



# Automotive Maintenance

## Merit Badge Workbook

This workbook can help you but you still need to read the merit badge pamphlet.

The work space provided for each requirement should be used by the Scout to make notes for discussing the item with his counselor, not for providing the full and complete answers. Each Scout must do each requirement.

No one may add or subtract from the official requirements found in **Boy Scout Requirements** (Pub. 33216 – SKU 34765).

The requirements were last issued or revised in 2009 • This workbook was updated in March 2012.

Scout's Name: \_\_\_\_\_ Unit: \_\_\_\_\_

Counselor's Name: \_\_\_\_\_ Counselor's Phone No.: \_\_\_\_\_

<http://www.USScouts.Org> • <http://www.MeritBadge.Org>

Please submit errors, omissions, comments or suggestions about improving this workbook to: [Workbooks@USScouts.org](mailto:Workbooks@USScouts.org)

**You will need access to a car or truck and its owner's manual to meet some requirements for this merit badge.**

1. Discuss with your counselor the safety equipment, tools, and clothing used while checking or repairing a motor vehicle. \_\_\_\_\_

Safety equipment: \_\_\_\_\_

\_\_\_\_\_

Tools: \_\_\_\_\_

\_\_\_\_\_

Clothing: \_\_\_\_\_

\_\_\_\_\_

Use this equipment, tools, and/or clothing (when needed or called for) in meeting the requirements for this merit badge.

2. **General Maintenance, Safety, and Registration.** Do the following:

a. Review the maintenance chart in the owner's manual. Explain the requirements and time limits. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

b. Demonstrate how to check the following:

1. Brake Fluid

2. Engine Oil

3. Coolant

4. Power steering fluid

5. Windshield washer fluid

6. Transmission fluid

7. Battery fluid (if possible) and condition of the battery terminals

c. Locate the fuse boxes; determine the size of fuses. \_\_\_\_\_

Demonstrate the proper replacement of burned-out fuses.

d. Demonstrate how to check the condition and tension of belts and hoses.

e. Check the lighting in the vehicle, including instrument, warning, and exterior bulbs.

f. Locate and check the air filter.

g. Explain the purpose, importance, and limitations of safety belts and passive restraints. \_\_\_\_\_

Purpose: \_\_\_\_\_

\_\_\_\_\_

Importance: \_\_\_\_\_

\_\_\_\_\_

Limitations: \_\_\_\_\_

\_\_\_\_\_

h. Find out the requirements for the state inspection in your state, including how often a vehicle needs to be inspected.

\_\_\_\_\_

\_\_\_\_\_

i. Explain the importance of registering a vehicle and find out the annual registration fee for renewing your family car's registration. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

3. **Dashboard.** Do the following:

a. Explain the function of the fuel gauge, speedometer, tachometer, oil pressure, and engine temperature gauge. \_\_\_\_\_

Fuel gauge: \_\_\_\_\_

\_\_\_\_\_

Speedometer: \_\_\_\_\_

\_\_\_\_\_

Tachometer: \_\_\_\_\_

\_\_\_\_\_

Oil pressure: \_\_\_\_\_

\_\_\_\_\_

Engine temperature gauge: \_\_\_\_\_

\_\_\_\_\_

Point out each one on the instrument cluster.

- b. Explain the symbols that light up on the dashboard and the difference between the yellow and red symbols. \_\_\_\_\_

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Explain each of the indicators on the dashboard, using the owner's manual, if necessary. \_\_\_\_\_

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4. **Tires.** Do the following:

- a. Explain the difference between tire manufacturer's and vehicle manufacturer's specifications and show where to find them.

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- b.  Demonstrate how to check pressure and properly inflate a tire.

Check the spare tire and make sure it is ready for use.

- c. Explain why wheel alignment is important to the life of a tire. \_\_\_\_\_

Explain camber, caster, and toe-in adjustments on wheel alignment.

