

CARs for Apprentices AMEs

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Maintaining the Canadian Aircraft

The **Canadian Aviation Regulations** apply to everything to do with civil aviation in Canada. Military aircraft are managed similarly under the Department of Defense. The CARs cover all civil airplanes, airports, air traffic control, airspace, and, in particular, the maintenance of civil aircraft in Canada. This manual is intended to help new Canadian aircraft technicians ("Aircraft Maintenance Engineers" or AMEs) to learn how to use the CARs in managing aircraft maintenance. The task that the AME is charged with is to analyse a work of aircraft maintenance to determine if it has been done correctly so that the people who use the aircraft (the pilots, for example) will be able to determine that the aircraft is fit for service. The AME, thus, communicates directly with the downstream users of the aircraft by handing off the aircraft to the pilot with a certification that maintenance done on the airplane was done properly. The pilot analyzes the AME's report, then decides if the airplane is fit to fly.

The CARs are more than just "regulations". They also contain related "standards". Thus the CARs usually state a requirement for something to be done (Regulations), and then state how it's to be done (Standards). In the paper edition, this is not always apparent, but the two sections are nicely integrated in the internet edition. The Transport Canada website displays the CARs in sequence, and provides links to the related Standards. Aircraft technicians are expected to know the Regulations AND the related Standards. Student AMEs should make every effort to master the online CARs; this, plus a few other research sites, is where most of the AMEs daily research will be done.

The first administrative level is to be found in the **Aeronautics Act**. This is the framework that sets the stage for the CARs. It says WHO can regulate aviation in Canada (answer: The government-appointed "Minister"), and HOW the regulation will be accomplished (by making "Regulations and Standards").

None of this applies to anything unless it appears to be an aircraft or something that can fly high enough to be a nuisance. Hovercraft and snowboards are exempt. If it can get 100 feet off the ground, then all of this stuff is activated.

The Aeronautics Act

The Government of Canada administers aviation under the authority of the Aeronautics Act. This is what gives the Minister of Transport the power to issue licences and register aircraft - and to create penalties for anyone who doesn't do what he's supposed to do. Under the Aeronautics Act, for example, the Minister can seize an aircraft if a penalty is not paid.

The Minister's office (one man can't do all this work) is called "Transport Canada". Transport Canada is headquartered in Ottawa at 330 Sparks Street (www.tc.gc.ca), and it has regional offices in every major city.

Section 4.9 of the **Aeronautics Act** sets out that the Minister is the one who's in charge of making all the rules and regulations concerning the maintenance, repair, and manufacture of all aircraft and replacement parts. The Minister is the person who created all the Regulations and Standards which follow here. If you ask, "Who gives the Minister the power to tell me what to do?" you will get the answer, "The Parliament of Canada voted to do it this way, so that's the way it's done." Period!

The **Aeronautics Act** is found on the internet at:

<http://www.tc.gc.ca/acts-regulations/GENERAL/A/aa/act/menu.html>

Which part of the AME's work is being licenced?

The AME licence is a privilege to sign a maintenance release for work performed. The privileges of the licence specifically permit an individual to certify their own maintenance, or that of others. What is being licenced is not the performance of work, but rather the certification of work performed. The AME signs that the task completed is done as it should be done - regardless of who did the work.

The Canadian Aviation Regulations (CARs)

The CARs are logically arranged in "Parts" and "Subparts". A "Part" (for example, Part IV) can be focussed on training, and a SubPart (for example, Part 403) can be focussed on training mechanics. Any CAR numbered beginning with "4" (example, 401,402,403, etc) will belong to Part IV. Any specific CAR (example, 401,402,403) is referred to as a "Subpart".

Any CAR can have detailed "how-it-must-be-done" information attached to it. These are called "Standards". It's not easy to visualize this system on paper, but it's ideally displayed on the internet as a series of links. The CARs were designed to be used on the internet, and students are urged to access and bookmark the CARs on the internet while they are working through this edition of CARs for the AME.

The **Canadian Aviation Regulations** are found at:

<http://www.tc.gc.ca/civilaviation/RegServ/Affairs/cars/menu.htm>

Part I - General Provisions

What and who is covered by the CARs:

All civil aircraft are covered by the CARs including training aircraft, amateur-built aircraft, balloons, gliders, jet transports, and helicopters. Military aircraft, model aircraft, rockets, and hovercraft are not covered. Anything to do with any aircraft covered by these regulations must be kept (by the owner) in case the Minister wishes to look at it 103.02. This usually means all logbooks, receipts, manuals, notices, computer data, etc.

