

# AUTOMOBILE TECHNOLOGY PREPARATION MANUAL

SkillsAlberta.com



## SKILLS CANADA ALBERTA

Skills Canada Alberta (SCA) Competitions challenge high school and post-secondary students to reach for their personal best in a variety of trade and technology competitions.

SCA brings together experts from industry and education to create innovative challenges that will test the competitors' skills, and connect them with like-minded students and mentors who have a keen interest in Automobile Technology.

Having participated in a SCA competition will demonstrate to employers that the student is committed to their field and have the personal confidence to take on challenges. Participation in a competition is a great addition to a resume, scholarship application and post-secondary application.

## COMPETITION OVERVIEW

Participation in Skills Canada competition will launch you into an exciting environment that respects the skills, talents and ambitions of Alberta's tradespeople. Your journey will begin at the regional or provincial level. Each year at the Provincial Skills Canada Competition SCA will select a competitor from the secondary and post-secondary competition to represent Alberta at the Skills Canada National Competition (SCNC). Every two years the SCNC is the selection event for the team that will represent Team Canada at the WorldSkills Competitions. The next year for WorldSkills is Kazan, Russia, 2019. The Automobile Technology Team Canada member is selected from the post-secondary category at SCNC.

Full Rules and Regulations are available at <http://skillsalberta.com/publications>

## CONTEST DESCRIPTION

Each contest area has a Contest Description (formerly Contest Description) which outlines the key elements of the competition. The Contest Description is the essential training tool you will use to develop a training plan and prepare for the competition. Contest Descriptions are posted in January for that year's competitions. Check back regularly for updates.

Please note that students who do not comply with the safety requirements outlined in the Contest Description will not be eligible to compete. Please carefully review the safety equipment and tools required to avoid disqualification. Participants should attempt mastery of all aspects of the Automobile Technology Contest Description.

## SECONDARY STUDENTS

Secondary (high school) students are registered by their teachers for the Regional or Provincial Skills Canada Competitions. The Automobile Technology is among seven regionalized SCA competitions that require secondary students to qualify at their Regional Skills Canada Competition (RSCC) for the Provincial Skills Canada Competition.

**Contact [KatherineK@skillsalberta.com](mailto:KatherineK@skillsalberta.com) for additional information.**

SCA suggests teachers bring students they believe would benefit from participation in upcoming years, to view the Provincial Skills Canada Competition as a spectator. This provides students with a clear understanding of the size, Contest Description and opportunity of the event.

To be eligible to compete as a secondary student in a 2018 SCA Competition students must be:

- Enrolled in a public, separate or private secondary school in the same school year in which the Provincial Skills Canada Competition is held
- Born on or after January 1, 1997
- An Alberta resident
- A Canadian citizen (Please confirm with your students that they are a Canadian citizen)

## TEACHERS NEW TO SKILLS CANADA ALBERTA

Entering students into a Skills Canada program for the first time can be intimidating. Following are tips to successfully incorporate Skills Canada into your program and add tremendous opportunity to your students' high school experience:

- Review the Contest Description document and the information in this preparation manual to identify key elements to begin preparing students. Contest Descriptions are located once you have selected your event and region <http://skillsalberta.com/eventlist>
- Become a Skills Champion at <http://skillsalberta.com/become-skills-school-0> to receive registration information and important updates including professional development opportunities and CTS Grants.
- If your school is already a Skill School we recommend creating your own login to ensure you receive the updates and information.
- Once online registration begins the competitions fill up fast. Review the registration documents to make note of key dates and times.
- Check the Contest Description regularly to become familiar with the project and identify changes.
- Attend a Skills Canada Competition to talk with our technical experts and other teachers to familiarize yourself with the projects.
- Refer to the CTS courses listed in the Contest Description and at the end of this document to identify recommended courses and topics students should cover in preparation for the competition.
- Bring your administrators and fellow teachers to a Skills Canada Competition to learn about the program.
- Bring your students to the Provincial Skills Canada Competition <http://skillsalberta.com/school-field-trip>
- Host a Skills Classroom Presentation to spark your students' interest in participating in an event <http://skillsalberta.com/skills-classroom>

## REGIONAL VERSUS PROVINCIAL COMPETITIONS

As a stepping stone to the Provincial Skills Canada Competitions, the regional competitions for high school students provide a welcoming and approachable environment for teachers and schools to become familiar with Skills Canada programs. Schools continue to integrate Skills Canada opportunities into their program to recognize the outstanding talent that resides in their school; talent that often doesn't receive the same recognition or opportunities as other endeavours, but none the less worthy of celebration.