Camber: \_\_\_\_\_

Caster: \_\_\_\_\_

Toe-in: \_\_\_\_\_

- d. Explain the purpose of the lateral-wear bar indicator. \_\_\_\_\_

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- e. Explain how to dispose of old tires in accordance with local laws and regulations. \_\_\_\_\_

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5. **Engine.** Do the following:

a. Explain how an internal combustion engine operates. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Tell the differences between gasoline and diesel engines. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Explain how a gasoline-electric hybrid vehicle is powered. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

b. Explain the purpose of engine oil. \_\_\_\_\_  
\_\_\_\_\_

Explain the API service code, the SAE number, and the viscosity rating. \_\_\_\_\_

API service code: \_\_\_\_\_  
\_\_\_\_\_

SAE number: \_\_\_\_\_  
\_\_\_\_\_

Viscosity rating. \_\_\_\_\_  
\_\_\_\_\_

c. Explain where to find the recommended oil type and the amount of oil to be used in the vehicle's engine. \_\_\_\_\_  
\_\_\_\_\_

6. **Cooling system.** Do the following:

a. Explain the need for coolant in the cooling system. \_\_\_\_\_  
\_\_\_\_\_

b. Explain how to flush and change the engine coolant in the vehicle, and how to properly dispose of the used coolant. \_\_\_\_\_

Flush: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Change: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Disposal: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

7. **Fuel system.** Do the following:

a. Explain how the air and fuel systems work together and why it is necessary to have an air filter and fuel filter. \_\_\_\_\_

How the air and fuel systems work together \_\_\_\_\_

\_\_\_\_\_

Why it is necessary to have an air filter: \_\_\_\_\_

\_\_\_\_\_

Why it is necessary to have a fuel filter. \_\_\_\_\_

\_\_\_\_\_

b. Explain how a how a fuel injection system works and how an on-board computer works with the fuel injection system.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

8. **Ignition and electrical systems.** Do the following:

a. Diagram and explain the parts of the electrical system. \_\_\_\_\_

\_\_\_\_\_

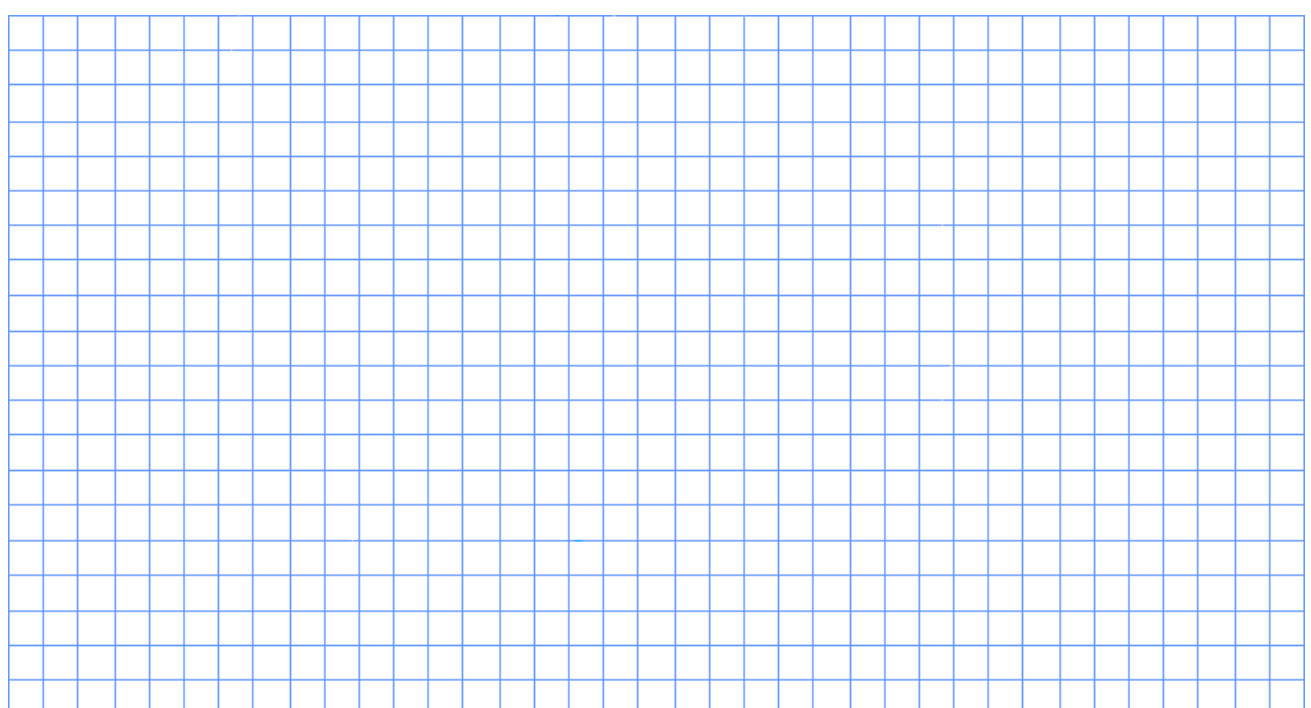
\_\_\_\_\_

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b. Explain the cylinder engine sequence. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

