

Apprenticeship Curriculum Standard

Transmission Technician

Level 1

310D

2003



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<u>Please Note</u>: This Standard has been revised to reflect the visual identity of Skilled Trades Ontario (STO) which replaced the Ontario College of Trades on January 1, 2022. The content of this Standard may refer to the former organization; however, all trade specific information or content remains relevant and accurate based on the original date of publishing.

Please refer to STO's website: <u>skilledtradesontario.ca</u> for the most accurate and up to date information. For information about BOSTA and its regulations, please visit <u>Building</u> <u>Opportunities in the Skilled Trades Act, 2021 (BOSTA).</u>

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Preface

This curriculum standard for the Transmission Technician trade program is based upon the on-the-job performance objectives, located in the industry-approved training standard.

The curriculum is organized into 2 levels of training. The Reportable Subjects Summary chart (located on page 5) summarizes the training hours for each reportable subject.

The curriculum identifies the learning that takes place in-school. The in-school program focuses primarily on the theoretical knowledge and the essential skills required to support the performance objectives of the Apprenticeship Training Standards.

Employers/Sponsors are expected to extend the apprentice's knowledge and skills through practical training on a work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to verify that all apprentices have achieved the learning outcomes identified in the curriculum standard.

It is not the intent of the in-school curriculum to perfect on-the-job skills. The practical portion of the in-school program is used to reinforce theoretical knowledge. Skill training is provided on the job.

Please refer to Skilled Trades Ontario website (<u>www.skilledtradesontario.ca</u>) for the most accurate and up-to-date information about Skilled Trades Ontario. For information on *Building Opportunities in the Skilled Trades Act, 2021 (BOSTA)*) and its regulations, please visit <u>Building Opportunities in the Skilled Trades Act, 2021, S.O. 2021, c. 28 - Bill 288 (ontario.ca)</u>

Pre-requisites

In order to advance to Level 2 of the apprenticeship program, an individual must have completed all of the units outlined in Level 1.

Hours Disclaimer (if applicable)

It is agreed that Training Delivery Agents (TDAs) may need to make slight adjustments (with cause) according to particular apprentice needs and may deviate from the unit sequencing and the prescribed practical and theoretical hours shown within the standard. However, all TDAs will comply with the hours at the reportable subject level.

Introduction

The Transmission Technician curriculum has been developed in keeping with the prescribed Ministry of Training, Colleges and Universities Training Standards. The curriculum is designed to adhere to the current grade reporting structures for the respective program specialities.

For easy reference, a time allocation has been included for each respective subject and unit, along with the Theory/Practical breakdown for the delivery of the Learning Content. More detailed time allocations for the instructor have been provided for each topic area to assure consistency for each apprentice intake.

The continual introduction of innovative techniques and more complex equipment is resulting in increasing demands for tradespersons who are not only skilled in the practical aspects of the trade, but who also have a sound theoretical knowledge of the inspecting, diagnosing, repair, and servicing requirements. The curriculum has been developed to provide this theoretical knowledge and to offer some practical applications to complement the on-the-job work experiences of Transmission Technician apprentices.

The objectives of the curriculum, therefore, are to provide a basis for:

- a. Sound theoretical training to meet the challenges presented by the increasingly more complex designs and testing techniques.
- b. A reinforcement of fundamental skills of the trade through the exposure to practical applications.
- c. Developing in the apprentices high standards of craftsmanship, problem-solving skills and personal pride in their trade.
- d. Developing desirable work attitudes and a keen sense of responsibility, particularly concerning public and personal safety.

The curriculum has been designed to give the instructor every reasonable opportunity for flexibility and innovation without deviating to any significant degree from the subject requirements, as determined by the Industry Committees and as prescribed in the Regulations for the Trades. Since the scope of the prescribed curriculum is quite extensive, the apprentices must be expected to reinforce the acquired knowledge through regular independent out-of-classroom assignments. The curriculum has been presented in a chronological sequence in keeping with sound teaching methodologies. However, the actual application of the sequence may differ somewhat between colleges because of scheduling, staffing, and facilities utilization.

The curriculum includes specific references to the Ministry of Training, Colleges and Universities Apprenticeship Training Standards. While these references to various performance objectives in the Training Standards have been linked to the respective inschool outcomes, employers should not assume complete coverage to a journeyperson level. The in-school delivery focuses primarily on the knowledge required to master the respective objectives outlined in the Training Standards. Employers, therefore, are expected to complete the training of these respective objectives by applying the prescribed in-school knowledge to the required practical learning experienced in the work setting.

To ensure that apprentices will be able to successfully demonstrate the learning outcomes according to performance criteria, specific times have been allocated in the respective areas to allow for some applications enhancement. It is of utmost importance that all application assignments relate to prescribed experiences only. Time constraints will not permit engaging apprentices in tasks of limited learning benefits that are unrelated to the curriculum outcomes. In the Learning Content section, whenever an assigned operation for an applied test or repair procedure indicates that a demonstration should be performed, there is only enough time allocated for the instructor to perform the activity. If the statement in the assigned operations begins with "perform," "outline," "describe," or "explain," the student is expected to complete the activity.

Regular evaluations of the apprentices' learning achievements must be performed in both theory and practical applications throughout the program to ensure consistency with learning outcome expectations. Testing of apprentice knowledge and skills will take place during the allotted delivery hours for each unit. In addition to providing an evaluation of apprentice competency, the review of test question answers is considered to be a valuable learning opportunity.

In all practical activities, the apprentices will observe the Occupational Health and Safety Act and the applicable regulations including use of personal protective equipment. Institutional regulations and policies may also apply.

Implementation:

October 2003

Stakeholders Information

A consortium of five colleges of applied arts and technology, working in collaboration with the MLITSD (Ministry of Labour, Immigration, Training and Skills Development) and industry stakeholders, participated in the development of this document. A Project Steering Committee was struck to guide the project development process for the Transmission Technician document.

The first step in the development process was to assemble a team, the Project Steering Committee (PSC), consisting of both industry representatives and apprenticeship in-school deliverers. The PSC initiated the plan for the project development that followed. The PSC established two curriculum development groups, each responsible for in-school apprenticeship curriculum documents for the motive power trades identified above.

The two working groups worked with advisory groups, made up of industry representatives, during the development of the curriculum, to ensure content validity. The curriculum development group members also worked with faculty in the colleges they were representing to broaden the consultation spectrum of the project. During various stages of the process, the PSC and participating industry advisory groups evaluated the draft curriculum documents and provided feedback and recommendations for revisions. The revisions to the curriculum documents were based on the new training standards that were developed by the MLITSD in consultation with industry advisory groups. The format that is used in this document has been approved by the MLITSD.