Automobile Technology High school competitors begin their journey with Skills Canada at a regional competition hosted in partnerships with the technical institutes across Alberta. The day is designed to be welcoming to students and provide a foundation for them to envision their next step into post-secondary studies.

The Regional Skills Canada Competitions bring together a community of technical experts, instructors, volunteers, teachers and students to build connections. Regardless of the outcome of the event, students will have a greater awareness of their strengths, and further discover the opportunities that are available to them as they develop their natural abilities.

## POST-SECONDARY STUDENTS

Post-secondary students begin their journey with SCA at the Provincial Skills Canada Competition (PSCC). Selection for the post-secondary competitions is done by Skills Canada Alberta, Apprenticeship and Industry Training, and the Technical Institutes.

To be considered to participate in the competition, complete the online nomination form at [www.skillsalberta.com/post-secondary-registration](http://www.skillsalberta.com/post-secondary-registration). Students should also contact their favourite instructor and let them know they are interested in competing. If a student is not contacted by SCA to compete, their technical institute can register them. Contact KatherineK@skillsalberta.com for information.

Once contacted by SCA to confirm they have been registered, students should talk with their employer about the time they will need off work to participate. Their employer may even pay the travel, hotel and registration fees. Competitors should also confirm with their employer that if they win, they will be asked to join Team Alberta to compete at the Skills Canada National Competition.

To participate in the 2018 PSCC a post-secondary student must:

- Be born on or after January 1, 1997
- Currently apprenticing in a trade or attending a post-secondary institution
- An Alberta resident
- A Canadian citizen

## COMPETITION STRATEGIES

### **Prior to the Competition**

- The time invested in preparing for the competition will correlate to the experience the student has at the competition.
- Work with an instructor to develop practical shop activities and competitions.
- Develop a schedule to maximize training time both in and out of the classroom.
- Find additional resources to assist in training such as a past competitor, mentor or instructor/coach.
- Ensure the student has adequate equipment and materials to properly train.
- Be prepared: Learn the material thoroughly and organize what materials will be needed for the competition. Use a checklist and always refer back to the Contest Description for additional information.
- Refer to the Contest Description for safety requirements and tools to bring to the event.

### **The Day of the Competition**

- Recognize that stress and anxiety are often experienced during competition. Remain calm and have fun.
- Time management at the competition will be critical. Pay attention to the time allocated to each station and stay focused.
- Approach the competition with confidence. Use strategies to personalize and visualize success.
- Arrive early. Allow plenty of time for traffic, to find the venue and arrive relaxed.
- Be well rested. Get a good night's sleep the night before the event.
- Eat a balanced meal. Avoid going to the competition with an empty stomach. Take a small snack to have during competition breaks.
- Read the directions carefully and do not be afraid to ask questions.
- Manage task time wisely, wear a watch.
- Do not panic when other competitors finish early.

### **After the Competition**

- Competitors often compete with SCA more than once. Students may move on to the next level of competition or compete in a future year, and will value the notes taken immediately following the competition when preparing for the next opportunity.
- List what worked, and hold onto these strategies. It does not matter how small the items are they are building blocks for success.
- List what did not work for improvement.
- Do not second guess the performance. Enter the Awards Ceremony knowing that the student did their best and regardless of the outcome they succeeded in tackling a great achievement.

## **SCORING**

When the participant arrives at each station they will receive information on the tasks to be completed at that station and the points awarded for each task. The participant should review the document to identify areas they are comfortable with and those that are most difficult. They should review the points allocated for each section to best manage their time. Do not get stuck on an item that is worth a few points.

## **SAFETY REQUIREMENTS**

Safety is the first priority at all SCA events. At the event you will participate in a safety orientation lead by the technical judges. During the PSCC **steel toe boots and safety glasses must be worn at all times**. Judges will be monitoring the competition floor for the safe use of tools at all times.