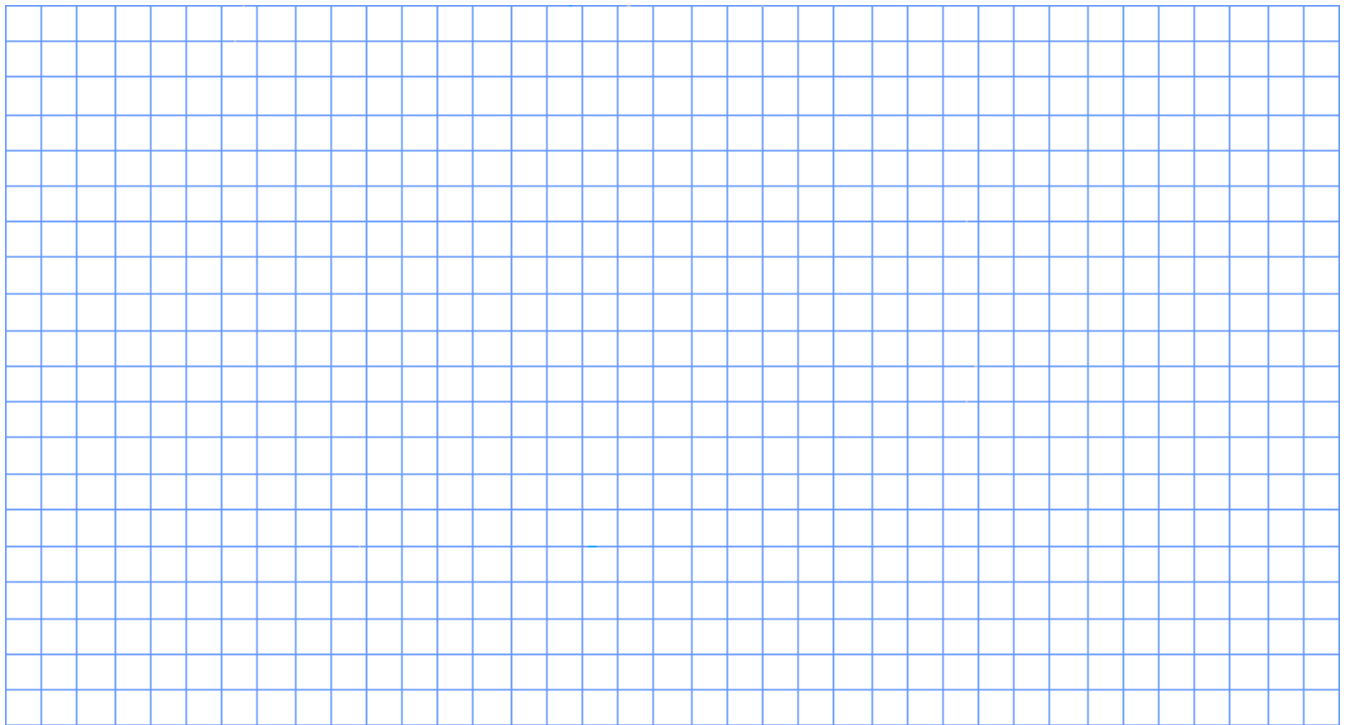
c. Explain the purpose of the spark gap. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

d.  Demonstrate how to change the spark plugs in any internal combustion engine (lawn mower, dirt bike, motorcycle).

e.  Demonstrate how to safely connect jumper cables to your car battery.

9. **Drive Train.** Do the following:

a. Diagram the drive train and explain the different parts. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



b. Explain the difference between automatic and standard transmissions. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

c. Explain the types of automatic transmission fluid. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

d. Explain the types of lubricants used in a standard transmission and in the differential. \_\_\_\_\_  
Transmission: \_\_\_\_\_  
\_\_\_\_\_  
Differential: \_\_\_\_\_  
\_\_\_\_\_

e. Explain the difference between front-wheel, rear- wheel, and four-wheel drive. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

10. **Brake System.** Do the following:

a. Explain the brake system (including anti-lock systems) and how it operates. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

b. Explain the differences between disc and drum systems. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

c.  Demonstrate how to check the condition of a vehicle's brake system. \_\_\_\_\_  
After checking make recommendations for repairs (if necessary). \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

11. Do TWO of the following:

- a. Determine the value of three different vehicles you are interested in purchasing. One must be new and one must be used; the third vehicle can be new or used. For each vehicle, find out the requirements and cost of automobile insurance to include basic liability and options for collision, comprehensive, towing, and rental car. Using the three vehicles you chose and with your merit badge counselor's assistance, complete the operation/maintenance chart provided in the merit badge pamphlet. Use this information to determine the operating cost per mile for each vehicle, and discuss what you learn with your counselor.