Level 1

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practical
1.0	Work Practices	24	18	6
2.0	Manual Transmission / Transaxle	48	33	15
3.0	Automatic Transmission / Transaxle	84	51	33
4.0	Drive Train Components	36	24	12
5.0	Electrical and Electronics	48	34	14
	Total	240	160	80

Reportable Subject Summary – Level 1

Number:	1				
Title:	Work Practice	es			
Duration	: Total Hou	ırs: 24	Theory: 18	Practic	al: 6
Prerequi	sites: N/A				
Co-requi	sites: Level I, S	ection 2, 3, 4,	5		
1.1 –	Safe Working P	ractices and Te	echniques		
	6 Total Hours	Theory:	6 hours	Practical:	0 hours
1.2 –	Fasteners and T	ightening Proc	edures		
	6 Total Hours	Theory:	4 hours	Practical:	2 hours
1.3 –	Precision Meas	uring Tools			
	6 Total Hours	Theory:	4 hours	Practical:	2 hours
1.4 –	Bearings, Seals	and Sealants			
	6 Total Hours	Theory:	4 hours	Practical:	2 hours

Number:	1.1		
Title:	Safe Working Practic	ces and Techniques	
Duration:	Total Hours: 6	Theory: 6	Practical: 0
Cross Refere	nce to Training Standards	:: 1.1-4, 1.7, 1.11-12	

Describe the pertinent information relating to *Workplace Hazardous Materials Information Safety (WHMIS), Occupational Health and Safety Act (OHSA), Repair and Storage Liens Act (RSLA)* and *Workplace Safety Insurance Board (WSIB).*

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 1.1.1 Describe Workplace Hazardous Materials Information Safety (WHMIS).
- 1.1.2 Describe the Occupational Health and Safety Act (OHSA).
- 1.1.3 Describe the Repair and Storage Liens Act (RSLA).
- 1.1.4 Describe the Workplace Safety Insurance Board (WSIB).

- 1.1.1 Describe Workplace Hazardous Materials Information Safety (WHMIS). [2/0]
 - right to know
 - legislation
 - safe handling of products
 - hazardous materials
 - Material Safety Data Sheets (MSDS)

- 1.1.2 Describe the Occupational Health and Safety Act (OHSA). [1/0]
 - legislation
 - obligation of employer and worker
- 1.1.3 Describe the *Repair and Storage Liens Act (RSLA).* [2/0]
 - payment for repairs or storage
 - lien
 - search for
 - Personal Property Security Registration (PPSR)
 - o registration by vehicle identification number (VIN)
 - o registration by individuals name
 - o registration by business name
 - dispute over lien
- 1.1.4 Describe the *Workplace Safety Insurance Board (WSIB).* [1/0]
 - reporting accidents to company
 - reporting accidents to WSIB
 - required records
 - training requirements
 - accident prevention
 - safety precautions
 - personal protection equipment
 - house keeping

Number:	1.2				
Title:	Fasteners and Tightening P	rocedures			
Duration:	Total Hours: 6	Theory: 4	Practical: 2		
Cross Reference to Training Standards: 5190.01-04, 5191.01-07, 5192.01-07, 5193.01-07, 5194.01-04, 5195.01-04					

Demonstrate a working knowledge of purpose, construction, applications and tightening of fasteners.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 1.2.1 Define the purpose and fundamentals of fasteners and tightening methods.
- 1.2.2 Describe the construction, composition, types, styles and application of the following fasteners.
- 1.2.3 Explain the principles of operation of fasteners and tightening procedures.
- 1.2.4 Perform installation and removal procedures for fasteners following manufacturers' recommendations.

- 1.2.1 Define the purpose and fundamentals of fasteners and tightening methods. [1/0]
 - thread terminology, fastener grades / application
 - Society of Automotive Engineers (SAE), International Standards (IS)
 - tensile strength, shear strength
 - grade, pitch, threads per inch
 - diameter, length, head size, yield point and fatigue
 - dynamic and static seal applications
 - loctite grades
 - never-seize
 - sealant applications
 - factors that effect torque / tension
 - o Iubrication
 - o temperature
 - o length / diameter
 - grade of fastener

- \circ condition of threads
- o composition of material
- 1.2.2 Describe the construction, composition, types, styles and application of the following fasteners:
 - [1/0]
 - bolts
 - nuts
 - screws
 - studs
 - locking devices
 - pins
 - rivets
 - keys
 - washers
 - retaining rings
 - helicoils
 - thread sealants and adhesives
- 1.2.3 Explain the principles of operation of fasteners and tightening procedures. [1/0]
 - torque to yield bolts and cap screws
 - torque effects of wet, dry and clean threads
 - locking devices
 - helicoil thread repair principles
 - temperature
 - compatibility
 - clamping force
- 1.2.4 Perform installation and removal procedures for fasteners following manufacturers' recommendations.

[1/2]

- verify thread strengths and torque requirements for wet and dry
- thread repair
 - o freeing seized threads, removal of broken studs / cap screws
 - o installation of helicoils, locking devices
- metal working practices
- drilling
- tapping
- hack sawing
- filing
- sealant selection, removal and installation practices
- loctite and never-seize application.

Number:	1.3				
Title:	Precision Measuring Tool	S			
Duration:	Total Hours: 6	Theory: 4	Practical: 2		
Cross Reference to Training Standards: 5190.02-04, 5191.02-07, 5192.02-07, 5193.02-07, 5194.02-04, 5195.02-04					

Demonstrate a working knowledge of the purpose, construction, principles of operation and calibration of precision and non-precision measuring tools.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 1.3.1 Define the purpose and fundamentals of precision and non-precision tools.
- 1.3.2 Describe the construction, types and application of precision measuring tools.
- 1.3.3 Explain the basic principles of operation of precision measuring tools.
- 1.3.4 Perform maintenance and calibration procedures of precision and non-precision measuring tools following manufacturers' recommendations.

- 1.3.1 Define the purpose and fundamentals of precision and non-precision tools. [1/0]
 - metric and Imperial measurements, and conversions
- 1.3.2 Describe the construction, types and application of precision measuring tools. [1/0]
 - micrometers
 - \circ inside
 - o outside
 - o depth
 - small hole gauges
 - calipers
 - vernier caliper
 - telescoping gauges
 - straight edges
 - dial indicators
 - non-precision

- 1.3.3 Explain the basic principles of operation of precision measuring tools. [2/0]
 - micrometers
 - ∘ inside
 - o outside
 - o depth
 - small hole gauges
 - calipers
 - vernier
 - telescoping gauges
 - straight edges
 - dial indicators
 - non- precision
- 1.3.4 Perform maintenance and calibration procedures of precision and non-precision measuring tools following manufacturers' recommendations. [0/2]
 - describe basic tool maintenance procedures
 - \circ storage

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- o lubrication
- o methods of restoring critical surfaces
- o adjustments, calibration
- demonstration of precision measuring activities as applied to various components and clearance checks
 - micrometer calibrating kit.

