



# COURSE OUTLINE

## TCT717

Prepared: Sylvain Belanger    Approved:

<b>Course Code: Title</b>	TCT717: STEERING, SUSPENSION AND BRAKE SYSTEMS
<b>Program Number: Name</b>	6081: T/C TECHN LEVEL II
<b>Department:</b>	MOTIVE POWER APPRENTICESHIP
<b>Semester/Term:</b>	18S
<b>Course Description:</b>	Upon successful completion the apprentice is able to understand the principles of operation of truck and coach air brake systems, is able to diagnose and repair truck and coach air brake systems, and suspension systems, is able to understand the principles of operation, diagnose and repair heavy duty hydraulic and air-over-hydraulic brakes, wheel end assemblies, and truck and coach mechanical suspensions, and is able to understand the operating principles of truck and coach tire and wheel assemblies, and air suspension systems.
<b>Total Credits:</b>	6
<b>Hours/Week:</b>	6
<b>Total Hours:</b>	48
<b>Essential Employability Skills (EES):</b>	<p>#2. Respond to written, spoken, or visual messages in a manner that ensures effective communication.</p> <p>#3. Execute mathematical operations accurately.</p> <p>#4. Apply a systematic approach to solve problems.</p> <p>#5. Use a variety of thinking skills to anticipate and solve problems.</p> <p>#6. Locate, select, organize, and document information using appropriate technology and information systems.</p> <p>#7. Analyze, evaluate, and apply relevant information from a variety of sources.</p> <p>#10. Manage the use of time and other resources to complete projects.</p>
<b>General Education Themes:</b>	Science and Technology
<b>Course Evaluation:</b>	Passing Grade: 50%, D
<b>Other Course Evaluation &amp; Assessment Requirements:</b>	<p>Theory testing 70%</p> <p>Practical application testing 30%</p> <p>Grade                      Definition Grade Point Equivalent                      A+ 90 - 100% 4.00</p>

A 80 - 89%  
B 70 - 79% 3.00  
C 60 - 69% 2.00  
D 50 - 59% 1.00  
F (Fail)49% and below 0.00

CR (Credit) Credit for diploma requirements has been awarded.  
S Satisfactory achievement in field /clinical placement or non-graded subject area.  
U Unsatisfactory achievement in field/clinical placement or non-graded subject area.  
X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.  
NR Grade not reported to Registrar's office.  
W Student has withdrawn from the course without academic penalty.

**Evaluation Process and Grading System:**

Evaluation Type	Evaluation Weight
practical application testing	30%
theory testing	70%

**Books and Required Resources:**

Heavy Duty truck systems by Sean Bennett  
Publisher: cengage Edition: 6

**Course Outcomes and Learning Objectives:**

**Course Outcome 1.**

Upon successful completion, the apprentice is able to understand the principles of operation of truck and coach air brake systems.

**Learning Objectives 1.**

Upon successful completion, the apprentice is able to:

7.1.1 Explain the purpose and fundamental of air brake system

[2/0]

- law of levers
- mechanical advantage
- coefficient of friction
- pneumatic principles
- pressure volume relationship
- spring brake chamber calculations
- potential energy
- liner force
- leverage
- brake torque
- brake friction factors
- electrical and electronics basics
- effects of vehicle load and speed

7.1.2 Identify the function, construction, composition, types, styles and application of air brake systems.

[2/0]

- foundation assemblies
- S-cam
- wedge
- disc
- actuator chambers
- air compressors

- air dryers
- tanks
- reservoirs
- control devices
- air governors
- mounting location
- heat protection
- coach heat resistant
- pressure regulators
- pressure protection valves
- safety valves
- control valves
- application
- interlock
- anti-compounding
- relay
- quick release
- combination
- check valves
- ratio
- two-way
- inversion
- bob-tail proportioning
- tractor protection valves
- service, emergency relay
- slack adjusters
- manual
- automatic
- hoses, lines and fittings
- CMVSS 121 requirements

7.1.3. Describe the principle(s) of operation of truck and coach air brake systems.

[4/0]

