

I. COURSE DESCRIPTION:

You will be introduced to the construction, operation, maintenance, and diagnosis of both highway truck and off road heavy machinery drive trains. The highway truck components will include tandem differentials, inter-axle differentials and twin countershaft transmissions. Off-road equipment drive trains will include, steering clutches and brakes, final drives, torque converters, power shift transmissions and hydrostatic drives.

Students will be required to follow proper safety procedures when performing the above tasks according to both Sault College Motive Power Department Standards and Vehicle Manufacturers safety regulations and specifications.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

1. **Explain the construction, operating principles, testing and diagnosis required to repair torque converters, fluid couplings, and hydraulic retarders.**

Potential Elements of the Performance:

- static and dynamic friction
- torque multiplication
- centrifugal force
- vortex and rotary flow
- kinetic energy
- hydrodynamic drive
- hydrostatic drive
- multiplication phase
- coupling phase
- hydraulic retarders
- pumps
- impeller
- stator, fixed and rotating
- overrunning clutch
- flywheel
- lock-up device

HYDRAULIC RETARDERS

- rotor and housing
- control valve

PERFORM A DEMONSTRATION OF TORQUE CONVERTER:

- stall tests
- relief valve tests
- performance tests
- Oil level check
- Oil condition

2. HYDROSTATIC DRIVES

Describe and define the purpose and fundamentals, types, designs and construction features and perform the inspection, testing, and diagnostic procedures following manufacturers' recommendations and perform assigned operations on hydrostatic drives.

Potential Elements of the Performance:

APPLICATION:

- traction drives
- non-traction drives

TYPES:

- open loop circuits
- closed loop circuits

FUNDAMENTALS:

- lubricant types
- hydraulic pressures and output force
- coolers and circuits

PERFORM TEST PRESSURES OF HYDROSTATIC DRIVE SYSTEMS

3. POWER SHIFT TRANSMISSIONS.

Define the purpose and fundamentals and perform inspection, testing, and diagnostic procedures following manufacturers' recommendations and perform assigned operations for power shift transmission systems.

Control Systems:

- hydraulic
- pneumatic
- electronic

Planetary Gear Sets:

- simple
- sun gear
- planet pinions and carrier
- ring gear
- compound

- lubrication
- Check and test fluid levels and condition.
- Perform a demonstration of recommended procedures to perform oil and filter changes.

4. **TANDEM AND INTERAXLE DIFFERENTIALS**

Define the purpose, operation and fundamentals of, and describe the functions, construction, composition, types, styles and application and perform disassembly, inspection, testing, diagnostic and reassembly procedures of multiple speed and double reduction drive axle assemblies following manufacturers' procedures.

Potential Elements of the Performance:

- Mechanical advantage
- Laws of levers
- Torque
- Input / output rotational speed
- Gear ratios
- Loading characteristics
- Differential action
- Thrust loads
- Power flow
- Bearing preloads
- Lubrication

Outline procedure for checking lubricant levels

- Outline recommended lubricant change levels
- Verify lubricant type and application
- Carrier removal, disassembly, reassembly and replacement procedure

Failure analysis to identify

- Shock failures
- Fatigue failures
- Torsional failures
- Surface failures
- Spinout failures
- Operational overloading
- Temperature effects

Demonstrate procedure for setting

- Pinion bearing preload
- Pinion depth
- Carrier bearing preload
- Drive gear set backlash

Procedure for checking

- Drive gear set contact patterns
- Drive gear set backlash
- Thrust screw adjustment

5. **SERVICING TWIN COUNTERSHAFT TRANSMISSIONS**
Recommend reconditioning or repairs following manufacturers' procedures and perform assigned operations on multiple countershaft manual transmission and auxiliary sections.