Number:	1.4				
Title:	Bearings, Seals and Seala	ants			
Duration:	Total Hours: 6	Theory: 4	Practical: 2		
Cross Reference to Training Standards: 5190.01-04, 5191.01-07, 5192.01-07, 5194.01-04, 5195.01-04					

Demonstrate a working knowledge of the purpose, construction, principles of operation, inspection and testing for bearings, seals and sealants.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 1.4.1 Define the purpose and fundamentals of automotive bearings, seals and sealants.
- 1.4.2 Describe the construction, composition, types, styles and application of bearings, seals and sealants.
- 1.4.3 Explain the principles of operation of bearings seals and sealants.
- 1.4.4 Perform inspection and testing procedures for bearings, seals and sealants following manufacturers' recommendations
- 1.4.5 Perform assigned operations following manufacturers' recommendations.

- 1.4.1 Define the purpose and fundamentals of automotive bearings seals and sealants. [1/0]
 - loads •
 - mountings
 - capacities
 - lubrication
- 1.4.2 Describe the construction, composition, types, styles and application of bearings seals and sealants. [1/0]

- friction bearings ٠
- anti-friction bearings
 - o ball
 - o roller
 - o **needle**

- seals
 - o dynamic
 - o static
- sealants
 - \circ hardening
 - \circ non-hardening
 - gaskets

٠

- o **yield**
- o creep
- 1.4.3 Explain the principles of operation of bearings seals and sealants. [2/0]
 - friction bearings
 - anti-friction bearings
 - ∘ ball
 - \circ roller
 - \circ needle
 - seals
 - \circ dynamic
 - o static
 - sealants
 - o hardening
 - \circ non-hardening
 - o **anaerobic**
 - \circ non-anaerobic
 - gaskets
 - yield
 - o creep
- 1.4.4 Perform inspection and testing procedures for bearings, seals and sealants following manufacturers' recommendations.
 - [0/1]
 - failure analysis
 - \circ scoring
 - o spalling
 - \circ over-heating
 - o **noise**
 - o vibration
 - \circ clearance
 - \circ migration
 - checks for leakage of seals or gaskets
 - shaft and housing bore condition
 - fluid compatibility

- 1.4.5 Perform assigned operations following manufacturers' recommendations. [0/1]
 - perform removal and installation of:
 - bearings
 - o friction
 - o non-friction
 - seals
 - o **static**
 - o **dynamic**
 - sealants and gaskets

Evaluation:

The following evaluation structure is only a suggested format. Specific evaluation of theory and practical components of training varies due to the resource material and training aides utilized

Evaluation Structure					
Theory Testing	Practical Application Testing	Research Assignment	Notebook and Organizational Skills		
50%	30%	10%	10%		

Number:	2		
Title:	Manual Transmission / T	ransaxle	
Duration:	Total Hours: 48	Theory: 33	Practical: 15
Prerequisites:	N/A		
Co-requisites:	Level I, Section 1, 3, 4, 5		

2.1	-	Drive Train Lubric	ation Systems	6		
		6 Total Hours	Theory:	6 hours	Practical:	0 hours
2.2	-	Differential Gear F	undamentals			
		6 Total Hours	Theory:	6 hours	Practical:	0 hours
2.3	-	Gear Ratios and A	Applied Calcul	ations		
		6 Total Hours	Theory:	6 hours	Practical:	0 hours
2.4	_	Transmission / Transm	ansaxle Remo	oval and Installation		
		3 Total Hours	Theory:	3 hours	Practical:	0 hours
2.5	_	Manual Transmiss	sion / Transax	le Construction		
		12 Total Hours	Theory:	12 hours	Practical:	0 hours
2.6	_	Manual Transmiss	sion / Transax	le Overhaul		
		15 Total Hours	Theory:	0 hours	Practical:	15 hours

Number:	2.1				
Title:	Drive Train Lubrication S	Systems			
Duration:	Total Hours: 6	Theory: 6	Practical: 0		
Cross Reference to Training Standards: 5190.01-04, 5191.01-07, 5192.01-07, 5194.01-04, 5195.01-04					

Demonstrate a working knowledge of drive train lubrication.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

2.1.1 Define the purpose and fundamentals of drive train lubrication.

- 2.1.1 Define the purpose and fundamentals of drive train lubrication. [6/0]
 - hydraulic fluids
 - \circ types
 - \circ viscosity
 - o additives
 - o temperature and fluid performance
 - o schematics
 - Society of Automotive Engineers (S.A.E.) and propriety symbols
 - American Petroleum Institute (A.P.I.)
 - o characteristics of lubricants
 - \circ static and dynamic friction
 - Iubrication
 - \circ gear oil
 - o engine oil
 - o synthetics
 - o cooling
 - automatic transmission fluid
 - o silicone
 - o additives
 - venting system inspection
 - o lubricating universal joints
 - o final drive lubrication
 - types of lubricants
 - service intervals

- o oil analysis
 - composition
 - odour
 - visual
 - contamination
 - tactile
 - static and dynamic friction
 - coefficient of friction
 - friction and heat
 - quality of lubrication
- o oil level inspection
 - hot
 - cold
- o filter changes
- drive line lubrication
- o checking for contamination
 - water
 - antifreeze
 - foreign particles

Number:	2.2		
Title:	Differential Gear Fun	damentals	
Duration:	Total Hours: 6	Theory: 6	Practical: 0
Cross Refere	nce to Training Standards	: 1.1-4, 1.7, 1.11-12	

Demonstrate a working knowledge of differential gears and their applications.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

2.2.1 Define the purpose, fundamentals, types, styles and application of differential gears.

- 2.2.1 Define the purpose, fundamentals, types, styles and application of differential gears. [6/0]
 - types of gears
 - o spur
 - o helical
 - o worm
 - gear theory
 - \circ rotation
 - o **speed**
 - o torque
 - \circ internal
 - \circ external
 - characteristics of gears
 - o thrust
 - o strength
 - o wear
 - o contact
 - o meshing
 - inspect gear tooth contact pattern
 - failure diagnosis
 - final drive assemblies
 - o gear types
 - bevel gear
 - spur bevel
 - helical
 - hypoid
 - spiral bevel

- gear set identification
 - \circ hunting
 - o non-hunting
 - o partial hunting
 - gear mounting

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- o straddle
- \circ overhung

Number:	2.3		
Title:	Gear Ratios and Applied	Calculations	
Duration:	Total Hours: 6	Theory: 6	Practical: 0
Cross Reference to Training Standards: 5190.01-02, 5192.01-02, 5195.01-02			

Demonstrate a working knowledge of gear ratios and their calculations.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

2.3.1 Describe the principles of operation for underdrive / overdrive assemblies and determine applied gear ratios.

- 2.3.1 Describe the principles of operation for underdrive / overdrive assemblies and determine applied gear ratios.[6/0]
 - gear ratios and calculations
 - speed and torque
 - direction of rotation
 - internal and external tooth gears
 - idler gears
 - counting of gear teeth on actual gear components and doing calculations
 - input to output shaft ratios
 - mechanical advantage
 - laws of leverage
 - \circ torque
 - o speed
 - o power flow.