- foundation assemblies
- S-cam
- wedge
- disc
- friction media
- actuator chambers
- standard
- coach chambers (DD3)
- long stroke
- air supply system
- compressors
- tanks
- air dryers
- reservoirs
- circuit protection valves
- pressure signaling valves
- gauge pressure application
- air control devices
- air governors
- pressure regulators
- pressure protection valve
- safety valves
- control valves
- application

- anti-compounding
- relay
- quick release
- combination
- check valves
- two-way
- inversion
- dash control valves
- tractor protection valves
- bobtail proportioning
- interlock valves and protection
- service emergency relay
- slack adjusters
- manual
- automatic
- brake timing and balance
- lines, hoses and fittings
- factors affecting friction surface face failure
- brake circuit operation
- brake fade
- inversion factors
- failure modes
- effects of load transfer

## **Course Outcome 2.**

Upon successful completion, the apprentice is able to diagnose and repair truck and coach air brake systems according to manufacturer and statutory safety standards.

## **Learning Objectives 2.**

Upon successful completion, the apprentice is able to:

7.2.1 Explain inspection, testing and diagnostic procedures on air brake systems.

[0/2]

- foundation brakes
- stroke length
- automatic slack adjusters
- disarm spring brake chambers according to recommended safe practice
- outline procedure for air compressor, air dryer, air receiver testing
- test and adjust governors
- test control valves for recommended operation
- brake torque balance
- brake timing
- outline brake disc and drum machining operations
- interpret pneumatic schematics
- interpret statutory inspection safety criteria

7.2.2 Identify reconditioning or repairs following manufacturers'™ procedures and perform assigned operations on air brake systems.

[0/2]

- foundation components
- relining
- machining practices
- perform complete wheel-end service
- S-cam foundation

- disc brake foundation
- pneumatic circuit components
- electrically actuated systems (brake by wire)
- perform air brake adjustment according to recommended procedures
- readjust air governors
- interpreting statutory specifications
- failure analysis

### **Course Outcome 3.**

Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair heavy duty hydraulic and air-over-hydraulic brakes.

### **Learning Objectives 3.**

Upon successful completion, the apprentice is able to:

7.3.1 Explain the purpose and fundamentals of heavy duty hydraulic and air-over-hydraulic brakes.

[0.5/0] - law of levers, mechanical advantages

- coefficient of friction
- hydraulic principles
- press volume relationship
- actuator / wheel cylinder calculations
- potential energy
- linear force
- leverage
- brake torque
- brake friction factors
- electrical and electronics basics
- effects of vehicle load and speed

7.3.2 Identify the function, construction, types, and application of heavy duty hydraulic and air-over-hydraulic brakes.

[0.5/0] - foundation brake assembly

- master cylinder
- metering valves
- proportioning valves
- power assist systems
- hydraulic plumbing
- wheel cylinders

7.3.3 Describe the principle(s) of operation of heavy duty hydraulic and air-over-hydraulic brakes.

7.3.4 Perform inspection, testing and diagnostic procedures on heavy duty hydraulic and air-over-hydraulic brakes.

[0/0.5] - identify hydraulic brake system components

- identify air over hydraulic brake system components
- verify brake system performance
- diagnose typical brake failure modes
- outline procedure for purging a hydraulic brake system
- outline procedure for performing a foundation-brake overhaul / service
- describe procedure required to replace the friction facings on brake shoes and pads

7.3.5 Recommend reconditioning or repairs following manufacturers' procedures on heavy duty hydraulic and air over hydraulic brakes.

[0/0.5] - perform failure analysis on failed foundation brake components

- determine serviceability of pneumatic and hydraulic circuit components

[2/0] - dual circuit hydraulic brake systems

- foundation brake assembly
- air over hydraulic brake systems
- air actuation / management circuit
- master cylinder
- metering valves
- proportioning valves
- power assist systems
- hydraulic plumbing
- wheel cylinders
- ABS systems

7.3.4 Perform inspection, testing and diagnostic procedures on heavy duty hydraulic and air-over-hydraulic brakes.

[0/0.5] - identify hydraulic brake system components

- identify air over hydraulic brake system components
- verify brake system performance
- diagnose typical brake failure modes
- outline procedure for purging a hydraulic brake system
- outline procedure for performing a foundation-brake overhaul / service
- describe procedure required to replace the friction facings on brake shoes and pads

7.3.5 Recommend reconditioning or repairs following manufacturers'™ procedures on heavy duty hydraulic and air over hydraulic brakes.