Potential Elements of the Performance:

Outline procedure for checking lubricant levels

- Outline recommended lubricant change intervals and procedure
- Verify lubricant types and application
- Transmission removal, disassembly, reassembly, timing and replacement procedures
- Auxiliary section removal, disassembly, reassembly, timing and replacement procedures
- Air pressure adjustment
- Pneumatic valve and cylinder replacement procedure
- O-ring replacement
- Air filter replacement
- System contaminant flushing

Perform failure analysis

- Shock failures
- Fatigue failures
- Torsional failures
- Surface failures

6. **FINAL DRIVES**
Explain the principles of operation, define the purpose and fundamentals and perform inspection, testing, and diagnostic procedures following manufacturers' recommendations and perform assigned operations of final drives.

Potential Elements of the Performance:

final drives

- bevel gear
- spiral gear
- helical and hypoid gear
- planetary
- inboard and outboard
- inspect final drives and check for:
 - gear contact patterns
 - gear backlash
 - bearing pre-load
- perform a demonstration of:
 - lubricating oil level checks
 - seal replacement procedures
 - mechanical face-type seal
 - bearing service
 - adjustment procedures

III. TOPICS:

1. TORQUE CONVERTERS, FLUID COUPLINGS AND HYDRAULIC RETARDERS
2. HYDROSTATIC DRIVES
3. POWER SHIFT TRANSMISSIONS
4. TANDEM AND INTERAXLE DIFFERENTIALS
5. SERVICING TWIN COUNTERSHAFT TRANSMISSIONS
6. FINAL DRIVES

IV.**REQUIRED RESOURCES/TEXTS/MATERIALS:**

Title: Heavy Duty Truck Systems

Edition: 5th ed., 12959#

Author: Bennett

Publisher: Thomson Nelson Learning Canada

Various Handouts as supplied.

Pens, pencils, calculator, 3-ring binder

*coveralls

*CSA approved steel toe boots (high top)

*CSA approved safety glasses

*these items mandatory for shop

V. EVALUATION PROCESS/GRADING SYSTEM:

The final grade for this course will be based on the results of classroom, assignments and shop evaluations weighed as indicated:

- Classroom – 30% of the final grade is comprised of term tests
- Assignments – 20% of the final grade is comprised of a number of technical reports
- Shop – 40% of the final grade is comprised of attendance, punctuality, preparedness, student ability, work organization and general attitude
- Employability Skills – 10% of final grade is comprised of attendance, class participation, show ability to follow direction and being a team player.
- **All Assignments must be typed.**
- **Assignments will be graded as follows:**
 - a) **One day after the original due date – 70% maximum.**
 - b) **Two or more days after the original due date – 50% maximum.**

(Student will be given notice of test and assignment dates in advance)

The following semester grades will be assigned to students:

Grade	<u>Definition</u>	<i>Grade Point Equivalent</i>
A+	90 – 100%	4.00
A	80 – 89%	3.00
B	70 - 79%	2.00
C	60 - 69%	1.00
D	50 – 59%	0.00
F (Fail)	49% and below	
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.	

VI. SPECIAL NOTES:

Attendance:

Sault College is committed to student success. There is a direct correlation between academic performance and class attendance; therefore, for the benefit of all its constituents, all students are encouraged to attend all of their scheduled learning and evaluation sessions. This implies arriving on time and remaining for the duration of the scheduled session.

It is the departmental policy that once the classroom door has been closed, the learning process has begun. Late arrivers will not be granted admission to the room.

Eye, Face and Foot Personal Protection Equipment (P.P.E):

Students are required to wear appropriate Personal Protection Equipment (P.P.E) in designated areas at all times. The designated areas for eye and foot protection in the Motive Power areas are: C1073 (Automotive), C1000, C1010, and C1040 (Truck/Coach and Heavy Equipment) and C1120 (Marine and Small Engines). Appropriate P.P.E must also be worn when facing hazards outside of these designated areas.

Minimum Eye Protection:

All protective eye wear shall meet the requirements of:

C.S.A. - Z94.3 or A.N.S.I. - Z87.1 +.

Approved safety glasses (lens and frames) shall have side protection such as wrap around design or fixed side shields.

Minimum Foot Protection:

1. Boot height- minimum 5 ½" uppers, measured from the top of the sole.
2. CSA Green Patch rating.

VII. COURSE OUTLINE ADDENDUM:

The provisions contained in the addendum located on the portal form part of this course outline.