Number:	2.4		
Title:	Transmission / Transaxle	Removal and Installa	tion
Duration:	Total Hours: 3	Theory: 3	Practical: 0
Cross Reference to Training Standards: 5191.01, 05-07			

Demonstrate a working knowledge of removal and installation of transmissions / transaxles.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

2.4.1 Outline recommended procedures for removal and installation of transmissions / transaxles following manufacturers' recommendations.

- 2.4.1 Outline recommended procedures for removal and installation of transmissions / transaxles following manufacturers' recommendations.
 [3/0]
 - rear wheel drive
 - o consult manufacturers' recommendations
 - o under vehicle inspection
 - o drain fluid
 - o disconnect battery
 - o sub frames / cross members
 - o exhaust
 - o engine support
 - mark drive shaft
 - linkage and wiring connections
 - o secure and support transmission
 - o cooler lines
 - o cooler flush
 - o flywheel / flexplate
 - o torque converter / ring gear
 - o dowel pins / alignment
 - front wheel drive
 - o consult manufacturers' recommendations
 - under vehicle inspection
 - o drain fluid
 - o disconnect battery
 - o sub frames / cross members
 - o hub nuts / wheel nuts
 - CV shafts

- \circ brake lines
- stored brake pressure
- o **exhaust**
- \circ engine support
- \circ suspension
- o ball joints
- o tie rod / steering linkage
- o springs / struts / shocks
- o electrical connectors
- linkage and wiring connections
 - o secure and support transmission
 - \circ cooler lines
 - o cooler flush
 - o flywheel / flexplate
 - o torque converter / ring gear
 - o dowel pins / alignment
 - engine / transaxle location and position
- air conditioning
 - o identify environmental damage potential of CFC/HFC/HFC
 - identify controls of CFC/HFC/CCFC
 - o identify personal safety
 - eye, hand and face protection
 - toxicity
 - flammability
 - inhalation
 - refrigerant temperature / pressure
 - identify equipment used for recover of refrigerants (requires Ozone Depletion Certification)
 - o identify major components
 - condenser
 - evaporator
 - compressor
 - hoses, lines, valves and fittings
 - receiver dehydration
 - accumulator-dryer

Number:	2.5		
Title:	Manual Transmission / Tr	ransaxle Construction	
Duration:	Total Hours: 12	Theory: 12	Practical: 0
Cross Reference to Training Standards: 5191.01-03			

Demonstrate a working knowledge of the construction and operation of manual transmissions / transaxles.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 2.5.1 Define the purpose, types, styles and fundamentals of manual transmissions / transaxles.
- 2.5.2 Define the construction of manual transmissions / transaxles.
- 2.5.3 Define the principles of operation of manual transmissions / transaxles.

Learning Content

2.5.1 Define the purpose, types, styles and fundamentals of manual transmissions / transaxles.

[2/0]

- transmissions / transaxles
- continuously variable transmission / transaxle
- 2.5.2 Define the construction of manual transmissions / transaxles. [4/0]
 - case
 - shafts
 - gear layout
 - Iubrication
 - seals and gaskets
 - synchronizers
 - bearings
 - bearing pre-load
 - transverse vs. longitudinal
 - final drive gearing
 - continuously variable
 - shift linkage
 - lock out systems

- 2.5.3 Define the principles of operation of manual transmissions / transaxles. [6/0]
 - test and verify power flow
 - final drive / differentials
 - o straight ahead
 - cornering
 - 4-speed transmission
 - 5-speed transmission
 - 6-speed transmission
 - 4-speed transaxle
 - 5-speed transaxle
 - observe manufacturers' service recommendations
 - Iubrication

Number:	2.6		
Title:	Manual Transmission	/ Transaxle Overhau	I
Duration:	Total Hours: 15	Theory: 0	Practical: 15
Cross Reference to Training Standards: 5191.01, 05-07			

Demonstrate a working knowledge of dismantling, diagnosing and reassembling of manual transmissions / transaxles.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

2.6.1 Inspect, dismantle, diagnose and reassemble transmission / transaxle following manufacturers' recommendations.

Learning Content

2.6.1 Inspect, dismantle, diagnose and reassemble manual transmissions / transaxles following manufactures' recommendations.

[0/15]

- identify transmissions / transaxles
- locate required manufacturers' information
- outline dismantle procedures and cautions
- diagnosis manual transmissions / transaxles related malfunction
- measuring practices
- failure analysis
 - o primary causes
 - secondary causes
 - discuss road test procedures
- non-destructive testing
- test and verify power flow
- inspect gear tooth contact pattern
- check bearing pre-load adjustment
- inspect / replace gaskets and seals
- failure analysis
 - wear / operator
 - o materials / fatigue

Evaluation:

The following evaluation structure is only a suggested format. Specific evaluation of theory and practical components of training varies due to the resource material and training aides utilized

Evaluation Structure				
Theory Testing	Practical Application Testing	Research Assignment	Notebook and Organizational Skills	
50%	30%	10%	10%	

N	umber:		3				
Ti	tle:		Work Pract	tices			
D	uration:		Total Hours	: 84	Theory: 51	Practio	cal: 33
Pr	rerequis	ites:	N/A				
C	o-requis	ites:	Level I, Sec	tion 1, 2, 4, 5			
3.1	_	Fluid	Power Fund	amentals			
		12 To	otal Hours	Theory:	10 hours	Practical:	2 hours
3.2	_	Auto	matic Transn	nission / Tran	saxle Fundamentals		
		9 Tot	al Hours	Theory:	9 hours	Practical:	0 hours
3.3	_	Auto	matic Transn	nission / Tran	saxle Principles of O	peration	
		15 To	otal Hours	Theory:	8 hours	Practical:	7 hours
3.4	_	Torq	ue Converter	Fundamenta	ls		
		9 Tot	al Hours	Theory:	9 hours	Practical:	0 hours
3.5	_	Torq	ue Converter	Inspection a	nd Diagnosis		
		6 Tot	al Hours	Theory:	3 hours	Practical:	3 hours
3.6	_	Plane	etary Gear Ti	rains			
		9 Tot	al Hours	Theory:	9 hours	Practical:	0 hours
3.7	_	Auto	matic Transn	nission / Tran	saxle Overhaul		
		18 To	otal Hours	Theory:	0 hours	Practical:	18 hours
3.8	_	Auto	matic Transn	nission / Tran	saxle Maintenance		
		6 Tot	al Hours	Theory:	3 hours	Practical:	3 hours

Number:	3.1		
Title:	Fluid Power Fundame	entals	
Duration:	Total Hours: 12	Theory: 10	Practical: 2
Cross Referer	nce to Training Standards:	5192.01-07	

Demonstrate a working knowledge of the principles of operation, inspection and testing of fluid power systems.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 3.1.1 Define the purpose and fundamentals of fluid power systems.
- 3.1.2 Describe the construction, composition, types, styles and application of fluid power systems.
- 3.1.3 Explain the basic principles of operations of fluid power systems.
- 3.1.4 Perform inspection and testing procedures following manufactures' recommendations.