Canadian Aviation Regulations 101 contains a useful section on Definitions. There are different requirements for different classes of aircraft, and the principal definitions are here. For instance, to find the definition of "advanced ultra-light aeroplane", you would look in this section. An aeroplane having a maximum permissible take-off weight of 5,700 kg (12,566 pounds) or less, or a helicopter having a maximum permissible take-off weight of 2 730 kg (6,018 pounds) or less is defined as a small aircraft. An aeroplane having a maximum permissible take-off weight of 5,700 kg (12,566 pounds) or more is classed as a large aircraft. Oddly enough, a helicopter over either limit is not classified as a large anything.

Work defined as "maintenance of an aeronautical product" **does not include servicing the aircraft** 101.

Statutory limitations are listed. For example, aircraft can be seized by the Minister for non-payment or non-compliance. If the Minister seizes anything to do with an aircraft (including the aircraft), the Minister is obliged to keep it in good condition and return it in the same condition 103.10. This usually happens after an accident, and everything is returned after the investigators have had their time looking at the evidence.

Part II - Aircraft Identification and Registration

Aircraft are marked according to international agreement. Have you noticed that all aircraft are marked with "English" registration marks? All the members of the United Nations have agreed, under the umbrella of the International Civil Aviation Organization (ICAO) to implement a standard aircraft identification scheme. There are no Russian or Chinese characters used to identify any aircraft. The only universal ICAO standard that concerns AMEs is the aircraft marking scheme. Pilot licences, for example, adhere to a universally-agreed ICAO standard, but this doesn't concern the AME.

Part of the international agreement on marking aircraft asks that every airframe 201.01, every engine 201.05, and every propeller 201.05 be marked with a permanent fire-proof data plate. This is unbelievably useful for identifying aircraft after an accident. It's not for catching smugglers or dealers in used parts (although it might be helpful). It's an offense to remove or alter any of these plates. Without the plate, the aircraft ceases to exist since it can't be uniquely identified.

An entire airplane can be reconstructed starting from the fuselage data plate, using replacement parts. Without the data plate, nothing can be done - the airplane becomes scrap.

Registration of Aircraft 202.13

This section applies to all aircraft except hang gliders and parachutes. The CARs define the nature of the whole enterprise: nobody (there are a few very limited exceptions) shall operate an aircraft in Canada unless it is registered. It can be registered in another country, but it must be registered somewhere. This book is going to focus entirely on the Canadian aircraft that must be registered in Canada. The biggest exception to this requirement is that a Canadian aircraft manufacturer may operate an unregistered aircraft for test or customer delivery purposes.

Types of Registration 202.17

Canadian civil aircraft can be registered only as:

- (a) *state aircraft;*
- (b) *commercial aircraft; or*
- (c) *private aircraft.*

Note that a private aircraft can NOT be operated as a commercial aircraft. A private aircraft must be *re-registered* in order to be operated commercially. If an aircraft is unserviceable, the Minister must be informed of the owner's intentions regarding the prospects for the aircraft. The Minister always wants to know who's taking care of an aircraft. If the registered owner of an aircraft moves the aircraft to a temporary operator in a remote location, and assigns control of the maintenance of the aircraft to the temporary operator of the aircraft, the registration of the aircraft will be cancelled 202

A military aircraft cannot be registered as a civil aircraft,

Identity for Registration Purposes 202.18

An aircraft exists if a piece of an aircraft exists. That is, if a fuselage exists, even without wings, then an aircraft is assumed to exist. However, wings alone do not make an aircraft. It starts as a fuselage. If the fuselage is destroyed or scrapped, the aircraft no longer exists (and cannot remain registered).

Issuance of a Certificate of Registration 202.25

Some kind of certificate, either provisional or temporary, will be issued by the Minister if an aircraft is registered by the boffins in the minister's office (Transport Canada). An aircraft can't be registered if it doesn't have a registration mark 222. If it's a permanent addition to the Canadian fleet, the aircraft will be given a continuing certificate of registration. The certificate of registration issued in respect of the aircraft must be carried on board the aircraft 202.26. This is one of many bits of paper the MUST be on board the aircraft when the aircraft is being operated. There are other bits that must NOT be aboard the aircraft, and they will be discussed later.

Any Canadian over the age of 16 can be registered as the owner of a Canadian aircraft. A valid and current Canadian corporation can own a Canadian aircraft if the corporation exists. If the corporation ceases to exist (for example, if it fails to maintain its corporate status), the aircraft registration ceases 202.15.