New vehicle: \_\_\_\_\_

Value: \_\_\_\_\_

Cost of automobile insurance: \_\_\_\_\_

Operating cost per mile: \_\_\_\_\_

Used vehicle: \_\_\_\_\_

Value: \_\_\_\_\_

Cost of automobile insurance: \_\_\_\_\_

Operating cost per mile: \_\_\_\_\_

Third vehicle: \_\_\_\_\_

Value: \_\_\_\_\_

Cost of automobile insurance: \_\_\_\_\_

Operating cost per mile: \_\_\_\_\_

What you learned \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

- b. Choose a car cleaner and wax product for a vehicle you want to clean. \_\_\_\_\_

Cleaner: \_\_\_\_\_

Wax: \_\_\_\_\_

Explain clear-coat paint and the precautions necessary for care. \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

- Clean the vehicle, both inside and out, and wax the exterior. \_\_\_\_\_

Use a vinyl and rubber protectant (on vinyl tops, rubber door seals, sidewalls, etc.) and explain the importance of the protectant. \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

- c. Locate the manufacturer's jack Use the jack to demonstrate how to engage the jack correctly on the vehicle, then change a tire correctly.

- d. Perform an oil filter and oil change on a vehicle.

Explain how to properly dispose of the used oil and filter. \_\_\_\_\_

\_\_\_\_\_

12. Find out about three career opportunities in the automotive industry. \_\_\_\_\_
1. \_\_\_\_\_
  2. \_\_\_\_\_
  3. \_\_\_\_\_

Pick one and find out about the education, training, and experience required for this profession.

Career: \_\_\_\_\_

Education: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Training: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Experience: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Discuss this with your counselor, and explain why this profession might interest you. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Requirement resources can be found here:**  
[http://www.meritbadge.org/wiki/index.php/Automotive Maintenance#Requirement resources](http://www.meritbadge.org/wiki/index.php/Automotive_Maintenance#Requirement_resources)

### Operation Maintenance Chart

The Auto Maintenance Merit Badge Pamphlet is missing the required Operation Maintenance Chart! Here is a sample chart that you might consider using until the BSA chart is published. The following is based on the interactive true cost of ownership calculator at Edmunds.com: <http://www.edmunds.com/apps/cto/CTOintroController>

<b>New Vehicle</b>	Monthly costs	Calculations for: Year: _____ Make/Model: _____
Total Purchase Price	\$	Including taxes, dealer fees, etc.
Financing (Payment)	\$	Assuming 3% of Price: <b>Price</b> X 0.03 (financing rates and terms vary greatly)
Depreciation	\$	Assuming 1% of Price: <b>Price</b> X 0.01 (new vehicles depreciate more)
Insurance	\$	A young male might average \$150 for a new car with comprehensive & collision
Tax & Fees	\$	Annual license and registration, fees, etc. ÷ 12 (typically near \$10/month)
Gas	\$	=\$/gallon ÷ Miles/gallon X _____ Miles/month (1,000 miles/month is average)
Maintenance/Repairs	\$	Batteries, brakes, hoses, exhaust system, tires, engine, etc (\$100/month?)
Total	\$	= Financing + Depreciation + Insurance + Taxes + Gas + Maintenance
÷ Monthly Miles	÷	miles Use same assumption as for gas. 1,000 miles/month is average.
= Cost per mile	=	The IRS assumes 55 cents/mile in 2012 though that estimate may be a low.

<b>Used Vehicle</b>	Monthly costs	Calculations for: Year: _____ Make/Model: _____
Total Purchase Price	\$	Including taxes, dealer fees, etc.
Financing (Payment)	\$	Assuming 3% of Price: <b>Price</b> X 0.03 (financing rates and terms vary greatly)
Depreciation	\$	Assuming 1% of Price: <b>Price</b> X 0.01 (new vehicles depreciate more)
Insurance	\$	A young male might average \$150 for a new car with comprehensive & collision
Tax & Fees	\$	Annual license and registration, fees, etc. ÷ 12 (typically near \$10/month)
Gas	\$	=\$/gallon ÷ Miles/gallon X _____ Miles/month (1,000 miles/month is average)
Maintenance/Repairs	\$	Batteries, brakes, hoses, exhaust system, tires, engine, etc (\$100/month?)
Total	\$	= Financing + Depreciation + Insurance + Taxes + Gas + Maintenance
÷ Monthly Miles	÷	miles Use same assumption as for gas. 1,000 miles/month is average.
= Cost per mile	=	The IRS assumes 55.5 cents/mile in 2012..