Learning Content

- 3.1.1 Define the purpose and fundamentals of fluid power systems. [2/0]
 - Pascal's Law and the application of static fluids
 - Boyle's Law, Charles' Law and Bernoulli's Law
 - laws of levers
 - pressure, force and area
 - flow and speed
 - measure of flow loss
 - orifices
- 3.1.2 Describe the construction, composition, types, styles and application of fluid power systems.

[3/0]

- pumps
- control valves

- ٠ actuators
- reservoirs
- oil coolers •

3.1.3 Explain the basic principles of operations of fluid power systems. [5/0]

- pumps •
- control valves •
- actuators ٠
- clutch master cylinders / slave cylinders •
- reservoirs •
- oil coolers •
- schematics •

3.1.4 Perform inspection and testing procedures following manufacturers' recommendations. [0/2]

- lines / fittings •
- valves ٠
- cylinders •
- reservoirs •
- fluids
- pumps
- filters ٠
- bleeding •
- flushing •

Number:	3.2		
Title:	Automatic Transmission	Transaxle Fundame	ntals
Duration:	Total Hours: 9	Theory: 9	Practical: 0
Cross Reference to Training Standards: 5192.01			

Demonstrate a working knowledge of the fundamentals, types and styles of automatic transmission / transaxle.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

3.2.1 Define the purpose, fundamentals, types and styles of an automatic transmission / transaxle.

- 3.2.1 Define the purpose, fundamentals, types and styles of an automatic transmission / transaxle. [9/0]
 - pumps
 - o positive displacement
 - o variable displacement
 - o internal / external
 - \circ gear / rotor
 - o vane
 - control system valves
 - o main control pressure regulator
 - o secondary pressure regulator
 - o manual valve
 - o throttle valve
 - o governor valve
 - shift valves
 - o vacuum valves
 - modulator valves
 - o converter control valves
 - \circ cutback / limit valves
 - governors
 - centrifugal
 - controlled leak
 - o apply devices

- \circ bands
 - single / double wrap
 - flex / rigid
 - paper / semi-metallic
- clutches
 - one-way clutches
 - sprag
 - roller
- o ratcheting mechanical
- parking mechanism
- o actuating rod
- o park pawl
- o park gear
- transmission / transaxle case passages and fluid circuits
 - $\circ \quad \text{in-line filters} \quad$
 - \circ orifices
 - \circ accumulators
 - o servos
 - cooling / lubrication system
 - heat exchanger
 - \circ lines

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- o auxiliary cooling systems
- o air cooled systems

Number:	3.3		
Title:	Automatic Transmiss	ion / Transaxle Princ	iples of Operation
Duration:	Total Hours: 15	Theory: 8	Practical: 7
Cross Referen	ce to Training Standards:	5192.01, 05-07	

Demonstrate a working knowledge of the principles of operation automatic transmission / transaxle components and systems.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 3.3.1 Define the purpose and fundamentals of valves, pumps, servos, clutches, schematics and fluids used in hydraulic systems.
- 3.3.2 Explain the principles of operation of automatic transmission / transaxle, apply devices and control systems.
- 3.3.3 Disassemble, inspect and reassemble automatic transmission / transaxle pumps, valve bodies, servos and pistons following manufacturers' recommendation.

- 3.3.1 Define the purpose and fundamentals of valves, pumps, servos, clutches, schematics and fluids used in hydraulic systems.[4/0]
 - pumps
 - o positive displacement / variable displacement
 - o internal / external
 - o gear / rotor
 - o **gerotor**
 - o vane
 - circuit pressure management
 - \circ circuit
 - \circ lube
 - \circ cooling
 - relief valves
 - hydraulic system effects from
 - o atmospheric pressure
 - o vacuum

- heat cavitations
- servos and valves
- o surface area
- o linear force
- o centrifugal force
- applied calculations
- 3.3.2 Explain the principles of operation of automatic transmission / transaxle, apply devices and control systems.

[4/0]

- pumps
 - o positive displacement / variable displacement
 - o internal / external
 - \circ gear / rotor
 - \circ gerotor
 - o vane
- apply devices
 - \circ servos simple / compound
 - bands
 - o clutches
 - o one-way clutches
- control system components
 - main or control pressure regulator
 - o manual valve
 - o throttle valve
 - o governor valve
 - o shift valve
 - o accumulators, servos
 - o vacuum modulator
 - o converter clutch control valves
 - \circ hydraulic circuits, power flow, schematics and tracing of circuits
- 3.3.3 Disassemble, inspect and reassemble automatic transmission / transaxle pumps, valve bodies, servos and pistons following manufacturers' recommendations. [0/7]
 - pumps
 - o positive displacement / variable displacement
 - o internal / external
 - o gear / rotor
 - o vane
 - apply devices
 - o servos simple / compound
 - o bands
 - \circ clutches
 - o one-way clutches

- control system components
 - main or control pressure regulator
 - o manual valve
 - o throttle valve
 - o governor valve
 - shift valve
 - o accumulators
 - \circ servos
 - o vacuum modulator
 - o converter clutch control valves
 - o tracing of hydraulic circuits

Number:	3.4		
Title:	Torque Converter Fu	ndamentals	
Duration:	Total Hours: 9	Theory: 9	Practical: 0
Cross Reference to Training Standards: 5192.01, 03, 04			

Demonstrate a working knowledge of the principles of operation and maintenance for torque converters.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 3.4.1 Define the purpose and fundamentals of fluid couplers and torque converters.
- 3.4.2 Describe the construction of torque converters.
- 3.4.3 Explain the principles of operation of torque converters.
- 3.4.4 Describe manufacturers' maintenance procedures for torque converters.

- 3.4.1 Define the purpose and fundamentals of fluid couplers and torque converters. [2/0]
 - vortex flow and rotary flow
 - heat production and control
 - oil flow characteristics
 - mechanical advantage of levers
 - centrifugal force
 - viscosity / friction
 - Newton's Laws of Action and Reaction
 - torque multiplication
- 3.4.2 Describe the construction of torque converters. [2/0]
 - elements
 - single stage
 - hydraulic clutch controls
 - torque converter components
 - \circ impeller
 - o turbine
 - o stator

- split guide rings
- o vane pitch
- shafts
 - o **turbine**
 - o direct drive shaft
 - \circ stator
 - pump drive
- fluid circuitry
- 3.4.3 Explain the principles of operation of torque converters.