Transfer of Legal Custody and Control 202

If the owner (registered) of a Canadian aircraft transfers any part of the legal custody and control of the aircraft, the registered owner shall, by not later than seven days after the transfer, notify the Minister of the transfer in writing. The new registration for the aircraft is usually the "*interim registration*", lasting for three months.

The *interim registration* of an aircraft is created by completing the information requested on the back of the continuing *Certificate of Registration* and forwarding it to the Minister 202.36. This is the usual procedure when an aircraft is sold.

A "*provisional registration*" is used when a new or imported aircraft is being moved about prior to sale or registration. This is analogous to the temporary paper licence plates for a new car. It's usually valid for only a very short time.

From this discussion, it should be obvious that the Minister wants to know the whereabouts of each and every aircraft, and who's in charge of it, at all times. This is accomplished through the various forms of *registration* described.

Leasing an Aircraft 203.03

The *leasing* of an aircraft (usually for commercial operations) works the same way as registration of an aircraft by an owner in that the same owner qualifications must be met, and the Minister must be advised. Since a lease is "legal custody and control" *FOR A LIMITED TIME*, the Minister also needs to know the dates of the lease, the name of the person who is responsible for the maintenance of the aircraft during the term of the lease, and the address of the main maintenance base for the aircraft. 203.05 The *Certificate of Registration* of a leased Canadian aircraft remains valid notwithstanding any change in leasing arrangements.

The registered owner of an aircraft is still in the loop regardless of the aircraft being leased. For example, the registered owner of the aircraft must forward to the lessee all airworthiness directives that apply to the aircraft 203.06.

Requirements for Registration Marks on Aircraft 202.01

No person shall operate a Canadian aircraft (in Canada) unless its *registration marks* are visible and are displayed properly. "*Properly*" means in accordance with the requirements of the *Aircraft Marking and Registration Standards* 222.01. The standards say how big the letters must be, where they must be, what colour they must be, and what fonts are permitted. Letters must be plain "Roman" which doesn't mean "Times Roman"; it means that the letters must be part of the Roman alphabet from A to Z, not Greek, Cyrillic, or Chinese for example.

Putting the Registration Marks on the Aircraft 202.01

The CARs dictate to the owner how and where to place the registration marks. Some aircraft are big and fat, with lots of room to place the marks in a convenient place. Some are small, spindly, and full of holes. In this case, the CARs may try to shift the burden of placement to the owner by saying, in effect, "you figure it out". For example, the CARs may ask the AME to place the marks "as near to the cockpit as possible" if the aircraft is an open truss structure 202.01.

An aircraft registered after 1975 shall have the *nationality mark* "C" followed by four registration marks 202.03. For example, "C-FABC". The "C" indicates Canada. The "F" as in "C-F", or "G" as in "C-G", indicates any normal aircraft, whereas "C-I" indicates an ultralight aircraft. Old-timers may have been initially registered 50 years ago as "CF-ABC", but they are required to re-register as "C-FABC" when repainted. This not not an insignificant matter since most of the Canadian fleet is more than 50 years old!

Every detail concerning size, color, and location of registration marks is spelled out in the CARs standard relating to registration marks 222.01. Since AMEs are responsible for verifying much of the work relating to the painting and assembly of aircraft, the AME is expected to determine and OK the correct installation of registration marks on an aircraft 222.01

A copy of the C of A can be used for operation of the aircraft; it's not necessary to use the original document 202. The registration of an aircraft can be cancelled if the registered owner of an aircraft "lends" the aircraft to someone else in another location 202.35. The wording of the regulation refers to "any part" of the legal custody and control on the aircraft, and this covers "lending" the aircraft to somebody who eventually needs to maintain the aircraft in order to keep it going. An operator who imports an aircraft into Canada must obtain a *provisional registration* for the aircraft 202.37.

Removing the Registration Marks 202.61

If an owner retires an aircraft, or the registration lapses, it ought to be "de-marked." The Minister may request the owner to remove the Canadian marks from the aircraft, after which the owner has within seven days to remove the marks. It's usually sufficient to simply paint over the registration marks. It's an offense to state that the marks have been removed if they're still visible.