[0/0.5] - perform failure analysis on failed foundation brake components

- determine serviceability of pneumatic and hydraulic circuit components

## **Course Outcome 4.**

Upon successful completion, the apprentice is able to understand the operating principles of truck and coach tire and wheel assemblies.

## **Learning Objectives 4.**

Upon successful completion, the apprentice is able to:

7.4.1 Explain the purpose and fundamental of tire and wheel assemblies.

[1/0] - centrifugal force

- hydro planning
- sliding and rolling friction
- ferrous and non-ferrous materials
- fastener torque
- static and dynamic balance

7.4.2 Identify the functions, construction, composition, types, styles and application of tire and wheel assemblies.

[1/0] - tires

- materials
- radials, bias ply
- wide base singles
- double sectional steering type
- wheel rims
- drop centre
- semi-drop
- three piece flat base (multiple piece)
- lock rings
- disc wheels
- cast spoked wheels

- wheel spacers
- fasteners
- hubs
- cast spoke
- steel disc
- aluminum disc
- lugs and nuts
- hub odometers

- bearings and retaining locks
- tapered roller
- washers
- lock nuts
- lubrication
- seals
- integral
- non-integral

7.4.3 Describe the principle(s) of operation of tire and wheel assemblies.

[2/0] - tires

- radial and bias ply
- wide base singles
- double sectional steering type
- rim sizing details / tire matching
- radials and bias ply
- dual wheels
- rolling radius
- tandem axles
- tire inflation and monitoring systems
- nitrogen inflation
- wheel rims and lock rings
- hubs
- cast spoke
- stud piloted
- hub piloted
- fasteners
- wheel hub odometers
- bearings
- tapered roller
- end play and preload
- preset
- unitized
- seals
- integral
- non-integral

7.4.4 Perform inspection, testing and diagnostic procedures on tire and wheel assemblies.

[0/3] visual inspection for:

- tire wear patterns
- tire matching
- alignment
- run-out
- check tire tread depth
- check bearing condition
- check seal condition
- remove and replace a wheel and hub assembly according to recommended procedures
- perform bearing adjustment according to Technology and Maintenance Council (TMC) procedures

- demonstration of seal removal and installation
- 7.4.5 Recommend reconditioning or repairs following manufacturers'™ procedures on tire and wheel assemblies.
- [0/1] - outline the dismantling and reassembly procedures of tires and rims
- outline static and dynamic tire balancing procedures
- outline the (TMC) Technology and Maintenance Council recommended wheel adjustment procedures

## **Course Outcome 5.**

Upon successful completion, the apprentice is able to understand the principles of operation, and be able to diagnose and repair wheel end assemblies

## **Learning Objectives 5.**

On successful completion, the apprentice is able to:

7.5.1 Explain the history, purpose and fundamentals of wheel end assemblies.

[0.5/0]

- TMC wheel end practices
- bearing failure analysis
- tire and rim assemblies

7.5.2 Describe the principle(s) of operation of low and zero maintenance of wheel end assemblies.

[1.5/0]

- lubrication
- oil
- grease
- synthetic
- API specifications
- optimized maintenance
- zero maintenance hub assemblies
- endplay
- preload
- preset hubs
- unitized
- spindle assemblies

7.5.3 Perform inspection and testing procedures of wheel end assemblies.

[0/1]

- visual inspection
- bearings wear patterns
- heat and discoloring
- galling
- spalling
- bearing match
- failure analysis
- bearing end play
- bearing fit
- hubs
- spindles

7.5.4 Recommend reconditioning or repairs following manufacturers'™ procedures on wheel end assemblies.

[0/1]



- perform bearing adjustment according to manufacturers' recommended procedures
- outline TMC wheel end procedure
- remove and replace bearings
- bearing cleaning precautions
- preset hubs
- alternate repair procedure

