTED LEARNING ACTIVITIES:

- Remove, service, test and install battery.
- Hook up for slow and fast charging 12 and 24 volts.
- Replace terminals on battery cables.
- Start an engine using booster batteries.

SUGGESTED RESOURCES:

- FOS - Electrical (Deere).
- Diesel Mechanics (Schulz).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1380 - Starting Systems

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1370

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to disassemble, test, repair and assemble starting motors and components.

OVERVIEW OF OBJECTIVES:
1. Disassemble, test, repair and assemble starting motors.
2. Test starter and circuit performance.
3. Diagnose starting system problems.
4. Service and repair air starting systems.
5. Service and repair hydraulic starting systems.
6. Service and repair starting aid components and functions.

CONTENT:
1. Disassemble, test, repair and assemble starting motors
    - Principles of operation of starting motor
    - Identification of parts
        - solenoid
        - drive mechanism
        - armature
        - field coil
        - pole shoe
        - commutator
        - brushes and holders
    - Types of starters
        - permanent magnet
        - electric
        - four poles - two coils
        - four poles - four coils
        - six poles - six coils
        - parallel wound
        - series wound
        - compound wound
        - 12 volt high out-put

        - air
        - hydraulic
    - Types of starter drive
        - bendix
        - overrunning clutch
        - dyer
        - follow thru
        - sprag
        - positork
        - friction-clutch
    - Types of starter switches
        - magnetic switch
        - solenoid switch
        - series-parallel switch
    - Disassembly procedures of starting motor
    - Cleaning procedures
    - Armature test
    - Field coil test
    - Solenoid test
    - Checking brushes
    - Checking bushings
    - Resurfacing commutator
    - Reassembly procedures
    - Pinion clearance check

2. Test starter and circuit performance
    - No load test
    - Torque test
    - Amperage draw test
    - Voltage drop test

3. Diagnose starting system problems
    - Engine will not crank
    - Engine cranks slowly
    - Starter turns but will not engage
    - Starter makes excessive noise

4. Service and repair air starting systems
    - Air motor starting systems
        - circuitry
            - valve

        - supply systems
    - principles of operation
    - applications (RPM)
    - types of motor
    - drive mechanisms
    - maintenance procedures
    - operational hazards and precautions
    - lubrication provisions

5. Service and repair hydraulic starting systems
    - Hydraulic starting systems
        - hydraulic circuitry
            - valve
            - supply systems
        - principles of operation
        - type(s) of motors
        - relationship to other hydraulic systems
        - major components and functions
        - drive mechanisms
        - cooling and lubrication provisions

6. Service and repair starting aid components and functions
    - Glow plugs
    - Intake manifold heater
    - Fluid starting aids
    - Block heater
    - Battery warmer
    - Booster battery

SUGGESTED LEARNING ACTIVITIES:

- Remove, disassemble, test, repair and assemble 12 volts starter.
- Remove, disassemble, test, repair and assemble heavy duty 24 volts starter.
- With appropriate test equipment make the following tests on starting circuit
    - voltage drop
    - amperage draw

SUGGESTED RESOURCES:

- Diesel Mechanics (Schulz).
- FOS - Electrical (Deere).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1390 - Charging System Components

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1370

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to disassemble, test, repair and assemble charging systems and components.

OVERVIEW OF OBJECTIVES:
1. Disassemble, test, repair and assemble alternator.
2. Test alternator performance.
3. Diagnose charging system problems.

CONTENT:
1. Disassemble, test, repair and assemble alternator
    - Basic Charging Systems
    - Principles of operation of alternators
    - Identification of parts
        - stator
        - rotor
        - diodes
        - rectifier bridge
        - diode trio
        - brushes
    - Types and functions of regulators
        - mechanical regulator
        - transistorized regulator
        - remote mounted regulator
        - integral type regulator
    - Types of alternators
        - brushless alternator
        - 24 volt alternator
        - 12/24 volt alternator
        - oil cooled alternator
    - Disassembly procedures of alternator
        - internal circuitry
        - stator test

- rotor test
- diodes test
- regulator test
- checking bearings condition
- checking slip ring condition
- cleaning procedures
- reassembly procedures

2. Test alternator performance
   - Alternator output test
     - voltage
     - amperage
     - appropriate testing equipment

3. Diagnose charging system problems
   - No alternator output
   - Low alternator output
   - High alternator output
   - Noisy alternator
   - Battery uses too much water

SUGGESTED LEARNING ACTIVITIES:

- Remove, disassemble, test, repair and assemble an alternator.
- With appropriate test equipment, check alternator output (amperage and voltage).
- Check and adjust alternator belt tension.

SUGGESTED RESOURCES:

- Diesel Mechanics (Schulz).
- FOS - Electrical (Deere).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2660 - Ignition Systems and Tune-Ups

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1300 SV1340 SV1350 SV1370

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to check and test ignition system components and perform tune-ups on gasoline engines.

OVERVIEW OF OBJECTIVES:
1. Check and test components of ignition systems (electronic).
2. Remove, service and install spark plugs.
3. Perform a complete tune-up on a gasoline engine.
4. Diagnose ignition system problems.

CONTENT:
1. Check and test components of ignition systems (electronic)
    - Principles of operation of ignition systems
    - Components
        - types of trigoring devices
            - LAD
            - Hall effects
        - magnetic
        - reluctor
        - control unit
        - distributor
        - rotor
        - coil
    - Check and test condition of the following components
        - pick-up coil
        - control unit
        - ignition coil
        - distributor cap
        - rotor

2. Remove, service and install spark plugs
    - Construction of spark plug
    - Types

- Heat range
- Removal procedures
- Cleaning procedures
- Inspections
- Gapping
- Testing
- Installation procedures

3. Perform a complete tune-up on a gasoline engine
   - Types
   - Testing procedures
   - Tune-up procedures
   - Tune-up intervals
   - Visual inspection of the engine
   - Check air intake system
   - Check engine compression
   - Adjust ignition timing

4. Diagnose ignition system problems
   - No spark at plugs
   - Weak or intermittent spark at plugs
   - Missing at idle or low speed
   - Missing during acceleration
   - Missing at all speeds
   - Coil failure
   - Short spark plug life
   - Pre-ignition
   - Detonation
   - Back fire in intake manifold
   - Back fire in exhaust manifold

SUGGESTED LEARNING ACTIVITIES:

- Check and test high tension leads.
- Perform a complete tune-up on a gasoline engine.

SUGGESTED RESOURCES:

NAME AND NUMBER: SV2670 - Air Conditioning Systems

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1110 SV1130 SV1190 SV1310

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service, inspect and repair air conditioning systems used on heavy equipment and truck and transport.

OVERVIEW OF OBJECTIVES:
1. Service, inspect and repair air conditioning systems.
2. Diagnose air conditioning problems.

CONTENT:
1. Service, inspect and repair air conditioning systems
    - Principles of refrigeration
        - liquid
        - gas
        - state of matter
        - pressure and heat
        - conduction
        - convection
        - radiation
        - refrigerants (freon)
    - Refrigeration cycle
        - compression
        - condensation
        - expansion
        - evaporation
    - Components of air conditioning systems
        - compressor
        - condenser
        - expansion valve, orifice tubes
        - evaporator
        - lines and connections
        - refrigerants and oil
        - principles of operation of major components
    - Air conditioing service tools

- vacuum pump
- charging hose
- gauge and manifold set
- thermometer
- refrigerant dispensing valve
- leak detector
- goggles

- Servicing the system
  - discharging the system
  - evacuating system using vacuum pump
  - safety rules when handling refrigerants
- Purging the system
- Charging the system
- Checking the system for leaks
- Checking and adding oil to reciprocating piston compressors
- Checking and adding oil to axial piston compressors

2. Diagnose air conditioning problems
   - Main categories of problems
     - electrical
     - mechanical
     - refrigeration
   - System produces no cooling
   - System will not produce sufficient cooling
   - System cools intermittently
   - System too noisy

SUGGESTED LEARNING ACTIVITIES:

- Check, remove and replace components of an air conditioning system.

SUGGESTED RESOURCES:

- FOS - Air Conditioning (Deere).
- Diesel Equipment II (Schulz).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2310 - Electric Brakes

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1130 SV1270

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service, repair and adjust electric brake systems.

OVERVIEW OF OBJECTIVES:
1. Inspect, repair and adjust electric brakes.
2. Diagnose electric brake problems.

CONTENT:
1. Inspect, repair and adjust electric brakes
    - Electric brake systems
        - principles of operation
    - Electro-mechanical actuating mechanical components
        - armature
        - magnet
    - Recognition and function of major components
        - rheostat control

2. Diagnose electric brake problems
    - Procedures to diagnose electrical brakes problems
        - broken wiring
        - malfunctioning solenoid
        - lining and drum wear
        - maintenance procedures
        - troubleshooting

SUGGESTED LEARNING ACTIVITIES:
- Theory only.

SUGGESTED RESOURCES:
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2320 - Manual Transmission Removal and Installation

SUGGESTED DURATION: 45 hours

PREREQUISITES: SV1280

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove and install manual transmission used on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Remove manual transmission.
2. Inspect parts for wear.
3. Install transmission.
4. Test transmission operation.

CONTENT:
1. Remove manual transmission
    - Removal procedures
        - drain transmission fluid
        - disconnect attaching parts
        - disconnect propeller shaft
        - use suitable lifting devices
        - importance of guide pins
        - follow service manual recommendations

2. Inspect parts for wear
    - Inspect transmission mounts
    - Check for loose or worn parts
    - Check shiftings linkage
    - Check for oil leaks

3. Install transmission
    - Installation procedures
        - importance of proper alignment of parts
        - torque attaching bolts
        - reconnect all attaching components
        - refill transmission fluid
        - follow service manual recommendations

4. Test transmission operation
    - Test drive transmission operation
    - Check transmission in all operation range
    - Check for abnormal noise
    - Check for oil leaks

SUGGESTED LEARNING ACTIVITIES:

- Remove and install a manual transmission.