[3/0]

- torque converter components
- vortex, rotary flow and centrifugal force
- flow characteristics
 - o impeller
 - o turbine
 - o stator
 - split guide rings
 - o pitch
 - o fixed vane
 - \circ variable vane
- rotary flow
- torque multiplication phase
- coupling phase
- stall phase
- 3.4.4 Describe manufacturers' maintenance procedures for torque converters. [2/0]
 - observe manufacturers' service recommendations
 - o pre-load
 - torquing
 - o alignment
 - interpret manufacturers' component identification
 - Vehicle Identification Number (V.I.N.)
 - o serial numbers
 - identification tags (I.D.)
 - casting numbers
 - o relevance of production date
 - o remanufacturing procedures
 - o identification markings

Number:	3.5		
Title:	Torque Converter In	spection and Diagnos	is
Duration:	Total Hours: 6	Theory: 3	Practical: 3
Cross Refere	nce to Training Standards	: 5192.01-02	

Demonstrate a working knowledge of inspection and testing procedures for torque converters.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

3.5.1 Perform inspection and testing procedures on torque converters following manufactures' recommendations.

- 3.5.1 Perform inspection and testing procedures on torque converters following manufactures' recommendations.[3/3]
 - performance inspection outline
 stall test procedure
 - demonstrate and perform stall test
 - o manufacturer's recommendations
 - o manufacturers' cautions
 - o maximum time
 - end play
 - one-way clutch
 - visual inspection
 - o ring gear
 - o drive lugs / pads
 - o balance weights
 - pilot dis-colouration
 - hub seal
 - \circ pump drive splines
 - o turbine splines
 - o stator one-way clutch operation
 - o end clearance
 - leak test
 - failure analysis
 - o visual fluid analysis
 - component dis-colouration

- o ballooning
- metal fatigue
- o **splines**
- o torque converter hub
- \circ ring gear
- check crankshaft pilot
- drive pump alignment
 - o confirm mounting dowel pin locations

Number:	3.6		
Title:	Planetary Gear Trains		
Duration:	Total Hours: 9	Theory: 9	Practical: 0
Cross Reference to Training Standards: 5192.01			

Demonstrate a working knowledge of the principles of operation of planetary gear trains.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 3.6.1 Define the purpose and fundamentals of planetary gear trains.
- 3.6.2 Explain the principle of operation and power flow through planetary gear trains.

- 3.6.1 Define the purpose and fundamentals of planetary gear trains. [3/0]
 - gear trains
 - \circ simple
 - o Simpson
 - \circ compound
 - o tandem compound
 - o Ravigneaux
- 3.6.2 Explain the principle of operation and power flow through planetary gear trains. [6/0]
 - gear trains
 - \circ simple
 - o Simpson
 - \circ compound
 - o tandem compound
 - o Ravigneaux

Number:	3.7		
Title:	Automatic Transmiss	sion / Transaxle Overl	haul
Duration:	Total Hours: 18	Theory: 0	Practical: 18
Cross Refere	nce to Training Standards:	5192.05, 06-07	

Demonstrate a working knowledge of overhaul procedures for automatic transmissions / transaxles.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

3.7.1 Dismantle, inspect and reassemble automatic transmissions / transaxles following manufacturers' recommendations.

Learning Outcomes

- 3.7.1 Dismantle, inspect and reassemble automatic transmissions / transaxles following manufacturers' recommendations. [0/18]
 - check and adjust input shaft endplay
 - trace the power flows through gear trains
 - check clutch clearance
 - gear trains
 - planetary (epicyclical)
 - simple
 - compound
 - Simpson
 - tandem compound
 - Ravigneaux
 - sun gear
 - planetary carrier and pinions
 - ring gear
 - apply devices
 - o **bands**
 - servos
 - accumulators
 - clearances
 - \circ clutches
 - o one-way clutches
 - control system valves
 - main or control pressure regulator

- o manual valve
- o throttle valve
- \circ governor valve
- $\circ \quad \text{case cleaning} \quad$
- seals

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- o inspection / replacement
 - lip
 - butt
 - locking
 - one piece
- disassembly / reassembly procedure

 air pressure testing
 - shop floor diagnostics
 - sequential troubleshooting
 - multi-check
- hydraulic pressure testing
- inspect and replace external seals and gaskets
- inspect vent assembly

Number:	3.8		
Title:	Automatic Transmis	sion / Transaxle Maint	tenance
Duration:	Total Hours: 6	Theory: 3	Practical: 3
Cross Referer	nce to Training Standards	: 5192.06-07	

Demonstrate a working knowledge of maintenance procedures for automatic transmissions / transaxles.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

3.8.1 Describe manufacturers' maintenance procedures for automatic transmissions / transaxles.

Learning Content

3.8.1 Describe manufacturers' maintenance procedures for automatic transmissions / transaxles.

[3/3]

- adjust bands including overdrive units and linkage
- change oil and filters
- adjust linkages
- outline road test procedures
- inspect for external leaks
 - ultra-violet leak detection
 - o seals
 - \circ sealants
 - o gaskets
 - lines and fittings
 - o case porosity
- effects of heat on sub-frames
- cooling line replacement and system flushing
- self regulating coolers

Evaluation Structure				
Theory Testing	Practical Application Testing	Research Assignment	Notebook and Organizational Skills	
50%	30%	10%	10%	

Number:	4		
Title:	Drive Train Components		
Duration:	Total Hours: 36	Theory: 24	Practical: 12
Prerequisites:	N/A		
Co-requisites:	Level I, Section 1, 2, 3, 5		

4.1– Clutch Devices

	3 Total Hours	Theory:	3 hours	Practical:	0 hours
4.2 -	- Dry Clutch Assemb	ly			
	12 Total Hours	Theory:	6 hours	Practical:	6 hours
4.3 -	- Clutch Controls And	l Related Cor	nponents		
	9 Total Hours	Theory:	7 hours	Practical:	2 hours
4.4 -	- Drive Shafts (RWD))			
	12 Total Hours	Theory:	8 hours	Practical:	4 hours

Number:	4.1		
Title:	Clutch Devices		
Duration:	Total Hours: 3	Theory: 3	Practical: 0
Cross Reference	e to Training Standards: 519	1.01	

Demonstrate a working knowledge of the purpose and types of clutch devices.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

4.1.1 Define the purpose, fundamentals and types of clutch devices.

Learning Content

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- 4.1.1 Define the purpose, fundamentals and types of clutch devices. [3/0]
 - coefficient of friction
 - static and dynamic
 - friction and heat
 - friction discs
 - o wet and dry
 - o single, dual and multiple
 - other types
 - o dog
 - o cone
 - o one-way
 - o sprag
 - \circ viscous
 - \circ electric
 - hydrodynamic
 - o centrifugal

Number:	4.2		
Title:	Dry Clutch Assembly		
Duration:	Total Hours: 12	Theory: 6	Practical: 6
Cross Referen	ce to Training Standards:	5191.01-02	

Demonstrate a working knowledge of the purpose and fundamentals of dry clutch assemblies.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 4.2.1 Define the purpose and fundamentals of dry clutch assemblies.
- 4.2.2 Perform inspection and testing procedures for dry clutch assemblies following manufacturers' recommendations.