## **Course Outcome 6.**

Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair truck and coach mechanical suspensions

## **Learning Objectives 6.**

Upon successful completion, the apprentice is able to:

7.6.1 Define the purpose and fundamental of mechanical suspension systems.

[2/0]

- oscillation
- Hooke's law
- articulation
- equalization
- isolation
- centre of gravity
- vehicle stability
- dampening
- hydraulics

7.6.2 Describe the functions, construction, composition, types, styles and application of mechanical suspension systems.

[2/0]

- leaf springs
- constant rate
- progressive rate
- auxiliary
- tandem
- two stage
- suspension system components
- walking beams
- radius rods / torque rods
- equalizers
- hangers
- shackles
- bushings
- saddles
- towers
- u-bolts
- slipper brackets
- rubber spring suspension components
- tower
- trunnion
- restrictor can
- rubber spring
- spring mounting hardware

7.6.3 Explain the principle(s) of operation of mechanical suspension systems.

[3/0]

- leaf springs
- constant rate
- progressive rate auxiliary
- tandem
- two stage
- deflection rate
- jounce and rebound
- oscillation
- dampening
- rubber springs
- spring rate
- dynamics
- stresses
- tensile
- compressional
- sheer
- wheel hop and wind up
- sprung and unsprung weight

7.6.4 Perform inspection and testing procedures of mechanical suspension systems.

[0/2]

- visual inspection
- cracks
- wear
- rust
- mountings
- leaf integrity and alignment
- radius and torque rod bushings
- slipper brackets and hangers
- equalizer assembly

7.6.5 Recommend reconditioning or repairs following manufacturers'™ procedures on mechanical suspension systems.

[0/1]

- outline procedure for servicing
- spring hangers and brackets
- removing and replacing leaf springs
- outline assembly of spring packs
- outline removal and replacement of equalizers and torque rods
- outline removal and replacement of mounting hardware

## **Course Outcome 7.**

Upon successful completion, the apprentice is able to understand the principles of operation of truck and coach air suspension systems.

## **Learning Objectives 7.**

Upon successful completion, the apprentice is able to:

7.7.1 Explain the purpose and fundamentals of air suspension systems.

[1/0]

- shock absorbers
- deflection of air springs

- pneumatics
- jounce and rebound
- wheel hop and wind up
- tensional and compression loading

7.7.2 Identify the function, construction, composition, types, styles and application of air suspension systems.

[1/0]

- air springs
- bag
- pedestal
- jounce blocks
- auxiliary
- tandem
- equalizing beam
- auxiliary torsion bar
- ride height components
- combination mechanical/ pneumatic suspensions
- shock absorbers types

7.7.3 Describe the principle(s) of operation of air suspension systems.

[2/0]

- air springs
- bag
- pedestal
- jounce blocks
- auxiliary
- tandem
- equalizing beam
- auxiliary torsion bar
- ride height factor
- combination mechanical/ pneumatic suspensions
- shock absorbers type

## **Course Outcome 8.**

Upon successful completion, the apprentice is able to diagnose and repair truck and coach suspension systems.

## **Learning Objectives 8.**

Upon successful completion, the apprentice is able to:

7.8.1 Perform inspection, adjustment, testing and diagnostic procedures on truck and coach suspension systems.

[0/3]

- visual inspection
- cracks
- wear
- rust
- bends
- twists
- test and adjust vehicle ride height
- test air springs for leaks and damage
- shock absorbers
- internal and external oil leaks

- corrosion
- tracking and alignment
- outline procedure for projecting frame / suspension diagrams

#### 7.8.2 Recommend reconditioning or repairs.

[2/1]

- perform height control valve adjustment
- outline servicing of:
  - spring hangers and brackets
  - air valves and height control valves
  - hoses and air springs
  - rubber cushions
- removing and replacing lead and air springs
- outline OEM frame and suspension wear limits
- outline safety check procedure for frame and suspension system components

**Date:**

Tuesday, April 24, 2018

Please refer to the course outline addendum on the Learning Management System for further information.