SUGGESTED RESOURCES:

- Heavy Equipment Repair (Nichols).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2330 - Clutches

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV2320

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, repair, install and adjust clutches used on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Remove, check, repair and install clutch assembly.
2. Disassemble, repair and assemble pressure plate assembly.
3. Remove, check and replace release bearing.
4. Remove, check and replace pilot bearing.
5. Remove, check and replace clutch brakes.
6. Check and repair clutch operating mechanism.
7. Install clutch assembly.
8. Diagnose clutch problems.

CONTENT:
1. Remove, check, repair and install clutch assembly
    - Principles of operation
    - Types and designs
        - single disk
        - double disk
        - multidisk
        - external band clutch
        - internal band clutch
        - over center clutch
    - Clutch disc
        - facing (asbestos & ceramic)
        - cushion springs
        - torsion springs
        - splines
    - Removal and installation procedures
    - Inspection
    - Safety precautions when working with asbestos

2. Disassemble, repair and assemble pressure plate assembly
   - Types of pressure plate
     - coil spring
     - diaphragm spring
     - angle spring
   - Disassembly procedures
   - Inspection
   - Assembly procedures

3. Remove, check and replace release bearing
   - Release bearing and mechanism
     - purpose
     - types
     - lubrication and recommendations
   - Removal and installation procedures
   - Inspection

4. Remove, check and replace pilot bearing
   - Pilot bearing
     - purpose
     - types
     - lubrication recommendations
   - Removal and installation procedures
   - Inspection

5. Remove, check and replace clutch brakes
   - Clutch brakes
     - purpose
     - types
   - Removal and installation procedures
   - Inspection

6. Check and repair clutch operating mechanism
   - Clutch operating mechanism
     - mechanical
     - hydraulic
     - pneumatic
   - Inspection for wear

7. Install clutch assembly
   - Installation procedures

- Check fly-wheel run-out
- Check clutch housing run-out
- Check clutch shaft condition
- Importance of disc alignment
- Pedal free play adjustments
- Clutch brake adjustments
- Recommended lubrication for pilot and release bearing

8. Diagnose clutch problems
   - Basic clutch troubleshooting
     - slipping
     - chattering
     - vibrations
     - grabbing
     - dragging
     - rattles
     - squeaks
     - failure

SUGGESTED LEARNING ACTIVITIES:

- Remove, repair, install and adjust clutch assembly in a vehicle

SUGGESTED RESOURCES:

- FOS - Power Trains (Deere).
- Diesel Equipment II (Schulz).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2340 - Manual Transmission Service and Repair

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV2320

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to disassemble, repair and assemble manual transmission.

OVERVIEW OF OBJECTIVES:
1. Disassemble, repair and assemble a manual transmission.
2. Check and service other types of transmissions.
3. Disassemble, repair and assemble transfer drives.
4. Remove, repair and install power take offs.
5. Diagnose problems in manual transmissions.

CONTENT:
1. Disassemble, repair and assemble a manual transmission
    - Principles of operation
        - mechanical advantages
        - gear ratio
        - types of gears
        - gears terminology
        - power flow
    - Types of transmission
        - sliding gear
        - collar shift
        - synchromesh
    - Transmission components
        - shaft
        - gears
        - bearings
        - seals
        - synchronizers
        - shifter rail and forks
        - shift controls
        - shift interlock mechanisms
    - Disassembly procedures

- Inspection of parts
- Reassembly procedures
- Precautions
- Importance of cleanliness
- Manufacturer's specifications
- Lubrication level
- Maintenance

2. Check and service other types of transmissions
   - Transfer cases
   - Principles of operation
   - Types and designs
   - Functions
   - Relationship to power train system

3. Disassemble, repair and assemble transfer drives
   - Disassembly and assembly procedures
   - Inspection of parts
   - Precautions
   - Importance of cleanliness
   - Manufacturer's specifications
   - Lubrication level
   - Maintenance

4. Remove, repair and install power take offs
   - Functions
   - Types and designs
   - Principles of operation
   - Service and alignment procedures
   - Installation precautions
   - Allowable tolerances
   - Manufacturer's specifications
   - Common failures

5. Diagnose problems in manual transmissions
   - Manual transmission troubleshooting
     - noisy in neutral
     - noisy in gear
     - hard to shift
     - sticks in gear
     - slips out of gear

- gear clash when shifting
- oil leaks

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, inspect, repair and assemble a manual transmission.

SUGGESTED RESOURCES:

- FOS - Power Trains (Deere).
- Diesel Equipment II (Schulz).
- Automotive Technology (Nash).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2350 - Torque Converters

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1280

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to repair, install and test torque converters.

OVERVIEW OF OBJECTIVES:
1. Disassemble, repair and assemble torque converter.
2. Test torque converter performance.
3. Diagnose problems in torque converter.
4. Check and service lock up clutches.

CONTENT:
1. Disassemble, repair and assemble torque converter
    - Principles of operation and construction of torque converters
        - torque multiplication
        - vortex flow
        - rotary flow
        - energy transfer reaction
        - single turbine
        - twin turbine
        - fluid coupling vs torque converter
        - two phase - two stage converter
    - Pump
    - Turbine
    - Stator
    - Free wheel mechanism
    - Disassembly and reassembly procedures
    - Inspection of parts
    - Importance of cleanliness
    - Manufacturer's specifications
    - Draining and filling procedures
    - Oil level interpretations

2. Test torque converter performance
    - Main oil pressure
    - Converter-out oil pressure
    - Lubrication oil pressure
    - Converter-out oil temperature
    - Transmission stall test

3. Diagnose problems in torque converter
    - Overheating
    - Noise
    - Leaks
    - Low power multiplication
    - Contaminated fluid

4. Check and service lock up clutches
    - Control mechanisms
    - Components
    - Service

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, inspect, repair and assemble a torque converter.
- Pressure test torque converter performance.

SUGGESTED RESOURCES:

- FOS - Power Trains (Deere).
- Diesel Equipment II (Schulz).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2360 - Powershift Transmission

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1140 SV2350

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to repair and install powershift transmissions used on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Describe the removal procedures for powershift transmissions.
2. Inspect parts for wear.
3. Disassemble, repair and assemble powershift transmissions.
4. Install transmission.
5. Change transmission filters and fluid.
6. Check and adjust powershift transmission pressure.
7. Test transmission operation.
8. Diagnose problems in powershift transmissions.

CONTENT:
1. Describe the removal procedures for powershift transmissions
    - Removal procedures
        - drain transmission fluid
        - disconnect attaching parts
        - disconnect propeller shaft
        - use suitable lifting equipment
        - follow service manual recommendations

2. Inspect parts for wear
    - Inspect transmission mounts
    - Check for loose or worn parts
    - Check shifting linkage
    - Check for oil leaks

3. Disassemble, repair and assemble powershift transmissions
    - Principle of operation and construction of powershift transmission
    - Planetary gear set and drive combination
    - Members of planetary gear set

    - sun
    - planet pinions
    - carrier
    - ring gear
- Components of powershift transmission
    - oil pumps
    - servos
    - bands
    - clutch plates
    - clutch discs
    - clutch piston
- Types of valves
    - pressure regulator valves
    - manual control valves
    - shifter valves
    - throttle valves
    - upshift valves
    - downshift valves
    - lubrication valves
    - balance valves
    - oil filter relief valves
    - cooler relief valves
    - modulator valves
- Governor
- Accumulator
- Oil cooler
- Oil filter
- Disassembly procedures
- Inspection of parts
- Importance of cleanliness
- Reassembly procedures
- Adjustments
- Importance of following manufacturer's specifications

4. Install transmission
    - Installation procedures
        - importance of proper alignment of parts
        - torque attaching bolts
        - reconnect all attaching parts
        - follow service manual recommendation
        - adjust shifting linkage

5. Change transmission filters and fluid
    - Procedures to remove filters
    - Importance of cleanliness
    - Selection of filter element
    - Installation procedures
    - Procedures for refilling transmission fluid
    - Fluid level interpretation
6. Check and adjust powershift transmission pressure
    - Main pump pressure
    - Clutch pack pressure
    - Filter relief valve pressure
    - Cooler relief valve pressure
    - Lubricating oil pressure

7. Test transmission operation
    - Test drive transmission operation
    - Check transmission in all operating ranges
    - Check for abnormal noise
    - Check for oil leaks

8. Diagnose problems in powershift transmissions
    - Powershift transmission troubleshooting
        - machine won't move
        - shifts erratically
        - clutches slipping
    - Low system pressure
    - Transmission overheating
    - Pressure test reading
    - Common failures
    - Manufacturer's specifications
    - Towing and pushing precautions

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, repair and assemble a powershift transmission.
- Test and adjust transmission pressure.

SUGGESTED RESOURCES:

- FOS - Power Trains (Deere).
- Diesel Equipment II (Schulz).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1290 - Differential Assemblies

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1280

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, check, repair, assemble and adjust differential assemblies used on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Remove differential assembly.
2. Inspect parts for wear.
3. Check and repair bushing in oscillating axle.
4. Disassemble, check, repair, assemble and adjust differential assembly.
5. Remove, repair and install differential locks.
6. Service and repair power dividers.
7. Install differential assembly.
8. Test differential operation.
9. Diagnose problems in differential assembly.