Please note that students who do not comply with the safety requirements outlined in the Contest Description will not be eligible to compete. Please carefully review the safety equipment and tools required to avoid disqualification.

## TOOLS & EQUIPMENT

The Competitor is responsible for the safe use of basic automotive hand tools. It is expected that the competitor is knowledgeable on the use and safety of the following tools (metric and imperial):

- Wrenches
- ¼", 3/8" and 1/2" ratchets, sockets and extensions
- Screwdrivers (Flat, Phillips, Robertson, Torx, Allen head)
- Hammers (ball peen, dead blow)
- Pry bars
- Pliers (combination, side cutters, needle nose, electrical, channel lock)
- Trouble lights
- Fender covers and seat protection
- Creepers
- Tape measures
- Battery Charger
- Battery/Starter/Charging System Tester
- Bearing Packer
- Belt Tension Gauge
- Coolant Tester (Bulb and Refraction)
- Cooling System Pressure Tester and Adapters
- Cylinder Leakage Tester
- Dial Indicator (Magnetic Base, Clamp-on, Imperial, Metric)
- Digital Multimeter (DVOM)
- Electric Heat Gun
- Engine Coolant Recovery Equipment or Recycler or Coolant Disposal Contract Service
- Electronic Service Information (ie All-Data, Mitchell on Demand, ShopKey)
- Feeler Gauges (Imperial, Metric)
- Hand Held Vacuum Pump
- Hydraulic Press with adapters
- Puller Set
- Remote Starter Switch
- Scan Tool (eg Snapon, Verus, Solus OTC)
- Serpentine Belt Tensioner Tools
- Snap Ring Pliers Set (External, Internal)
- Soldering Gun
- Spark Plug Boot Puller
- Tap and Die Set (Standard, Metric)
- Telescopic Gauges
- Temperature Gun (Infrared)
- Thread Repair Insert Kit
- Tire Inflator Chuck
- Tube Quick Disconnect Tool Set
- Tubing Bender
- Tubing Cutter/Flaring Set (Imperial, ISO)

- Valve Core Removing Tool
- Vernier Calipers (Imperial, Metric)

## COMPETITION DESCRIPTION

The student will rotate through seven stations each with a focus on a specific area. Review the Contest Description for information on the time allotted to complete each station. Contest Descriptions are located at <http://skillsalberta.com/eventlist>

### 1. COMPONENT AND TOOL IDENTIFICATION

Competitors will be required to identify components and tools related to the other six competition areas. At the post-secondary level, they will also be required to select the function of the component and tool from a supplied list. Review the tools listed in the other sections and be familiar with their function and appearance.

### 2. BRAKES AND STABILITY CONTROL SYSTEMS

Students will remove, inspect, measure, and replace brake components. The following tasks may be part of a competition:

- Remove, inspect, and measure brake drum diameter; determine necessary action
- Remove, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble
- Pre-adjust brake shoes; install brake drums or drum/hub assemblies and wheel bearings; make final checks and adjustments
- Remove caliper assembly
- Inspect rotor, measure rotor thickness, thickness variation, and lateral runout; determine necessary action
- Install wheel and torque lug nuts
- Inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine necessary action
- Remove, inspect, and replace pads and retaining hardware
- Lubricate and reinstall caliper, pads, and related hardware; seat pads and inspect for leaks
- Measure final rotor thickness and compare with specifications
- Measure final rotor thickness and compare with specifications
- Retract and re-adjust caliper piston on an integral parking brake system
- Check brake pad wear indicator; determine necessary action
- Remove and reinstall rotor
- Be able to flare and bend brake tubing
- Determine if a wheel speed sensor needs replacing

#### Brake Tools

- Dial Indicator
- Brake Drum and Rotor Micrometer
- Brake Spring Removal Tool
- Digital or Dial Calliper
- Brake Clearance Transfer Gauge

- Flaring Tools
- Tubing Cutter and Pipe Bender
- Steel Rule
- Digital Micrometer

### 3. SUSPENSION AND STEERING SYSTEMS

Students will inspect a suspension and steering system, and perform adjustment and service procedures. Key components may include:

- Identify the type of suspension and steering systems used in a vehicle
- Dismount, inspect, and remount tire on wheel (may have Tire Pressure Monitoring System); balance wheel and tire assembly (static and dynamic). Check the assembly for road force variation
- Inspect, remove and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount
- Inspect tire condition; identify tire wear patterns; measure and understand tread depth; check for correct tire size and application (load and speed ratings) and adjust air pressure; determine necessary action
- Understand function of the anti-bar system, coil springs, steering rack and constant velocity shaft
- Perform a pre-alignment inspection and measure vehicle ride height
- Flare and bend brake tubing
- Analyze alignment data

**Wheels and Tires Diagnosis and Repair** - All items below are required **for post-secondary only**.

- Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action
- Measure wheel, tire, axle flange, and hub runout; determine necessary action
- Diagnose tire pull problems; determine necessary action
- Check road force variation on a wheel and tire assembly and perform necessary adjustments
- Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system sensor
- Inspect tire and wheel assembly for air loss; perform necessary action
- Identify and test tire pressure monitoring system (indirect and direct) for operation
- Demonstrate knowledge of steps required to remove and replace sensors in a tire pressure monitoring system

#### **Steering and Suspension Tools**

- Tire Pressure Monitoring Tools
- Air Pressure Gauge
- Coil Spring Compressor
- Tire Balancer and Changer
- Ball Joint Dial Indicator
- Ball Joint Press
- Brake Pedal Depressor
- Pitman Arm Puller
- Power Steering Pump Pulley Removing and Installing Tools

- Shock Absorber Tools
- Strut Spring Compressor Tool
- Tie Rod Puller
- Wheel Alignment Equipment-4 wheel (including alignment tools)
- Wheel Weight Pliers

## 4. DRIVELINE

Students will identify paths of power through the clutch, to manual transmission and to the differential.

### Clutch

- Identify the components in a clutch assembly (release bearing, pilot bearing, clutch disc, pressure plate and flywheel)
- Assemble a clutch assembly to a flywheel - Post Secondary only

### Manual Transmission

- Describe the operational characteristics of a manual transmission/transaxle
- Calculate gear ratios in a manual transmission/transaxle
- Identify which gear is selected in a manual transmission/transaxle
- Identify the input shaft, mainshaft, countershaft and reverse idler shaft in a manual transmission/transaxle
- Measure the endplay of an input shaft or a countershaft

### Driveshaft

- Remove and install a universal joint in a driveshaft
- Properly phase a two piece driveshaft
- Inspect, service, and replace CV joints
- Measure shaft runout; measure and adjust driveline angles

### Differential Assemblies

- Check the fluid level of a differential assembly
- Measure pinion bearing pre-load
- Pre-load differential side bearings
- Roll a gear tooth pattern and interpret the pattern. Identify the changes required to correct a poor gear tooth pattern
- Measure drive axle flange runout and shaft end play; determine necessary action.

### Driveline Tools

- Dial Indicator
- Feeler Gauges
- Clutch Aligning Tool
- Straight Edge
- Universal Joint Press

## 5. BODY ELECTRICAL

Students will diagnose basic electrical circuits and components. These could include parallel circuits and series-parallel circuits. Relay operations may be incorporated into the circuits.

### General: Electrical System Diagnosis

- Demonstrate knowledge of electrical/electronic series, parallel, and series-parallel circuits using principles of electricity (Ohm's Law)
- Demonstrate knowledge of Common Electrical Symbols
- Demonstrate proper use of a digital multimeter (DVOM) when measuring source voltage, voltage drop (including grounds), current flow and resistance.
- Demonstrate knowledge of the causes and effects from shorts, grounds, opens, and resistance problems in electrical/electronic circuits
- Check operation of electrical circuits with a test light
- Check operation of electrical circuits with fused jumper wires P-1
- Perform solder repair of electrical wiring
- Inspect and test switches, connectors, relays, solenoid solid state devices, and wires of electrical/electronic circuits; determine necessary action
- Use wiring diagrams during the diagnosis (troubleshooting) of electrical/electronic circuit problems
- Perform battery state-of-charge test (Open Circuit Voltage); determine necessary action

### Vehicle Electrical Systems

- Diagnose faults in the following vehicle systems:
- Horn system
- Back-up light system
- Rear defogger grid system
- Brake light system
- Power door lock system
- Headlight system

### Electrical Tools

- DVOM and Amp Clamp Attachment
- Test Light (12v circuit tester)
- LED Test Light
- Electrical Pin Out Kit
- Jumper Wire
- Amp Clamp for the DVOM

## 6. ENGINE MECHANICAL

Students may be required to measure crankshaft, connecting rod bore, camshaft, piston and valve train. Students may also be tested on basic engine timing concepts.