The registration marks, once applied, must not be removed until the aircraft is no longer registered 202.61. There are some (as usual) exceptions: the marks on an aircraft being test flown by a manufacturer may be removed after the test flight. Obviously, the marks will be briefly obliterated when an aircraft is being painted, but try not to get caught moving an

aircraft around without its marks! However, the registration marks must be removed from the aircraft, and any installed transponder/TCAS system data, must be removed if the aircraft is exported 202.38 The transponder/TCAS system must be removed since it is hard-coded with the electronic version of the aircraft registration and will reply to ATC queries using the old registration unless it is removed or re-coded.

Part III - Aerodromes and Airports

There is nothing in Part III for AMTs. Occasionally an AME will be asked to put up a windsock for an airport operator, or help repair a maintenance tractor, but that's about the limit of an AME's airport-related skills.

Part IV - Personnel Licensing and Training

CAR 403 is referred to as "Subpart 3 of Part IV." Other Subparts refer to pilots, Air Traffic Controllers, etc, but we'll not be discussing the other specialties. Subpart 3 (CAR 403) applies not only to AMEs, but also to student AMEs and AME training organizations.

Nobody can work on aircraft unless they are knowledgeable and their skill-sets are current 403.05. This section refers to the "privileges" of an AME licence. The *privileges* of an AME refers to the permission granted to an AME by the Minister to evaluate the standard of work performed on an aircraft component.

An AME is the person who can decide if a component (an "aeronautical product") is up to standard, and can approve it by signing a "Maintenance Release". In some cases, someone who has been approved by an AMO, but who may not be licensed as an AME, may also evaluate the standard of work 403.02. An AME must have successfully completed an applicable approved course of maintenance training before engaging in any of this work 566.02, and the AME must be current (up-to-date) in his specialty 403.05. It's not possible to do AME work as a part-time hobby.

Part V - Airworthiness

The general format for assessing airworthiness is laid down by ICAO in a format called the "*Airworthiness Manual*" (ICAO DOC 9760). In the CARs, the *Airworthiness Manual* has been published as sections 500 to 593 of Part V 500.01(2). This part of the CARs is harmonized with ICAO and the FAA, which explains why the numbering is different from the rest of the CARs. In some cases, the numbering matches the FAA sequence: FAA Part 23 is analogous to AWM 523; Part 25 is AWM 525, and so forth. But it doesn't always work this way since the entire *Airworthiness Manual* numbering system is an international compromise. The (Part V) AWM *Standards* are an oddball mixture of both "Chapters" and "Standards". Click on *Part V -> Subpart 71 -> Standard 571* (yes, that's what it says!) for more information and history.

Aircraft airworthiness certification in Canada concerns AMEs, but the certification of aircraft is not universally accepted by all countries. The USA has its own certification system, Russia has another, and Europe has yet another. Canada accepts the USA's system under reciprocal agreements between Canada and the USA only, and acceptance by Europe or Russia is outside the Canada-USA system. For example, if an aircraft is certified airworthy in Canada, it is automatically airworthy in the USA. If it's to be operated in Australia or France, the aircraft will need to be recertified separately in each of those places. Ultralights and homebuilts do not need to be recertified since they are not certified in the first instance.

Aircraft are only *airworthy* at a given time. No aircraft is airworthy forever. The test for airworthiness is, "Is this aircraft exactly the same as the day it left the factory 507.02?" And the only person who can answer this question is the AME 507.10. During its life, an aircraft is continually being used, worn out, and repaired. Each time that maintenance is done, the aircraft is to be brought back to its original factory condition, and re-certified as such by the AME.

In addition, every aircraft must report back to the Minister *every year* as to its airworthiness condition. The airworthiness of an aircraft must be continually re-established. Once a year, the owner must report to the Minister on the status of the aircraft by filing an **Annual Airworthiness Information Report** on form # **24-0059**. The owner must report the characteristics of the aircraft, serial numbers of all the bits and pieces, the hours flown, and the dates of any inspections 501.02. Most of the information is pre-printed on the form # 24-0059 when it is mailed to the owner and simply needs to be confirmed.

If any components listed on the form 24-0059 have been replaced, the owner is to cross out the old information and write in the new information. The information needed by the Minister is listed on the next page.