CONTENT:
1. Remove differential assembly
    - Removal procedures
        - drain differential oil
        - disconnect attaching parts
        - jacking techniques
        - follow service manual recommendations

2. Inspect parts for wear
    - Inspect differential mounts
    - Check for loose or worn parts

3. Check and repair bushing in oscillating axle
    - Pivot pin and bushings
    - Bushing types and material
    - Procedure to remove and install pin and bushings
    - Lubrication

4. Disassemble, check, repair, assemble and adjust differential assembly
    - Recognize functions of major components
        - Ring gear
        - Pinion gears
        - Spiders gears
        - Side gears
        - Bearings
        - Seals
    - Types of differentials
        - single speed
        - single reduction
        - double reduction
    - Nomenclature of gear
        - face
        - flank
        - heel
        - toe
    - Types of gears
    - Disassembly procedures of differential
    - Inspection of parts
    - Adjustments
        - pinion depth
        - bearings preload
        - tooth contact
        - backlash
    - Importance of cleanliness
    - Reassembly procedures
    - Manufacturer's specifications

5. Remove, repair and install differential locks
    - Principles of operation
    - Purpose
    - Types and designs (differential locks)
        - mechanical
        - hydraulic
        - nonspin
        - torque proportional

6. Service and repair power dividers
    - Principles of operation
    - Purpose

- Types and designs
- Method of shifting

7. Install differential assembly
   - Installation procedures
     - importance of proper alignment of parts
     - proper torque of attaching bolts
     - reconnect all attaching parts
     - refill differential fluid
     - follow service manual recommendations

8. Test differential operation
   - Test drive differential operation
   - Check for abnormal noise
   - Check for oil leaks

9. Diagnose problems in differential assembly
   - Differential troubleshooting
   - Noise interpretation
     - growling
     - knocking
   - Leaking oil
   - Oil level interpretations
   - Common failures
   - Manufacturer's specifications

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, repair and assemble differential assembly.

SUGGESTED RESOURCES:

- FOS - Power Trains (Deere).
- Diesel Equipment II (Schulz).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2370 - Drive Axles and Final Drives

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1280

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, disassemble, repair, adjust and assemble drive axles and final drives used on wheel and track type vehicles.

OVERVIEW OF OBJECTIVES:
1. Remove and install axles.
2. Remove, disassemble, repair, assemble and install final drives (wheel type vehicle).
3. Remove, disassemble, repair, assemble and install final drives (track type vehicle).
4. Diagnose problems in final drive assemblies and axles.

CONTENT:
1. Remove and install axles
    - Types of axles
        - semi-floating
        - three quarter floating
        - full floating
        - axle bearings
        - axle retaining method
    - Removal and installation procedures

2. Remove, disassemble, repair, assemble and install final drives (wheel type vehicle)
    - Removal procedures of final drive
    - Principles of operation
    - Types of design of final drives
        - gear drive
        - planetary drive
        - inboard final drive
        - outboard final drive
    - Components identification
        - ring gear
        - sun gear
        - pinions gear
        - bearings

        - seals
    - Repair procedures
    - Inspection of parts
    - Adjustments of bearings
    - Installation procedures
    - Lubrication recommendations

3. Remove, disassemble, repair, assemble and install final drives (track type vehicle)
    - Removal procedures of final drive
    - Principles of operation
    - Types and design of final drives
        - single reduction
        - double reduction
        - gear drive
        - planetary drive
    - Components identification
        - sprocket shaft
        - final drive shaft
            - pinion shaft
        - planetary gears
    - Types of bearings
    - Types of seals
    - Types of lubrication systems
        - splash
        - pressurized
    - Disassembly procedures
    - Inspection of parts
    - Repair procedures
    - Adjustment of bearings
    - Installation procedures
    - Lubrication recommendations

4. Diagnose problems in final drive assemblies and axles
    - Final drive troubleshooting
        - noise interpretation
        - overheating
        - leaking oil
        - common failures
        - manufacturer's specifications
    - Axles failures

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, repair and assemble a final drive (wheel type vehicle).
- Disassemble, repair and assemble a final drive (track type vehicle).

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- FOS - Power Trains (Deere).
- Heavy Equipment Repair (Nichols).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1400 - Lighting Gauges

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1300 SV1340 SV1350

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this course, the apprentice will be able to remove, test and replace lights, gauges and safety components used on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Interpret and use electrical symbols, schematics and diagrams.
2. Remove, test and replace light bulbs.
3. Remove, check and replace circuit protection.
4. Remove, check and replace switches.
5. Remove, test and replace gauges and sending units.
6. Remove, test and replace accessories components.
7. Diagnose lighting, gauges and accessories problems.
8. Test starting circuit problems.
9. Test charging circuit problems.

CONTENT:
1. Interpret and use electrical symbols, schematics and diagrams
    - Recognition of symbols commonly used in wiring diagrams
    - Interpretation of schematics and diagrams
        - color coding
        - number coding
        - procedures for tracing problems by using schematics and diagrams

2. Remove, test and replace light bulbs
    - Bulb identification
        - single filament
        - double filament
        - sealed-beam
        - halogen beam
        - bulbs rating
    - Headlights
    - Parklights
    - Brakelights

- Signal lights
- Revolving lights
- Dash lights
- Removal procedures
- Test procedures
- Replacement procedures
- Installation procedures
- Headlight aiming procedures

3. Remove, check and replace circuit protection
   - Purpose
   - Types
     - fuse
     - circuit breakers
     - fusible link
   - Terminal block
   - Junction block
   - Relays
   - Removal procedures
   - Test procedures
   - Installation procedures

4. Remove, check and replace switches
   - Types of switches
     - ignition switch
     - toggle switch
     - push-pull switch
     - cutout switch
     - multiple contact switch
     - push button switch
     - pressure switch
     - safety switch
   - Removal procedures
   - Test procedures
   - Installation procedures

5. Remove, test and replace gauges and sending units
   - Mechanical gauges
   - Electrical gauges
   - Electronic gauges
   - Types of gauges

- pressure gauge
- temperature gauge
- fuel gauge
- ammeter gauge
- voltmeter gauge

- Sending unit
  - function
  - types
- Removal procedures
- Test procedures
- Installation procedures

6. Remove, test and replace accessories components
   - Flashers
   - Horns
   - Buzzers
   - Wiper motor
   - Heater motor
   - Hourmeter
   - Tachometer
   - Relays
   - Back-up alarm
   - Removal procedures
   - Test procedures
   - Installation procedures
   - Fuel heaters

7. Diagnose lighting, gauges and accessories problems
   - Types of failure
     - open
     - short
     - ground
   - Dim lights
   - Lights burn out prematurely
   - Failure of gauges
   - Failure of warning devices

8. Test starting circuit problems
   - Engine will not crank
   - Engine cranks slowly
   - Starter turns but will not engage

- Voltage drop test
- Amperage draw test

9. Test charging circuit problems
   - Alternator output test
     - voltage and amperage
   - No alternator output
   - Low alternator output
   - High alternator output

SUGGESTED LEARNING ACTIVITIES:

- Remove, check and reinstall lighting system components.
- Remove, check and reinstall gauges and sending unit.
- Test starting circuit problems.
- Test charging circuit problems.

SUGGESTED RESOURCES:

- FOS - Electrical (Deere).
- Diesel Mechanics (Schulz).
- Auto Service and Repair (Stockel).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2380 - Hydraulics

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1140 SV1190

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, repair and install hydraulic hoses and fittings.

OVERVIEW OF OBJECTIVES:
1. Remove and replace hydraulic hoses.
2. Remove and install hydraulic fittings.
3. Remove and replace fitting to hose.
4. Remove and replace hydraulic pipes and tubing.

CONTENT:
1. Remove and replace hydraulic hoses
    - Hose classification
        - low pressure
        - medium pressure
        - high pressure
        - extreme high pressure
    - Types of hoses
        - fabric braid
        - single wire braid
        - double wire braid
        - spiral wire
    - Hose construction
        - inner tube
        - reinforcement layers
        - outer cover
    - Hose selection
    - Size ratings of hoses
        - identification of hose sizes
        - interpretation of dash number
        - flow capacities of hoses
    - Removal and installation procedures of hoses

2. Remove and install hydraulic fittings
    - Types and style of fittings
        - crimped (permanent)
        - reusable
        - low pressure
        - medium pressure
        - high pressure
        - male and female fittings
    - Flare angles 45° and 37° (JIC & SAE)
    - Flare fitting
    - Inverted flare fitting
    - Split flange fitting
    - 45° and 90° fitting
    - Marking identification for size and pressure ratings
    - Methods of sealings fittings
        - thread seal
        - cone seat seal
        - o-ring seal
        - split flange seal
        - inverted flare
    - Sealing compounds and compatibility
        - teflon tape
        - liquid teflon

3. Remove and replace fitting to hose
    - Crimped type fittings
        - types of hose crimping machine
        - crimping procedures
        - importance of following proper procedures
        - importance of cleanliness
    - Reusable type fittings
        - installation procedures for low pressure fittings
        - installation procedures for high pressure fittings
        - importance of cleanliness
    - Tightening procedures and torque values of fittings

4. Remove and replace hydraulic pipes and tubing
    - Types of pipes and tubing
    - Identification of sizes
    - Removal and installation procedures
    - Proper routing of pipes and tubing

- Bending
- Reuse versus replacement

SUGGESTED LEARNING ACTIVITIES:

- Remove and install hydraulic hose.
- Install a crimped type fitting to a hydraulic hose.
- Install a reusable type fitting to a hydraulic hose.