## Testing

- Perform a compression test
- Perform a cylinder leakage test

## Engine Block and Heads

- Measure cylinder for diameter, taper and out of round
- Measure crankshaft journals for diameter, taper and out of round
- Measure crankshaft to main bearing clearance using plastigage
- Measure a piston for diameter, taper and out of round
- Remove and install a piston into a cylinder
- Remove and install rings on a piston
- Install and torque a main bearing cap and/or a connecting rod cap
- Measure gasket surfaces for warpage
- Install a timing chain/belt on an engine
- Calculate engine displacement based on bore and stroke measurements
- Verify correct camshaft timing.
- Measure crankshaft end play and identify how and where endplay is controlled
- Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer's specifications and procedures
- Visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition
- Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine necessary action
- Adjust valves (mechanical or hydraulic lifters)
- Inspect and replace camshaft. Measure camshaft lobe lift
- Remove and install a valve in a cylinder head
- Measure a valve spring for free height, straightness and tension
- Establish camshaft position sensor indexing

## Engine Tools

- Dial Indicators
- Feeler Gauges
- Piston Ring Compressor
- Piston Ring Pliers
- Piston Installation Hammer
- Straight Edge
- Plastigage
- Telescoping Gauges
- Small Hole Gauges
- Torque Wrenches
- Micrometers
- Digital or Dial Caliper
- Compression Tester

- Cylinder Leakdown Tester
- Precision Straight Edge
- Piston Ring Compressor
- Piston Ring Pliers
- Connecting Rod Vice
- Torque to Angle Gauge
- V-blocks
- Valve Spring Compressor
- Valve Spring Compressor for Overhead Cam Engines

## 7. DRIVABILITY

Students will be given one realistic problem to identify and resolve. Evaluation will be based on:

- Proper use of safety equipment
- Proper use of diagnostic literature
- Proper use of diagnostic equipment
- Logical order of repair, proper repair and verification of repair

Tasks in the competition may include:

- Research applicable vehicle and service information, service precautions, and technical service bulletins
- Retrieve and record diagnostic trouble codes and clear codes when applicable
- Access and use service information to perform step-by-step (troubleshooting) diagnosis
- Perform active tests of actuators using a scan tool; determine necessary action
- Use a scan tool to monitor engine data
- Use a DVOM to diagnose circuit faults (opens, shorts to ground, shorts to voltage and high resistance)
- Use a scanner and perform an injector kill test (injector drop test)
- Remove and inspect spark plugs. Install and torque spark plugs
- Measure spark plug wire resistance to determine if a plug wire is open, has high resistance or can be put back into service

Drivability Tools

- Scan Tool
- Test Lights (12v Circuit Tester)
- Electrical Pin-out Kits
- Jumper Wires
- DVOM
- Battery Chargers
- Injector Pulse Tester
- Spark Tester

## HIGH SCHOOL CTS COURSES

The following high school Career and Technology Studies (CTS) courses include related material useful in preparing for the competition. Not all elements of the courses will be tested at the competition and students do not need to have completed the courses to participate.

MEC1015: Mechanics Tools & Materials

MEC1040: Engine Fundamentals

MEC1090: Electrical Fundamentals

MEC2030: Lubrication & Cooling

MEC2040: Fuel & Exhaust Systems

MEC2060: Ignition Systems

MEC2070: Emission Controls

MEC2090: Electrical Components

MEC2110: Braking Systems

MEC2130: Drive Line

MEC2140: Transmissions/Transaxles

MEC2150: Suspension Systems

MEC2160: Steering Systems

MEC3030: Engine Diagnosis

MEC3040: Engine Tune-up

MEC3060: Engine Reconditioning – Head

MEC3070: Engine Reconditioning – Block

MEC3090: Computer Systems

MEC3130: Automatic Transmissions

MEC3150: Wheel Alignment