- 4.2.1 Define the purpose and fundamentals of dry clutch assemblies. [5/0]
 - flywheel
 - o conventional
 - dual mass
 - o flat
 - \circ dished
 - \circ ring gear
 - pilot bearing types
 - pressure plate assembly
 - o helical spring
 - standard
 - semi-centrifugal
 - diaphragm spring
 - friction disc assembly
 - o facings
 - materials
 - organic
 - metallic
 - ceramic
 - o attachment
 - bonded
 - riveted
 - wave springs vs. flat centre segments

- hub designs
 - solid
 - cushioned
 - crankshaft torsional vibration
 - torsional springs
 - torsional dampers
 - > stop pins
 - friction dampers
- \circ dual disc clutch assemblies
- o flywheel
- o intermediate plate
- o power flow
- 4.2.2 Perform inspection and testing procedures for dry clutch assemblies following manufacturers' recommendations.
 [1/6]
 - visual inspection
 - o flywheel
 - heat cracks
 - glazing
 - scoring
 - burn spots
 - distortion
 - flywheel-machining practices
 - ring gear replacement procedures
 - clutch assemblies
 - o oil contamination
 - o friction material wear
 - o shimming after machining
 - o torsional spring and hub wear
 - o spline wear
 - o alignment
 - torquing
 - pressure plate
 - \circ condition of finger wear
 - o finger height
 - o release levers
 - component matching
 - o stacking height

Number:	4.3		
Title:	Clutch Controls And Rela	ated Components	
Duration:	Total Hours: 9	Theory: 7	Practical: 2
Cross Reference to Training Standards: 5191.01, 03-04			

Demonstrate a working knowledge of the operation and adjustment procedures for clutch controls and related components.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 4.3.1 Describe the construction, operation and adjustment of clutch controls and related components.
- 4.3.2 Perform assigned operations for clutch assemblies following manufacturers' recommendations.

Learning Content

4.3.1 Describe the construction, operation and adjustment of clutch controls and related components.

[5/0]

- bell housings
 - \circ dowel pins
 - o cross shaft assembly
 - \circ linkages
 - release bearing
 - release mechanisms
 - clutch fork
 - o **mechanical**
 - cable
 - linkage
 - rods
 - clutch start safety switch
 - clutch over centre assist spring
- hydraulic
 - o master cylinder
 - o slave cylinder
- clutch housing
 - perform alignment inspections
 - bell housing face concentricity alignment

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- bell housing bore concentricity alignment
- clutch assembly alignment
- release mechanisms
 - o linkage
 - \circ hydraulic
 - \circ cable
 - \circ free play
 - o proper clutch adjustment procedures
- Iubrication practices
- outline manufacturers' recommended service procedures
- troubleshooting practices
- hydraulics
 - o bleeding
- outline and recondition master and slave cylinders
- 4.3.2 Perform assigned operations for clutch assemblies following manufacturers' recommendations.

[2/2]

- familiarization with manufacturers' service literature
- perform clutch adjustment
- fluid levels
- flushing
- identification of hydraulic media
- special safety precautions
- fluid replacement

Number:	4.4			
Title:	Drive Shafts (RWD)			
Duration:	Total Hours: 12	Theory: 8	Practical: 4	
Cross Reference to Training Standards: 5190.01-04				

Demonstrate a working knowledge of rear wheel drive line purpose, construction, principles of operation and inspection.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 4.4.1 Define the purpose and fundamentals of drive line systems.
- 4.4.2 Describe the function, composition, construction and principles of operation of drive line assembly components.
- 4.4.3 Dismantle, inspect and reassemble driveline assemblies with the prescribed service tools and equipment following manufacturers' recommendations.

Learning Content

- 4.4.1 Define the purpose and fundamentals of drive line systems. [2/0]
 - fundamentals
 - relationship of drive shaft speed and balance
 - o centrifugal force
 - linear movement
 - o angular measurement
- 4.4.2 Describe the function, composition, construction and principles of operation of drive line assembly components.

[6/0]

- drive shafts
 - universal joints
 - o cardan joint
 - o double cardan
 - variable velocity
 - o phasing
 - fluctuating speed

- 4.4.3 Dismantle, inspect and reassemble driveline assemblies with the prescribed service tools and equipment following manufacturers' recommendations.
 [0/4]
 - visual inspection
 - o drive line angle measurements
 - o drive line alignment
 - o trim height / frame height
 - spring sagging
 - \circ drive line phasing
 - \circ drive line indexing
 - vibration and noise
 - o **balance**
 - universal joints
 - operating angles
 - hanger bearings
 - applied tools and equipment
 - o protractor
 - U-joint removal equipment
 - o dial indicator
 - \circ inclinometer

Evaluation:

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The following evaluation structure is only a suggested format. Specific evaluation of theory and practical components of training varies due to the resource material and training aides utilized.

Evaluation Structure				
Theory Testing	Practical Application Testing	Research Assignment	Notebook and Organizational Skills	
50%	30%	10%	10%	

Number:	5		
Title:	Electrical And Electronic	S	
Duration:	Total Hours: 48	Theory: 34	Practical: 14
Prerequisites:	N/A		
Co-requisites:	Level I, Section 1, 2, 3, 4		

5.1	-	Electrical Fundamentals				
		18 Total Hours	Theory:	14 hours	Practical:	4 hours
5.2	-	Diagnostic Test E	quipment			
		12 Total Hours	Theory:	7 hours	Practical:	5 hours
5.3	-	Applied Electrical	Schematics			
		6 Total Hours	Theory:	6 hours	Practical:	0 hours
5.4	-	Battery Fundame	ntals			
		6 Total Hours	Theory:	3 hours	Practical:	3 hours
5.5	-	Circuit Repair And	d Protection D	evices		
		6 Total Hours	Theory:	4 hours	Practical:	2 hours

Number:	5.1			
Title:	Electrical Fundamentals			
Duration:	Total Hours: 18	Theory: 14	Practical: 4	
Cross Reference to Training Standards: 5190.01, 5191.01, 5192.01, 5193.01, 5195.01				

Demonstrate a working knowledge of the purpose, principles of operation and applications of electrical concepts.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 5.1.1 Define the purpose, fundamentals and principles of electricity.
- 5.1.2 Describe the application of electrical concepts.

- 5.1.1 Define the purpose, fundamentals and principles of electricity. [10/0]
 - atomic structure
 - conductors and insulators
 - electron and conventional theories
 - sources of electricity
 - o heat
 - o pressure
 - o friction
 - \circ chemical
 - o light
 - \circ magnetism
 - Ohm's Law
 - current flow, heat and resistance
 - magnetism
 - electromagnetism
 - electromagnetic induction
 - Standard Information (S.I.) System, e.g. mega, kilo, milli, micro

- 5.1.2 Describe the application of electrical concepts. [8/0]
 - voltage
 - amperage
 - resistance
 - wattage
 - electrical circuit component
 - electrical circuits
 - \circ series
 - o parallel
 - series parallel

Number:	5.2			
Title:	Diagnostic Test Equipmer	nt		
Duration:	Total Hours: 12	Theory: 7	Practical: 5	
Cross Reference to Training Standards: 5190.01-02, 5191.01-02, 5192.01-02, 5193.01-02, 5195.01-02				

Demonstrate a working knowledge of the purpose, construction and principles of operation for diagnostic test equipment.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 5.2.1 Define the purpose and fundamentals of diagnostic test equipment.
- 5.2.2 Describe the construction, types, styles and application of diagnostic test equipment.
- 5.2.3 Explain the operating principles of diagnostic test equipment.
- 5.2.4 Connect and operate diagnostic test equipment following manufacturers' recommendations.