SUGGESTED RESOURCES:

- FOS - Hydraulics (Deere).
- Diesel Equipment I (Schulz).
- Diesel Mechanics (Schulz).
- Industrial Hydraulics Manual (Vickers).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2390 - Reservoirs and Fluid Conditioners

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV2380

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service hydraulic reservoirs, and remove, service and install filters.

OVERVIEW OF OBJECTIVES:
1. Drain reservoir and service intake filter.
2. Remove, service and install filter.
3. Remove, service and install fluid conditioners.
4. Identify basic service procedures.

CONTENT:
1. Drain reservoir and service intake filter
    - Types and designs of reservoirs
    - Shape and construction
    - Capacity of reservoirs
    - Features of reservoirs
        - filler cap
        - oil level gauge
        - baffles
        - intake filter (strainers)
        - return filter
        - outlet and return lines
        - drain plug
    - Reservoir ventilation
    - Pressurized reservoir
    - Procedures to drain reservoirs
    - Procedures to remove and install intake filter
    - Refilling the reservoirs
    - Interpretation of oil levels
    - Importance of cleanliness

2. Remove, service and install filter
    - Types of filters
        - surface filter
        - depth filter

    - edge filter
- Filter element material
- Micron ratings of filter
- Types of filtering systems
    - full flow system
    - by pass system
- Filter selection
- Damaging effect of dirty filter
- Filter condition indicators
- Servicing oil filter
    - procedures to remove and install
    - inspection
    - cleanliness
    - precautions
- Importance of cutting open used filter to check for presence of foreign particles

3. Remove, service and install fluid conditioners
    - Heat exchanger
    - Cooling
    - Heating
    - Types of coolers
        - air to oil
        - water to oil
    - Function of coolers
    - Principles of operation
    - Location in relation to system
    - Recognition of faulty operation
    - Removal procedures
    - Cleaning methods
        - air pressure
        - steam pressure
        - precautions measures
        - installation procedures
        - testing

4. Identify basic service procedures
    - Venting reservoir
    - Pressure reservoir

SUGGESTED LEARNING ACTIVITIES:

- Drain hydraulic oil and fluids, inspect or clean intake filter and refill reservoir.

- Remove, service and install hydraulic filters.
- Check condition and service hydraulic oil cooler.

SUGGESTED RESOURCES:

- FOS - Hydraulics (Deere).
- Diesel Equipment I (Schulz).
- Industrial Hydraulics Manual (Vickers).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2400 - Hydraulic Pumps and Motors

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV2390

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to disassemble, inspect, repair and assemble hydraulic pumps and motors.

OVERVIEW OF OBJECTIVES:
1. Remove and replace hydraulic pumps.
2. Disassemble, repair and assemble hydraulic pumps.
3. Diagnose hydraulic pump problems.
4. Remove and replace hydraulic motors.
5. Disassemble, check, repair and assemble hydraulic motors.
6. Diagnose hydraulic motor problems.

CONTENT:
1. Remove and replace hydraulic pumps
    - Function of the pump
    - Pump classification
        - non-positive displacement
        - positive displacement
        - fixed displacement
        - variable displacement
    - Pump ratings/selections
    - Types of pumps
    - Gear types
        - external gears
        - internal gears
        - gerotor
    - Vane type
        - balanced
        - unbalanced
    - Piston type
        - axial
        - radial
        - bend-axis
    - Identification of pump components
        - gear pump

- vane pump
- piston pump

- Removal procedures of pumps
- Sealing of openings
- Installation procedures
- Importance of cleanliness

2. Disassemble, repair and assemble hydraulic pumps
   - Disassembly procedures
   - Pump inspections
     - wear patterns
     - clearance and tolerance
     - normal wear
     - specifications
   - Reassembly procedures
   - Precautions
   - Importance of cleanliness
   - Importance of following service manual recommendations

3. Diagnose hydraulic pump problems
   - Pump failures and causes
     - no fluid delivery
     - pump making noise
     - excessive fluid leakage
     - excessive pump wear
     - misaligned drive shaft
     - pump cavitation
     - pump aeration

4. Remove and replace hydraulic motors
   - Types of motors
     - gear
     - vane
     - piston
   - Fixed and variable displacements motor
   - Directional and by directional motors
   - Torque rating
   - Speed rating
   - Horsepower rating
   - Motor application and efficiency
   - Identification of motor components for
     - gear motor

    - vane motor
    - piston motor
  - Removal procedures of motors
  - Sealing of openings
  - Installation procedures
  - Importance of cleanliness

5. Disassemble, check, repair and assemble hydraulic motors
  - Disassembly procedures
  - Cleanliness
  - Check wear pattern
  - Check tolerances
  - Importance of following service manual recommendations
  - Reassembly procedures

6. Diagnose hydraulic motor problems
  - Motor won't turn
  - Slow motor operation
  - Erratic motor operation
  - Motor turns in wrong direction
  - Motor shaft not turning

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, check, repair and reassemble the following types of pumps
  - gear
  - vane
  - piston
- Disassemble, check, repair and reassemble a hydraulic motor.

SUGGESTED RESOURCES:

- FOS - Hydraulics (Deere).
- Diesel Equipment I (Schulz).
- Industrial Hydraulics Manual (Vickers).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2410 - Hydraulic Control Valves

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV2400

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this course, the apprentice will be able to disassemble, inspect, repair and assemble various types of hydraulic valves.

OVERVIEW OF OBJECTIVES:
1. Remove and install hydraulic control valves.
2. Disassemble, check, repair and assemble valves.
3. Diagnose hydraulic valve problems.

CONTENT:
1. Remove and install hydraulic control valves
    - Major types of valves
        - pressure control
        - directional control
        - volume control
    - Pressure control valves
        - direct acting relief valve
        - pilot operated (compound) relief valve
        - pressure reducing valves
        - sequence valves
        - unloading valves
        - secondary valves
    - Directional control valves
        - open center valves
        - close center valves
        - two-way, two position valve
        - three-way, two position valve
        - three-way, three position valve
        - four-way, three position valve
        - four-way, four position valve
        - check valves
        - rotary valves
        - spool valves

- pilot controlled valves
- electro-hydraulic valves
- valves stack
- unibody valves
- shuttle valves
- anticavitation valves
- counterbalance valves
- quick drop valves
- load check valves

- Volume control valves
  - flow control
  - flow divider
  - priority valve
  - proportional valve
- Removal procedures of valves
- Importance of cleaning valves and surrounding area
- Releasing hydraulic pressure
- Sealing of openings
- Installation procedures

2. Disassemble, check, repair and assemble valves
   - Disassembly procedures
   - Inspections
   - Importance of cleanliness
   - Reassembly procedures
   - Adjustment procedures
   - Importance of following manufacturer's specifications

3. Diagnose hydraulic valve problems
   - Pressure control valves
     - low pressure
     - high pressure
     - excessive noise or chatter
     - unable to adjust properly
   - Directional control valves
     - faulty valve shifting
     - cylinder creeps
     - load drops when raised
     - oil overheating
   - Volume control valves
     - variations in flow

- improper flow
- erratic flow

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, check, repair and assemble directional control valve.
- Disassemble, check, repair and assemble various types of hydraulic valves.

SUGGESTED RESOURCES:

- FOS - Hydraulics (Deere).
- Diesel Equipment I (Schulz).
- Industrial Hydraulics Manual (Vickers).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2420 - Hydraulic Cylinders

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV2410

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, disassemble, inspect, repair, assemble and install hydraulic cylinders.

OVERVIEW OF OBJECTIVES:
1. Remove and install hydraulic cylinders.
2. Disassemble, check, repair and assemble hydraulic cylinders.
3. Diagnose hydraulic cylinder problems.

CONTENT:
1. Remove and install hydraulic cylinders
    - Types of cylinders
        - single acting
        - double acting
        - balanced
        - unbalanced
        - telescoping
        - ram
    - Features of cylinders
        - stroke control
        - cushions
        - protection check valves
    - Cylinder components
        - barrel
        - rod
        - piston
        - seals and packing
    - Removal procedures
    - Importance of cleanliness
    - Sealing of openings
    - Installation procedures
    - Safety

2. Disassemble, check, repair and assemble hydraulic cylinders
   - Disassembly procedures
   - Cylinder inspections
   - Service manual recommendations
   - Check rod condition
   - Reassembly procedures
   - Importance of cleanliness

3. Diagnose hydraulic cylinder problems
   - External leakage
   - Internal leakage
   - Creeping of cylinder
   - Sluggish operation
   - Lack of lubrication
   - Burrs on piston rod
   - Loose mounting (pins and bushings)
   - Misalignment

SUGGESTED LEARNING ACTIVITIES:

- Remove, disassemble, repair, assemble and install a hydraulic cylinder.

SUGGESTED RESOURCES:

- FOS - Hydraulics (Deere).
- Diesel Equipment I (Schulz).
- Industrial Hydraulics Manual (Vickers).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2430 - Hydraulic Accumulators

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV2410

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service, inspect and repair hydraulic accumulators and oil coolers.

OVERVIEW OF OBJECTIVES:
1. Remove and install hydraulic accumulators.
2. Disassemble, check, repair and assemble hydraulic accumulators.
3. Diagnose hydraulic accumulator problems.