Information required to complete the **Annual Airworthiness Information Report** (form # **24-0059**):`

- (a) Aircraft nationality and registration marks *;
- (b) Aircraft total hours flown since new, and aircraft hours flown in the last calendar year;
- (c) Except for an aircraft being operated pursuant to Part IV or Part VII of the Canadian Aviation Regulations the date of the most recent annual or equivalent inspection, and:
 - (1) the name and licence number of the **Aircraft Maintenance Engineer (AME)** who conducted and certified the inspection;
 - (2) in the case where it was an **Approved Maintenance Organization (AMO)** which conducted the inspection, the name and approval number of the AMO; or
 - (3) in the case of an aircraft that is operated under a special certificate of airworthiness in the owner-maintenance or amateur-built classification, the name of the owner if it was the owner who conducted the inspection;
- (d) Whether the aircraft was significantly damaged since the last report and, if applicable, the date of repair certification;
- (e) Applicable Type Certificate number *;
- (f) Aircraft base of operation *;
- (g) Transport Canada region in which the aircraft is registered *;
- (h) Type of flight authority *;
- (i) Aircraft purpose (i.e. private, commercial or state) *;
- (j) Aircraft make, model and serial number *;
- (k) Aircraft empty weight and maximum certified take-off weight *;
- (l) Engine(s), make, model and serial number(s), if applicable *;
- (m) Propeller(s), make, model and serial number(s), if applicable *;
- (n) Skis, make and model, if applicable *;
- (o) Floats, make and model, if applicable *; and,
- (p) Certification, by the date and signature of the registered owner, that the reported information is correct.

The information with an asterisk (*) is pre-printed on the form and usually needs only to be confirmed.

Ultralight aircraft are exempt in order to provide an outlet for recreational aviators who don't wish to be regulated and may be reluctant to report anything to the government. In return for being let off the hook, ultralights are supposed to stay away from big-city airports, refrain from carrying passengers, and not fly over urban areas. For some aviators, this is a fair compromise, but serious airplanes need access to big airports in urban areas, and they're stuck with reporting annually.

The **AAIR** must be submitted on or before the *anniversary of the issue of the C of A*.

507 - Permission to Fly, please!

If an aircraft is airworthy, it is entitled to have a **Flight Authority** 507.04; if it's not airworthy, it may be able to fly for the purpose of maintenance or repair only with the permission of a **Specific Purpose Flight Permit** 507.08. The Flight Authority will limit how the aircraft may be flown. Dangerous airplanes (water bombers, amateur-builts, and ultralights, for example) may be issued a Flight Authority that prohibits carrying passengers. Amateur-built airplanes may be issued a Flight Authority that requires the owner to warn passengers that the aircraft doesn't have a Type Approval; that is, it's not certified to any national standard 511.

Type Approvals require documentation - lots of it! An **Engine Type Approval**, for example, requires an Engine operating manual, Engine installation manual, and an Engine maintenance manual 511. If the engine is a variation on a standard type, it will need its own unique manuals. The manufacturer of an approved aeronautical part must have a "Manufacturer Approval" (Standards Chapter 561). And, before an approved part can be screwed onto an aircraft, it must have a release (by an AME) under 561.

571 - Who can sign on the dotted line?

After an aircraft is presented for inspection, someone must examine every bit of the aircraft to ensure that it is airworthy. In other words, someone must determine that this aircraft in every respect, is the same as when it left the factory decades earlier. If any bits were replaced along the way, the pedigrees of the replaced bits will need to be examined. If any repairs were made to the aircraft, the engineering of the repairs must be confirmed. If any notices regarding the airworthiness of the aircraft were issued, it must be confirmed that all notices were analyzed and acted upon.

With respect to certification, there are only two accepted signatures that we need to concern ourselves with:

1. the Aircraft Maintenance Engineer (AME)
2. the Aircraft Maintenance Organization (AMO)

Only an Aircraft Maintenance Engineer may certify an aircraft for the purpose of obtaining a flight authority. Thus, the main duty of a licenced AME is to determine and certify the standard to which aircraft maintenance has been completed 571.10.

There is an exception to the narrow limitation of signing off certain tasks: *flight training units* (flight schools). Since flight schools operate high-use, simple aircraft, it is not necessary that an AME sign off the routine simple daily maintenance *if* the technicians doing the work have been trained for this work 571.10. The technician is to be trained in the procedures contained in the operator's *Maintenance Control Manual*.

In most cases, it's not always necessary that the AME perform the work in order to sign the maintenance release. However, if an unlicenced person is doing the work, it's required that the AME personally observe the task being completed 571.11.

571 cont'd - What does the AME look at?

Every repaired aircraft component is certified as serviceable by means of a signed *Maintenance Release* 571.06. There will be one of these for every removable component of the aircraft. The person who signs the *Maintenance Release* (either an AME alone or an AME as part of an AMO) must be qualified to sign the release, and the AME must figure out if the signatures are legitimate 571.11-13. Individual components that may be sent out for overhaul must have an **Airworthiness Approval Form 24-0038** *attached and available* if an AME is to determine the airworthiness of an aeronautical product overhauled by a third party.