<b>Third Vehicle</b>	Monthly costs	Calculations for: Year: _____ Make/Model: _____
Total Purchase Price	\$	Including taxes, dealer fees, etc.
Financing (Payment)	\$	Assuming 3% of Price: <b>Price</b> X 0.03 (financing rates and terms vary greatly)
Depreciation	\$	Assuming 1% of Price: <b>Price</b> X 0.01 (new vehicles depreciate more)
Insurance	\$	A young male might average \$150 for a new car with comprehensive & collision
Tax & Fees	\$	Annual license and registration, fees, etc. ÷ 12 (typically near \$10/month)
Gas	\$	=\$/gallon ÷ Miles/gallon X _____ Miles/month (1,000 miles/month is average)
Maintenance/Repairs	\$	Batteries, brakes, hoses, exhaust system, tires, engine, etc (\$100/month?)
Total	\$	= Financing + Depreciation + Insurance + Taxes + Gas + Maintenance
÷ Monthly Miles	÷	miles Use same assumption as for gas. 1,000 miles/month is average.
= Cost per mile	=	The IRS assumes 55.5 cents/mile in 2012.

## Important excerpts from the [‘Guide To Advancement’](#), No. 33088:

Effective January 1, 2012, the ‘Guide to Advancement’ (which replaced the publication ‘Advancement Committee Policies and Procedures’) is now the *official* Boy Scouts of America source on advancement policies and procedures.

- **[ Inside front cover, and 5.0.1.4 ] — Unauthorized Changes to Advancement Program**  
***No council, committee, district, unit, or individual has the authority to add to, or subtract from, advancement requirements.***  
(There are limited exceptions relating only to youth members with disabilities. For details see section 10, “Advancement for Members With Special Needs”.)
- **[ Inside front cover, and 7.0.1.1 ] — The [‘Guide to Safe Scouting’](#) Applies**  
Policies and procedures outlined in the ‘Guide to Safe Scouting’, No. 34416, apply to all BSA activities, including those related to advancement and Eagle Scout service projects. [Note: Always reference the online version, which is updated quarterly.]
- **[ 7.0.3.1 ] — The Buddy System and Certifying Completion**  
Youth members must not meet one-on-one with adults. Sessions with counselors must take place where others can view the interaction, or the Scout must have a buddy: a friend, parent, guardian, brother, sister, or other relative —or better yet, another Scout working on the same badge— along with him attending the session. When the Scout meets with the counselor, he should bring any required projects. If these cannot be transported, he should present evidence, such as photographs or adult certification. His unit leader, for example, might state that a satisfactory bridge or tower has been built for the Pioneering merit badge, or that meals were prepared for Cooking. If there are questions that requirements were met, a counselor may confirm with adults involved. Once satisfied, the counselor signs the blue card using the date upon which the Scout completed the requirements, or in the case of partials, initials the individual requirements passed.
- **[ 7.0.3.2 ] — Group Instruction**  
It is acceptable—and sometimes desirable—for merit badges to be taught in group settings. This often occurs at camp and merit badge midways or similar events. Interactive group discussions can support learning. The method can also be attractive to “guest experts” assisting registered and approved counselors. Slide shows, skits, demonstrations, panels, and various other techniques can also be employed, but as any teacher can attest, not everyone will learn all the material.  
  
There must be attention to each individual’s projects and his fulfillment of *all* requirements. We must know that every Scout — actually and *personally*— completed them. If, for example, a requirement uses words like “show,” “demonstrate,” or “discuss,” then every Scout must do that. It is unacceptable to award badges on the basis of sitting in classrooms *watching* demonstrations, or remaining silent during discussions. Because of the importance of individual attention in the merit badge plan, group instruction should be limited to those scenarios where the benefits are compelling.
- **[ 7.0.3.3 ] — Partial Completions**  
Scouts need not pass all requirements with one counselor. The Application for Merit Badge has a place to record what has been finished — a “partial.” In the center section on the reverse of the blue card, the counselor initials for each requirement passed. In the case of a partial completion, he or she does not retain the counselor’s portion of the card. A subsequent counselor may choose not to accept partial work, but this should be rare. A Scout, if he believes he is being treated unfairly, may work with his Scoutmaster to find another counselor. An example for the use of a signed partial would be to take it to camp as proof of prerequisites. Partials have no expiration except the 18th birthday.