CONTENT:
1. Remove and install hydraulic accumulators
    - Purpose of accumulators
    - Types of accumulators
        - pneumatic
        - weight-loaded (introduction)
        - spring-loaded
    - Components of accumulators
        - oil chamber
        - piston
        - bladder
        - gas valve
        - packing
        - nitrogen gas
    - Services and non-service
        - test procedures

2. Disassemble, check, repair and assemble hydraulic accumulators
    - Service manual recommendations
    - Procedures to remove accumulator from machine
    - Disassembly procedures
    - Bleeding procedures
    - Inspections
    - Importance of cleanliness

- Reassembly procedures
- Charging accumulator
- Charging equipment
- Precautions
- Procedures to install accumulator on machine

3. Diagnose hydraulic accumulator problems
   - Accumulator charge valve leaking
   - Internal leakage
   - Effect of different charge pressure

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, check, repair and reassemble a hydraulic accumulator.

SUGGESTED RESOURCES:

- FOS - Hydraulics (Deere).
- Diesel Equipment I (Schulz).
- Industrial Hydraulics (Vickers).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2440 - Hydraulic Steering Systems (Articulated)

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV2420

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to disassemble, inspect, repair and assemble steering components from articulated vehicles.

OVERVIEW OF OBJECTIVES:
1. Remove and install articulated steering components.
2. Disassemble, check, repair and reassemble articulated steering valves.
3. Diagnose articulated steering problems.

CONTENT:
1. Remove and install articulated steering components
    - Types of articulated steering
        - semi-hydrostatic
        - hydrostatic
            - steering wheel rock back and forth
        - metering pump steering
        - pilot-operated hydrostatic steering
        - orbital steering
    - Emergency steering system
    - Components of articulated steering
        - steering valves
        - cylinders
        - oil lines
        - filters
        - pump
        - accumulator
        - follow up link
    - Procedures to remove steering components
    - Importance of cleanliness
    - Procedures to install steering components
    - Safety precautions

2. Disassemble, check, repair and reassemble articulated steering valves
    - Disassembly procedures
        - importance of cleanliness
        - service manual recommendations
        - adjustments
        - reassembly procedures

3. Diagnose articulated steering problems
    - Slow steering
    - Hard steering
    - Opposite steering
    - No steering
    - Steering wheel does not center
    - Steering wheel rocking back and forth
    - Steering wheel continues to turn

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, repair, adjust and reassemble articulated steering valves.

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- FOS - Hydraulics (Deere).
- Heavy Equipment Repair (Nichols).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2450 - Hydrostatic Transmissions

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV1290 SV2330 SV2340 SV2360 SV2370 SV2410

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, disassemble, repair, assemble and install hydrostatic transmissions.

OVERVIEW OF OBJECTIVES:
1. Remove and install a hydrostatic transmission.
2. Service transmission controls.
3. Disassemble, repair and assemble hydrostatic transmissions.
4. Diagnose problems in hydrostatic transmissions.

CONTENT:
1. Remove and install a hydrostatic transmission
    - Theory of hydrostatic drive
    - Principles of operation
    - Types of hydrostatic drives (possible pump-motor combinations)
    - Advantages and disadvantages of hydrostatic drives
    - Hydrostatic transmission components
        - pump
        - motor
        - charge pump
        - filter
        - reservoir
        - cooler
        - valves
    - Procedures to remove hydrostatic transmission
    - Importance of cleanliness
    - Bleeding procedures
    - Procedures to install hydrostatic transmission

2. Service transmission controls
    - Type
        - mechanical
        - electronic

- diagnostic
- Service adjustment procedures

3. Disassemble, repair and assemble hydrostatic transmissions
   - Disassembly procedures
   - Inspection of parts
   - Importance of cleanliness
   - Reassembly procedures
   - Adjustments
   - Importance of following manufacturer's specification

4. Diagnose problems in hydrostatic transmissions
   - Machine will not move in either direction
   - Machine moves in one direction only
   - System noisy
   - System operating hot
   - Neutral hard to find
   - Acceleration and deceleration sluggish

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, repair and assemble a hydrostatic transmission.

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- FOS - Power Trains (Deere).
- Heavy Equipment Repair (Nichols).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2460 - Diagnose and Test Hydraulic Systems

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV2430 SV2440 SV2450

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to diagnose and test hydraulic systems.

OVERVIEW OF OBJECTIVES:
1. Identify basic steps for diagnosing and testing hydraulic systems.
2. Use and interpret schematics and hydraulic diagrams.
3. Use hydraulic testers.
4. Test hydraulic systems.
5. Diagnose problems in hydraulic systems.

CONTENT:
1. Identify basic steps for diagnosing and testing hydraulic systems
    - Basic rules for troubleshooting hydraulic systems
        - know the system
        - ask the operator
        - operate the machine
        - inspect the machine
        - list the possible causes
        - reach a conclusion
        - test your conclusion
        - use service info
        - interpret data

2. Use and interpret schematics and hydraulic diagrams
    - System knowledge of schematics and diagrams
    - Color coding of pressure oil
    - Hydraulic symbols
    - Basic steps to follow when tracing problems by using hydraulic diagrams

3. Use hydraulic testers
    - Types of hydraulic testers
    - By-pass tester

- In-line tester
- Pressure gauges
- Flow meter tester
- Temperature gauge
- Interpreting test data
- Precautions when testing

4. Test hydraulic systems
   - Test pump efficiency
     - flow
     - pressure
     - leakage
     - temperature
   - Test main relief valve setting
   - Test individual circuit setting
   - Test circuit efficiency by using cycle time

5. Diagnose problems in hydraulic systems
   - System inoperative
   - System operates slowly
   - System operates erratically
   - System operates too fast
   - Oil foaming in the system
   - Overheating of oil in the system
   - Pump makes noise
   - Load drops with control valve in neutral position
   - Cylinder lowers when control valve is in slow raise position
   - Contaminated hydraulic oil

SUGGESTED LEARNING ACTIVITIES:

- With appropriate test equipment, check the following items on a hydraulic system
  - pump efficiency
  - main relief valve setting
  - individual circuit relief valve setting
  - check circuits cycle time

SUGGESTED RESOURCES:

- FOS - Hydraulics (Deere).
- Diesel Equipment I (Schulz).
- Heavy Equipment Repair (Nichols).
- Service Manual.

- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2470 - Winches, Wire Ropes and Accessories

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV2320 SV2410

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to disassemble, repair and assemble winches; remove and install wire ropes and accessories used on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Remove and install winches.
2. Disassemble, check, repair and assemble winches.
3. Diagnose winch problems.
4. Remove and install wire rope from a winch drum.
5. Remove and install wire rope connections and anchors.
6. Diagnose wire rope failures.

CONTENT:
1. Remove and install winches
    - Types and designs of winches
        - mechanical winch
        - hydraulic winch
    - Principles of operation
        - neutral position
        - pull-in position
        - power-out position
        - hold position
    - Winch operation
        - gearing
        - drums
        - clutches
        - brake band
        - control valves
        - pump
        - fair leads
        - lubrication
        - drives

- power take off
- single coupling
- double coupling

2. Disassemble, check, repair and assemble winches
   - Disassembly procedures
   - Wear tolerances
   - Service manual specifications
   - Cleanliness
   - Adjustments
   - Reassembly procedures
   - Safety precautions

3. Diagnose winch problems
   - Winch drive shaft won't turn
   - Lack of reel-in power
   - Brake will not hold the load
   - Drum turns while valve in neutral
   - Winch makes noise

4. Remove and install wire rope from a winch drum
   - Wire rope terminology
     - strands number
     - strands material
     - grades
   - Lay
     - overwind
     - underwind
     - left lay
     - right lay
   - Methods to secure wire rope to the drums
   - Seizing wire rope
   - Cutting wire rope
   - Drum capacity
   - Unspooling cable

5. Remove and install wire rope connections and anchors
   - Fitting
   - Clamps
   - Wedges
   - Hooks

- Thimbles

6. Diagnose wire rope failures
   - Lack of lubrication
   - Improper rope selection
   - Rope crushing
   - Rope bending
   - Rope kinking
   - Safety factors

SUGGESTED LEARNING ACTIVITIES:

- Disassemble, repair and assemble a winch.
- Adjust brake bend on a winch.
- Remove and reinstall a wire rope on a winch drum.
- Install different types of connections to wire rope.

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- Heavy Equipment Repair (Nash).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2480 - Cabs and ROPS

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1100 SV1110 SV1150 TS1510 TS1530

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, inspect, repair and install cabs and roll over protection structures (ROPS) used on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Remove, inspect, repair and replace cabs.
2. Remove, inspect, repair and replace ROPS.

CONTENT:
1. Remove, inspect, repair and replace cabs
    - Cab components
        - cab frame
        - cab platform
        - floor mat
        - cab windows
        - cab doors
        - door handles
        - door locks
        - seat
        - seat support and suspension
        - seat belts
    - Removal procedures
    - Repair procedures
    - Installation procedures

2. Remove, inspect, repair and replace ROPS
    - Roll over protective structure (ROPS)
        - construction
        - features
        - safety precautions
        - removal procedures
        - service and repair procedures and regulations
        - installation procedures

SUGGESTED LEARNING ACTIVITIES:

SUGGESTED RESOURCES:

- Heavy Equipment Repair (Nichols).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV1410 - Fire Suppression Units

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1100 SV1110 SV1150 SV1170 SV1180 TS1510 TS1530

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service, inspect and repair fire suppression systems used on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Service, inspect and repair fire suppression units.