- 5.2.1 Define the purpose and fundamentals of diagnostic test equipment. [6/0]
 - pressure gauges
 - vacuum gauges
 - electronic equipment
 - module testers
 - hand-held scan tools
 - digital tachometer
 - oscilloscopes
- 5.2.2 Describe the construction, types, styles and application of diagnostic test equipment. [1/0]
 - pressure gauges
 - vacuum gauges
 - electronic equipment
 - module testers
 - hand-held scan tools

- digital tachometer
- oscilloscopes
- 5.2.3 Explain the operating principles of diagnostic test equipment. [0/3]
 - pressure gauges
 - vacuum gauges
 - electronic equipment
 - module testers
 - hand-held scan tools
 - digital tachometer
 - oscilloscopes
- 5.2.4 Connect and operate diagnostic test equipment following manufacturers' recommendations.

[0/2]

- pressure gauges
- vacuum gauges
- electronic equipment
- module testers
- hand-held scan tools
- digital tachometer
- oscilloscopes

Number:	5.3			
Title:	Applied Electrical S	Schematics		
Duration:	Total Hours: 6	Theory: 6	Practical: 0	
Cross Reference to Training Standards: 5190.01-02, 5191.01-02, 5192.01-02, 5193.01-02, 5195.01-02				

Demonstrate a working knowledge of the application of wiring schematics, locating electrical components and tracing electrical circuits.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 5.3.1 Define the purpose and fundamentals of electrical wiring schematics.
- 5.3.2 Describe the function, construction, composition, types, styles and application of manufacturers' wiring diagrams.
- 5.3.3 Locate electrical components and trace electrical circuits of vehicles systems with the prescribed manufacturers' wiring diagrams.

- 5.3.1 Define the purpose and fundamentals of electrical wiring schematics. [2/0]
 - wiring identification methods
 - o colour codes, number codes
 - o gauge sizes
 - numbering procedure
 - electrical symbols
 - o circuit identification methods
 - wiring diagram types
- 5.3.2 Describe the function, construction, composition, types, styles and application of manufacturers' wiring diagrams. [2/0]
 - layout
 - interpretation
 - sample wiring diagrams for major manufacturers

- 5.3.3 Locate electrical components and trace electrical circuits of vehicle systems with the prescribed manufacturers' wiring diagrams. [0/2]
 - demonstrate and perform
 - o on-vehicle verification of wiring diagram circuits
 - \circ colour codes
 - \circ connections
 - $\circ~$ gauge and metric wire sizes
 - o circuit numbers

Number:	5.4			
Title:	Battery Fundamentals			
Duration:	Total Hours: 6	Theory: 3	Practical: 3	
Cross Reference to Training Standards: 5193. 01- 04				

Demonstrate a working knowledge of the purpose, construction, principles of operation, inspection and testing of batteries.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 5.4.1 Define the purpose and fundamentals of batteries.
- 5.4.2 Describe the construction, composition, types, styles and application of batteries.
- 5.4.3 Explain the principles of operation of batteries.
- 5.4.4 Perform inspection and testing procedures on batteries following manufacturers' recommendations.
- 5.4.5 Perform assigned operations on batteries following manufacturers' recommendations.

- 5.4.1 Define the purpose and fundamentals of batteries. [1/0]
 - amp-hour rating (AH)
 - cranking amps (CA)
 - reserve capacity (RC)
 - cold cranking amps (CCA)
 - temperature effects
 - internal resistance factors
 - specific gravity and temperature compensation for electrolyte
- 5.4.2 Describe the construction, composition, types, styles and application of batteries. [1/0]
 - lead acid

- low maintenance
- maintenance-free batteries
- gelled cell batteries
- 5.4.3 Explain the principles of operation of batteries. [1/0]
 - battery chemical action during charging and discharging
 - temperature effect on charging and internal resistance ratings
- 5.4.4 Perform inspection and testing procedures on following manufacturers' recommendations [0/2]
 - visual inspection
 - state of charge
 - surface discharge
 - load test
 - high rate discharge
 - three-minute charge
 - temperature adjustments

5.4.5 Perform assigned operations on batteries following manufacturers' recommendations.

[0/1]

- maintenance
- state of charge
- storage
- activation
- cleaning precautions
- charging precautions
- removal and replacement procedures
- safe handling precautions for servicing , charging and handling

Number:	5.5			
Title:	Circuit Repair And P	rotection Devices		
Duration:	Total Hours: 6	Theory: 4	Practical: 2	
Cross Reference to Training Standards: 5193.01-04				

Demonstrate a working knowledge of the purpose, construction, principles of operation, inspection and testing of circuit protection devices.

Learning Outcomes and Content

Upon successful completion the apprentice is able to:

- 5.5.1 Define the purpose and fundamentals of circuit repair and protection devices.
- 5.5.2 Describe the construction, composition, types, styles and application of circuit repair and protection devices.
- 5.5.3 Explain the principles of operation of circuit protection devices.
- 5.5.4 Perform inspection, testing procedures and circuit repair of protection devices with the prescribed service tools and equipment following manufacturers' recommendations.

Learning Content

- 5.5.1 Define the purpose and fundamentals of circuit repair and protection devices. [1/0]
 - opens .
 - shorts
 - ground
 - unintentional grounds
 - high resistance connections
 - safety when repairing electrical circuits
- 5.5.2 Describe the construction, composition, types, styles, application of circuit repair and protection devices.

[2/0]

- wiring and terminals
 - o wire size
 - o identification
 - o connectors

- o soldering
- circuit protection devices
 - o **fuses**
 - o circuit breakers
 - o fusible links
- 5.5.3 Explain the principles of operation of circuit protection devices. [1/0]
 - circuit protection devices
 - o fuses
 - \circ circuit breakers
 - o fusible links
- 5.5.4 Perform inspection, testing procedures and circuit repair of protection devices with the prescribed service tools and equipment following manufacturers' recommendations.

[0/2]

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- circuit protection
 - o fuses
 - o circuit breakers
 - \circ fusible links
 - wiring repair
 - o cleaning
 - o splicing
- crimping
 - \circ soldering
 - corrosion protection
 - circuit analysis to identify:
 - o shorts
 - o opens
 - o grounds
 - o high resistance

Evaluation:

The following evaluation structure is only a suggested format. Specific evaluation of theory and practical components of training varies due to the resource material and training aides utilized

Evaluation Structure					
Theory Testing	Practical Application Testing	Research Assignment	Notebook and Organizational Skills		
50%	30%	10%	10%		



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