CONTENT:
1. Service, inspect and repair fire suppression units
    - Types and functions of fire suppression units
    - Where it is used
    - Types and designs
    - Principles of operations
    - Components
        - actuator (remote and dashboard type)
        - actuation cartridge
        - bursting disc
        - expellent gas cartridge
        - dry chemical tank
        - indicator fill cap
        - nozzle
        - blow-off cap
        - hoses and fittings
    - Checking appearance of dry chemical tank
    - Checking nameplate for readability on tank
    - Checking fill cap gasket
    - Inspecting threads on fill cap
    - Checking pressure relief vent
    - Checking dry chemical level and condition
    - Checking tank mounting bracket
    - Checking condition of actuator cartridge
    - Checking nozzle opening
    - Checking condition of hoses and fittings

- Recording date of maintenance
- Procedures to recharge the system

SUGGESTED LEARNING ACTIVITIES:

- Service, inspect and repair fire suppression units.

SUGGESTED RESOURCES:

- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2490 - Portable Air Compressors

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1130 SV1190 SV1400

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service and repair portable air compressors.

OVERVIEW OF OBJECTIVES:
1. Service and repair air compressors.
2. Operate the air compressor.
3. Diagnose air compressor problems.

CONTENT:
1. Service and repair air compressors
    - Types of compressors
    - rotary
        - reciprocating
        - single stage
        - double stage
    - Rating of compressors
    - Major components of air compressor unit
        - air receiver (reservoir)
        - intercooler
        - compressor
        - gauges
        - air lines and fittings
        - line oiler
        - filter
        - cooling system
        - lubrication system
        - unloader valve
        - governor
    - Valves
        - safety valves
        - manual blowdown valves
        - automatic blowdown valves

- pressure valves
- air inlet valves
- minimum pressure valves
- drain valves
- three way selector valves

- Auxiliary compressor
  - purpose
  - connection
- Factors affecting pressure drop
- Servicing the air compressor
- Lubricant recommendation
- Filter replacement
- Oil change intervals
- Cooling system service
- Air cleaner service
- Preventive maintenance
- Adjustments of air pressure

2. Operate the air compressor
   - Before starting the compressor
   - Starting the compressor
   - Stopping the compressor

3. Diagnose air compressor problems
   - Too low air pressure
   - Too high air pressure
   - Excessive lubricating oil consumption
   - Unable to obtain correct engine speeds
   - Overheating of compressor high discharge air
   - Short air cleaner element life

SUGGESTED LEARNING ACTIVITIES:

- Service and repair air compressor unit.
- Check and adjust air pressure on an air compressor.

SUGGESTED RESOURCES:

- Heavy Equipment Repair (Nichols).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2500 - Booms and Attachments

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV1140 SV2420 WD2320

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to remove, inspect, repair and install booms, pins and bushings used on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Remove and install booms.
2. Remove and install pins and bushings.
3. Service booms and attachments.

CONTENT:
1. Remove and install booms
    - Types and construction of boom
        - main boom
        - secondary booms
        - telescoping booms
        - stabilizer or outrigger
    - Removal procedures
    - Precautions
    - Inspections
    - Following manufacturer's recommendations
    - Installation procedures

2. Remove and install pins and bushings
    - Types and designs of pins and bushings
    - Removal procedures
    - Inspections
    - Lubrication recommendations
    - Installation procedures

3. Service booms and attachments
    - Importance of following manufacturer's recommendations
    - Inspecting boom for cracks
    - Inspecting pins and bushing wear

- Lubrication recommendations

SUGGESTED LEARNING ACTIVITIES:

- Remove one section of a boom and check or replace all bushings and pins.

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- Heavy Equipment Repair (Nichols).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2510 - Blades, Buckets and Cutting Edges

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV2420 WD2320

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this course, the apprentice will be able to remove, repair and install blades, buckets and cutting edges used on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Remove, repair and install blades.
2. Remove, reverse or replace and install cutting and corner edge.
3. Remove, repair and install buckets.
4. Remove and replace bucket teeth.
5. Check and service quick coupling attachments.

CONTENT:
1. Remove, repair and install blades
    - Types and construction of blades
        - straight blade
        - angle blade
    - Components
        - push arm
        - pitch arm
        - tilt arm
        - landside
        - pins
        - cutting edge
        - corner edge
    - Types and applications of cutting edge
    - Moldboard construction
    - Removal procedures of blades
        - blades inspection
        - bushing and pin replacement

2. Remove, reverse or replace and install cutting and corner edge
    - Procedures to remove cutting and corner edge
    - Reversing principles of cutting edge

- Installation procedures
- Importance for cleanliness
- Importance of torquing all attaching bolts

3. Remove, repair and install buckets
   - Types and construction of bucket
     - multipurpose bucket
     - rock bucket
     - snow bucket
     - four in one bucket
     - side dump bucket
     - backhoe bucket
     - excavator bucket
   - Components
     - cutting edge
     - teeth
     - shank
     - bushings
     - pins
     - arms
   - Removal procedures of buckets
   - Buckets inspections
   - Replacement of shank
   - Replacement of cutting edge
   - Replacement of pins and bushings
   - Installation procedures

4. Remove and replace bucket teeth
   - Removal procedures of teeth
   - Method to attach teeth to shank
   - Importance of using proper teeth
   - Teeth reversible principles (if applicable)
   - Installation procedures of teeth

5. Check and service quick coupling attachments
   - Types of quick coupling systems
     - hydraulic operated
     - air operated
   - Advantages
   - Service procedures

SUGGESTED LEARNING ACTIVITIES:

- Remove, replace or reverse a cutting edge from a blade.
- Remove and install bucket teeth.
- Remove and install a bucket from a machine.

SUGGESTED RESOURCES:

- Diesel Equipment II (Schulz).
- Heavy Equipment Repair (Nichols).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2520 - Aprons, Bowls and Tailgates

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV2510

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service and repair aprons, bowls and tailgates used on scrapers.

OVERVIEW OF OBJECTIVES:
1. Repair bowl, apron and tailgates (ejector).
2. Remove, reverse or replace cutting edge.

CONTENT:
1. Repair bowl, apron and tailgates (ejector)
    - Principles of operation of scrapers
    - Types of scrapers
        - two axles
        - three axles
        - push loading scraper
        - push-pull scraper
        - elevating scraper
        - two engines scraper
    - Components
        - bowl
        - apron
        - ejector (tailgates)
        - gooseneck
        - cutting edge
    - Repair procedures
    - Check for cracks
    - Check for worn pins and bushings
    - Safety precautions

2. Remove, reverse or replace cutting edge
    - Procedures to remove cutting edge
    - Reversing principles
    - Installation procedures

- Importance for cleanliness
- Importance of torquing all attaching bolts

SUGGESTED LEARNING ACTIVITIES:

- Remove, change and install a cutting edge from a bowl scraper.
- Service and repair aprons, bowls and tailgates from a scraper.

SUGGESTED RESOURCES:

- Heavy Equipment Repair (Nichols).
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2530 - Feller Heads

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV2490

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service and repair feller heads used on forestry machinery.

OVERVIEW OF OBJECTIVES:
1. Service and repair feller heads.

CONTENT:
1. Service and repair feller heads
    - Feller heads
        - principles of operations
        - types and designs
    - Removal procedures of components
    - Repair procedures
    - Inspection
    - Importance of following manufacturer's specifications
    - Installation procedures of components
    - Maintenance recommendations

SUGGESTED LEARNING ACTIVITIES:
- Service and repair feller head assembly.

SUGGESTED RESOURCES:
- Service Manual.
- Use appropriate audio-visual material where available.

NAME AND NUMBER: SV2540 - Delimber Mechanism

SUGGESTED DURATION: 30 hours

PREREQUISITES: SV2490 SV2500

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service and repair delimber mechanisms used on forestry machinery.

OVERVIEW OF OBJECTIVES:
1. Service and repair delimber mechanisms.

CONTENT:
1. Service and repair delimber mechanisms
    - Delimber mechanisms
        - principles of operation
        - types and designs
    - Removal procedures of components
    - Repair procedures
    - Inspection
    - Importance of following manufacturer's specifications
    - Installation procedures of components
    - Maintenance recommendations

SUGGESTED LEARNING ACTIVITIES:
- Service and repair delimber mechanism units.

SUGGESTED RESOURCES:
- Service Manual.
- Use appropriate audio-visual manual where available.

NAME AND NUMBER: SV2550 - Service and Repair Circle Bearing

SUGGESTED DURATION: 15 hours

PREREQUISITES: SV2410

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to service and repair circle bearing assemblies used on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Service and repair circle bearing assemblies.
2. Service and repair swing reducer assemblies.

CONTENT:
1. Service and repair circle bearing assemblies
    - Types and designs of bearings
    - Removal procedures
    - Bearing inspection
    - Bearing replacement and adjustment procedures
    - Lubrication recommendations
    - Following manufacturer's recommendations
    - Installation procedure
    - Service procedures

2. Service and repair swing reducer assemblies
    - Principles of operation
    - Types and designs
    - Removal procedures
    - Repair procedures
    - Adjustments of parts
    - Lubrication recommendations
    - Installation procedures
    - Service procedures

SUGGESTED LEARNING ACTIVITIES:

SUGGESTED RESOURCES:

- Heavy Equipment Repair (Nichols).
- Diesel Equipment II (Schultz).
- Service Manual.
- Use appropriate audio-visual manual where available.

NAME AND NUMBER: SV2560 - Preventive Maintenance Inspections

SUGGESTED DURATION: 15 hours

PREREQUISITES: Entire Program

EVALUATION: Theory and practical applications require a minimum pass mark of 70%

OUTCOME:
Upon successful completion of this unit, the apprentice will be able to perform a complete preventive maintenance inspection, to manufacturer's specifications, on heavy equipment machinery.

OVERVIEW OF OBJECTIVES:
1. Perform preventive maintenance inspections.

CONTENT:
1. Perform preventive maintenance inspections
    - Follow procedures carefully
    - Preventive maintenance program
        - scheduled lubrication
        - scheduled servicing
        - frequent cleaning
        - adjusting
        - inspecting
        - correction of defects
        - keeping complete records
        - legal responsibility
    - Preventive maintenance chart
    - Importance of respecting scheduled maintenance
    - Importance of good written inspection report
    - Following report checklist
    - Fluid check the following items
        - engine
        - transmission
        - differential
        - final drive
        - hydraulic
        - radiator
    - Oil level interpretation and condition
    - Checking the following filters
        - air

  - fuel
  - hydraulic systems
  - transmission
  - power steering
- Checking belt tension
- Checking and cleaning battery
- Checking brake systems
- Checking hydraulic systems
- Checking power train systems
- Checking lighting systems
- Checking all gauges
- Checking air conditioning systems
- Checking charging systems
- Checking starting systems
- Checking engine operation
- Checking exhaust system for leaks
- Checking tire pressure
- Checking track sag
- Checking condition of cutting edge
- Checking condition of bucket teeth
- Checking for oil leaks
- Checking for loose or missing parts
- Fill inspection report sheet to manufacturer's specifications

SUGGESTED LEARNING ACTIVITIES:

- Perform preventive maintenance inspections on a machine according to manufacturer's recommendations.

SUGGESTED RESOURCES:

- Heavy Equipment Repair (Nichols).
- Service Manual.
- Use appropriate audio-visual manual where available.

REQUIRED RELATED COURSES

CM-2150 WORKPLACE COMMUNICATIONS

Description:

This course is designed to introduce students to the principles of effective communication including letters, memos, short report writing, oral presentations and interpersonal communications.

Course Outcomes:

Upon completion of the course, students will be able to:
- understand and apply communication skills as outlined in the Employability Skills 2000, Conference Board of Canada
- understand the importance of well-developed writing skills in business and in career development.
- understand the purpose of the various types of business correspondence.
- examine the principles of effective business writing.
- examine the standard formats for letters and memos.
- write effective letters and memos.
- examine the fundamentals of informal reports and the report writing procedure.
- produce and orally present an informal report
- examine effective listening skills and body language in communication

Objectives and Content:

1. Apply rules and principles for writing clear, concise, complete sentences which adhere to the conventions of grammar, punctuation, and mechanics.

2. Explain the rules of subject-verb agreement.

3. Define and describe the major characteristics of an effective paragraph

4. Examine the Value of Business Writing Skills
   i) Describe the importance of effective writing skills in business
   ii) Describe the value of well-developed writing skills to career success as referenced in the Employability Skills

5. Examine Principles of Effective Business Writing
   i) Discuss the rationale and techniques for fostering goodwill in business communication, regardless of the circumstances
   ii) Review the importance of revising and proofreading
   iii) Differentiate between letter and memo applications in the workplace & review

samples
iv) Identify the parts of a business letter and memo
v) Review the standard formats for business letters and memos
vi) Examine samples of well-written and poorly written letters and memos
vii) Examine guidelines for writing sample letters and memos which convey: acknowledgment, routine request, routine response, complaint, refusal, persuasive request and letters of appeal.

6. Examine the Fundamentals of Informal Business Reports
   i) Identify the purpose of the informal report
   ii) Identify the parts and formats of an informal report
   iii) Identify methods of information gathering
   iv) Describe the methods of referencing documents
   v) Review the importance of proof reading and editing

7. Examine types of presentations
   i) Review & discuss components of an effective presentation
   ii) Review & discuss delivery techniques
   iii) Review & discuss preparation & use of audio/visual aids
   iv) Discuss & participate in confidence building exercises used to prepare for giving presentations

8. Interpersonal Communications
   i) Examine and apply listening techniques
   ii) Discuss the importance of body language

Practical:

1. Write well-developed, coherent, unified paragraphs which illustrate the following: A variety of sentence arrangements; conciseness and clarity; and adherence to correct and appropriate sentence structure, grammar, punctuation, and mechanics.

2. Write sample letters and memos which convey: acknowledgment, routine request, routine response, complaint, refusal, persuasive request and letters of appeal.

3. Gather pertinent information, organize information into an appropriate outline & write an informal report with documented resources.
   i) Edit, proofread, and revise the draft to create an effective informal report and present orally using visual aids
   ii) Participate in confidence building exercises

4. Present an effective presentation.

5. Evaluate presentations.

MR-1220 CUSTOMER SERVICE

Description:

This course focuses on the role of providing quality customer service. It is important to have a positive attitude and the necessary skills to effectively listen and interpret customer concerns about a product, resolve customer problems, and determine customer wants and needs. Students will be able to use the skills and knowledge gained in this course to effectively provide a consistently high level of service to the customer.

Course Outcomes:

Upon successful completion of this course, students will be able to:
- define customer service
- explain why service is important
- describe the relationship between “service” and “sales”
- demonstrate an understanding of the importance of a positive attitude
- demonstrate methods of resolving customer complaints

Objectives and Content:

1. Define quality service
   - i) Identify and discuss elements of customer service
   - ii) Explain the difference between Service vs. Sales or Selling
   - iii) Explain why quality service is important
   - iv) Identify the various types of customers & challenges they may present
   - v) Describe customer loyalty
   - vi) Examine barriers to quality Customer Service

2. Explain how to determine customers wants and needs
   - i) Identify customer needs
   - ii) Explain the difference between customer wants and needs
   - iii) Identify ways to ensure repeat business

3. Demonstrate an understanding of the importance of having a positive attitude
   - i) Identify & discuss the characteristics of a positive attitude
   - ii) Explain why it is important to have a positive attitude
   - iii) Explain how a positive attitude can improve a customer’s satisfaction
   - iv) Define perception and explain how perception can alter us and customers
   - v) Describe methods of dealing with perception

4. Communicating effectively with customers
   - i) Describe the main elements in the communication process
   - ii) Identify some barriers to effective communication
   - iii) Explain why body language is important
   - iv) Define active listening and state why it is important
   - v) Identify and discuss the steps of the listening process
   - vi) Identify and discuss questioning techniques

5. Demonstrate using the telephone effectively
   - i) Explain why telephone skills are important
   - ii) Describe the qualities of a professional telephone interaction

6. Demonstrate an understanding of the importance of asserting oneself
   - i) Define assertiveness
   - ii) Discuss assertive techniques
   - iii) Explain the use of assertiveness when dealing with multiple customers

7. Demonstrate techniques for interacting with challenging customers in addressing complaints & resolving conflict
   - i) Examine & discuss ways to control feelings
   - ii) Examine & discuss ways to interact with an upset customer
   - iii) Examine & discuss ways to resolve conflict/customer criticism
   - iv) Examine & discuss ways to prevent unnecessary conflict with customers

Practical:

1. Participate in activities to demonstrate knowledge of the course objectives.

SP-2330 QUALITY ASSURANCE/QUALITY CONTROL

Description:

This course is designed to give students an understanding of the concepts and requirements of QA/QC such as, interpreting standards, controlling the acceptance of raw materials, controlling quality variables and documenting the process. It includes information on quality concepts, codes and standards, documentation, communications, human resources, company structure and policy, teamwork and responsibilities.

Course Outcomes:

Upon completion of this course, students will be able to:
- develop the skills and knowledge required to apply quality assurance/quality control procedures as related to the trade
- develop an awareness of quality principles and processes
- apply quality assurance/quality control procedures in a shop project

Objectives & Content:

1. Describe the reasons for quality assurance and quality plans.

2. Explain the relationship between quality assurance and quality control.

3. Describe quality control procedures as applied to the production and checking of specifications and processes in applicable occupations.

4. Describe quality control procedures as applied to the acceptance and checking of raw materials.

5. Explain the role of communications in a quality environment.

6. Explain why it is important for all employees to understand the structure of the company and its production processes.

7. Explain how human resource effectiveness is maximized in a quality managed organization.

8. Explain the role of company policy in quality management.

9. Explain the purpose of codes and standards in various occupations.

10. Explain the concepts of quality
    - i) cost of quality
    - ii) measurement of quality
    - iii) elements of quality
    - iv) elements of the quality audit
    - v) quality standards
    - vi) role expectations and responsibilities

11. Explain the structure of quality assurance and quality control
    - i) Describe organizational charts
    - ii) Identify the elements of a quality assurance system such as ISO, CSA, WHMIS, Sanitation Safety Code (SSC)
    - iii) Explain the purpose of the quality assurance manual
    - iv) Describe quality assurance procedures

12. Examine quality assurance/quality control documentation
    - i) Describe methods of recording reports in industry
    - ii) Describe procedures of traceability (manual and computer-based recording)
    - iii) Identify needs for quality control procedures

Practical:

1. Apply quality control to a project
    - i) Follow QA/QC procedures for drawings, plans and specifications in applicable occupations.
    - ii) Calibrate measuring instruments and devices in applicable occupations.
    - iii) Interpret required standards
    - iv) Follow QA/QC procedures for accepting raw materials
    - v) Carry out the project
    - vi) Control the quality elements (variables)
    - vii) Complete QA/QC reports

MC-1050 INTRODUCTION TO COMPUTERS

Description:

This course is designed to give the student an introduction to computer systems. Particular emphasis is given to word processing, spreadsheet, e-mail and the Internet and security issues.

Course Outcomes:

Upon completion of this course, students will have a basic understanding of:
– computer systems and their operation.
– popular software packages, their applications
– security issues of Computers

Objectives & Content:

1. Identify the major components of microcomputer system hardware and software system.

2. Describe the functions of the microprocessor.
   i) Describe and give examples of I/O DEVICES.
   ii) Describe primary storage (RAM, ROM, Cache).
   iii) Define bit, byte, code and the prefixes k.m. and g.
   iv) Describe secondary storage (diskettes and hard disks, CD ROMS, Zip Drives etc).
   v) Describe how to care for a computer and its accessories.

3. Describe microcomputer software
   i) Define software.
   ii) Describe types of operational and application software
   iii) Define file and give the rules for filenames and file extensions.

4. Describe windows software
   i) Start and quit a Program
   ii) Demonstrate how to use the help function
   iii) Locate a specific file using the **find** function
   iv) Identify system settings:wall paper, screen saver, screen resolution, background
   v) Start a program by using the Run Command
   vi) Shutting down your computer

5. Identify File Management commands
   - i) Demonstrate how to view directory structure and folder content
   - ii) Organize files and folders
   - iii) Copy, delete, and move files and folders
   - iv) Create folders
   - v) Maximize and minimize a window
   - vi) Describe windows task bar

6. Describe Keyboards
   - i) Identify and locate alphabetic and numeric keys
   - ii) Identify and locate function key & special keys

7. Describe Word Processing
   - i) Describe Windows components
   - ii) Menu bar
   - iii) Menu indicators
   - iv) Document window
   - v) The Status bar
   - vi) The Help feature
   - vii) Insertion point movements

8. Describe the procedure used to development of a document
   - i) Enter text
   - ii) Change the display

9. Describe the procedure for opening, saving and exiting documents
   - i) Saving a document
   - ii) Closing a document.
   - iii) Starting a new document Window
   - iv) Opening a document
   - v) Exiting word processor

10. Describe the procedure for editing a Document
    - i) Adding new text
    - ii) Deleting text
    - iii) Using basic format enhancement (split and join paragraphs, insert text)

11. Describe the main Select Features
    - i) Identify a selection
    - ii) Moving a selection
    - iii) Copying a selection
    - iv) Deleting a selection

v) Saving a selection

12. Explain how to change Layout Format
    i) Changing layout format: (margins, spacing, alignment, paragraph indent, tabs, line spacing, page numbering)

13. Explain how to change Text Attributes
    i) Changing text attributes: (bold, underline, font, etc.)

14. Describe the Auxiliary Tools
    i) Using Spell Check & Thesaurus

15. Describe Print features
    i) Selecting the Print Feature: (i.e; number of copies and current document)
    ii) Identifying various options in print screen dialogue box

16. Examine & Discuss Electronic Spreadsheet
    i) Spreadsheet Basics
    ii) The Worksheet Window

17. Describe Menus
    i) Menu Bar
    ii) Control menu
    iii) Shortcut menu
    iv) Save, Retrieve form menus

18. Describe the components of a worksheet
    i) Entering constant values and formulas
    ii) Using the Recalculation feature

19. Describe Use ranges
    i) Typing a range for a function
    ii) Pointing to a range for a function
    iii) Selecting a range for toolbar and menu commands

20. Describe how to print a worksheet
    i) Printing to the Screen
    ii) Printing to the Printer
    iii) Printing a selected Range

21. Describe how to edit a worksheet
    - i) Replacing cell contents
    - ii) Inserting & deleting rows and columns
    - iii) Changing cell formats
    - iv) Changing cell alignments
    - v) Changing column width
    - vi) Copying and moving cells

22. State major security issues in using computers
    - i) Pass words
    - ii) Accessing accounts
    - iii) Viruses and how they can be avoided
    - iv) Identity theft and ways to protect personal information

23. Describe how to use Electronic Mail
    - i) E-mail etiquette
    - ii) E-mail accounts
    - iii) E-mail messages
    - iv) E-mail message with attachments
    - v) E-mail attachments
    - vi) Print e-mail messages
    - vii) Deleting e-mail messages

24. Explain the Internet and its uses
    - i) The World Wide Web(www)
    - ii) Accessing Web sites
    - iii) Internet Web Browsers
    - iv) Internet Search Engines
    - v) Searching Techniques
    - vi) Posting documents on-line

Practical:

1. Create a document using Word Processing.

2. Complete word processing exercises to demonstrate proficiency in word processing

3. Prepare and send e-mails with attachments

4. Retrieve documents and e-mail attachments and print copies

5. Develop & print a spread sheet.

6. Post a document on-line

SD-1700 WORKPLACE SKILLS

Description:

This course involves participating in meetings, information on formal meetings, unions, workers' compensation, employment insurance regulations, workers' rights and human rights.

Course Outcomes:

Upon completion of this course, students will be able to:
- Participate in meetings
- Define and discuss basic concepts of:
  - unions
  - workers' compensation
  - employment insurance
  - workers' rights
  - human rights
  - workplace diversity
  - gender sensitivity

Objectives & Content:

1. Meetings
   - i) Identify & discuss meeting format and preparation required for a meeting.
   - ii) Explain the purpose of an agenda.
   - iii) Explain the roles and responsibilities of meeting participants.
   - iv) Explain the purpose of motions and amendments and withdrawals.
   - v) Explain the procedure to delay discussion of motions.
   - vi) Explain the voting process.

2. Unions
   - i) State why unions exist.
   - ii) Give a concise description of the history of Canadian labour.
   - iii) Explain how unions function.
   - iv) Explain labour's structure.
   - v) Describe labour's social objectives.
   - vi) Describe the relationship between Canadian labour and the workers.
   - vii) Describe the involvement of women in unions.

3. Worker's Compensation
   - i) Describe the aims, objectives, benefits and regulations of the Workplace

Health, safety and Compensation Commission.

ii) Explain the internal review process.

4. Employment Insurance
   i) Explain employment insurance regulations
   ii) Describe how to apply for employment insurance.
   iii) Explain the appeal process.
   iv) Identify the components of a letter of appeal.

5. Worker's Rights
   i) Define labour standards.
   ii) Explain the purpose of the Labour Standards Act.
   iii) Identify regulations pertaining to:
      – Hours of work
      – Minimum wages
      – Employment of children
      – Vacation pay
   iv) Explain the purpose of the Occupational Health & Safety Act as it refers to workers' rights

6. Human Rights
   i) Describe what information cannot be included on an employment application.
   ii) Describe what information cannot be included in an interview.
   iii) Examine the Human Rights Code and explain the role of the Human Rights Commission.
   iv) Define harassment in various forms and identify strategies for prevention.

7. Workplace Diversity
   i) Define and explore basic concepts and terms related to workplace inclusively including age, race, culture, religion, socio-economic, sexual orientation with an emphasis on gender issues and gender stereotyping.

8. Gender Sensitivity
   i) Explore gender and stereotyping issues in the workplace by identifying strategies for eliminating gender bias.

Practical:

1. Prepare an agenda.

2. Participate in a meeting.

3. Analyze a documented case of a human rights complaint with special emphasis on the application, time frame, documentation needed, and legal advice available.

SD-1710 JOB SEARCH TECHNIQUES

Description:

This course is designed to give students an introduction to the critical elements of effective job search techniques.

Course Outcomes:

Upon completion of this course, students will be able to:

– Demonstrate effective use of Job Search Techniques

Objectives & Content:

1. Identify and examine employment trends and opportunities

2. Identify sources that can lead to employment

3. Access and review information on the Newfoundland and Labrador Apprenticeship and Certification Web site and the Apprenticeship Employment Gateway

4. Analyze job ads and discuss the importance of fitting qualifications to job requirements

5. Identify and discuss employability skills as outlined by the Conference Board of Canada.

6. Discuss the necessity of fully completing application forms**.**

7. Establish the aim/purpose of a resume

8. Explore characteristics of effective resumes, types of resumes, and principles of resume format .

9. Explore characteristics of an effective cover letter.

10. Identify commonly asked questions in an interview.

11. Explore other employment related correspondence.

12. Explore the job market to identify employability skills expected by an employer.

13. Conduct a self-analysis and compare with general employer expectations.

14. Discuss the value of establishing and maintaining a portfolio.

Practical:

1. Complete sample application forms.

2. Write a resume.

3. Write an effective cover letter.

4. Establish a portfolio.

5. Write out answers to commonly asked questions asked during interviews.

6. Identify three potential employers from the Apprenticeship Employment gateway, Apprenticeship & Certification web site.

SD-1720 ENTREPRENEURIAL AWARENESS

Description:

This course is designed to introduce the student to the field of entrepreneurship, including the characteristics of the entrepreneur, the pros and cons of self-employment, and some of the steps involved in starting your own business.

Course Outcomes:

Upon completion of this course, the student will be able to:

– Identify the various types of business ownership, the advantages and disadvantages of self-employment and identify the characteristics of an entrepreneur.
– State the purpose and identify the main elements of a business plan.

Objectives & Content:

1. Explore Self-Employment: An Alternative to Employment
   i) Identify the advantages and disadvantages of self-employment vs. regular employment
   ii) Differentiate between an entrepreneur and a small business owner
   iii) Evaluate present ideas about being in business

2. Identify and discuss various types of business ownership

   i) Explore the Characteristic of Entrepreneurs
   ii) Identify characteristics common to entrepreneurs
   iii) Compare one's own personal characteristics with those of entrepreneurs.
   iv) Examine one's present ideas about business people

3. Identify Business Opportunities
   i) Distinguish between an opportunity and an idea.
   ii) Examine existing traditional and innovative business ventures
   iii) Identify and summarize the role of various agencies that support business development.
   iv) Identify potential business opportunities.

4. Review the Entrepreneurial Process.
   i) Explain the entrepreneurial process
   ii) Describe the purpose of a business plan

iii) Identify & discuss the main elements of a business plan

Practical:

1. From a list potential business opportunities prepare a list of elements that would have to be included in a business plan.