Some parts of an aircraft can't be sent out for overhaul - they're too big or too heavy. A pressurized fuselage, for example. Or the wing of a transport aircraft. Even the vertical fin of a big Boeing may be too big to move very far. It's easier to bring the technicians to the part. In this case, repairs are done by an AMO according to "*field service standards*" 571. In this case, it is not the AMO who inspects the AMO's specialized work; it's the AME who inspects the completed work. Major repairs such as structural repairs must be done in accordance with "*approved data*" 571.13. This means engineering data from the manufacturer. In such cases, the AME must request engineering drawings ("blueprints", as they used to be called in the old days).

Blueprinting was a method for making prints from original hand-drawn engineering data. The original was done on high-quality, translucent linen-base paper, and a manual printing process was used to reproduce a "blueprint" of the drawing. The print paper was exposed to light shone through the original drawing (by passing the two sheets over a fluorescent light). The print paper was exposed to ammonia fumes in a simple sealed box over a dish of ammonia. The exposed part of the paper changed color (usually to blue), and a semi-permanent paper print was the result. In "modern times" all this is done on computers, and the "blueprints" are produced on laser printers and plotters. It may not even be necessary to print the drawing. In most cases, the drawing can be viewed on a computer monitor just as effectively. Or the drawing may be fed directly into a milling machine. But the drawing might still be called a "blueprint".

In some cases, the work may be especially complicated or *proprietary* (done with specialized tools or processes at a factory location, for instance). Not every AME can overhaul an Airbus landing gear, for example, or a Rolls-Royce turbine wheel. In this case, *field limits* will be specified by the manufacturer. Beyond the limits, the manufacturer must become involved in the maintenance process 571.

With modern mass-production, there may be lots of parts that will fit as replacements, and the AME must decide on the airworthiness of the replacement parts. When an aircraft is certified, all the parts are identified, usually with brand-names and serial numbers. Just as a Honda automobile can drive around with non-Honda replacement parts underneath, so can an aircraft. However, in a certified aircraft (unlike automobiles), the replacement parts must be approved by whoever certified the aircraft in the first place (usually the manufacturer). Thus, the pistons in a Lycoming engine may be replaced with non-Lycoming pistons only if the aircraft builder says so (not the engine builder). This may affect European aircraft using USA-made engines, for example. USA-made aircraft are generally entitled and permitted by the FAA to use USA-made generic replacement parts 571, but this freedom doesn't extend to European or Canadian aircraft 571.

Used airworthy parts can be used without a *maintenance release document* to maintain an aircraft, but they cannot come from storage. The used parts must come directly from an airworthy installation 571.08, with no intervening storage. If the part comes from storage, it must be recertified 571.08.

571 - Doing the work:

"Elementary work" - means those tasks that are listed as elementary work in the Aircraft Equipment and Maintenance Standards *Appendix A of Standard 625*; an oil change is "elementary work". So is a simple tire replacement or fabric patch.

The work on an aircraft must always be done the way it's supposed to be done 605.85. The AME's task is to certify that work done on an aircraft is completed in accordance with the manufacturer's recommendations, or as close to them as possible. Where the recommendations of the aircraft manufacturer are incompatible with those of the engine, propeller, or appliance manufacturer, the recommendations of the aircraft manufacturer are used. The manufacturer is the one who certified that the aircraft as *assembled* will do the job stated by the manufacturer. Sometimes an engine must run at one speed in aircraft 'A', but at a different speed in aircraft 'B' due to airframe vibration considerations. In this case, the aircraft manufacturer's data is to be used.

Where the manufacturer has not made specific recommendations regarding maintenance or repair methods, standard industry practices are to be used. These practices include, but are not limited to, methods published by Transport Canada, a foreign Civil Aviation Authority, the manufacturer of a similar product, or other practices that may not be published provided they are generally accepted by the Canadian aviation industry. The most often used reference for standard practices is the FAA's Advisory Circular 43.13 (AC43.13-1B&2A). This is a massive 500-page manual of time-tested methods for doing most generic maintenance and repair tasks in small aircraft such as rivetting, patching, splicing, wiring, dope & fabric, etc.

Any person who performs maintenance or elementary work on an aircraft shall use the most recent methods, techniques, practices, parts, materials, tools, equipment and test apparatus. Any device or test equipment, must be calibrated by means traceable to a national standard 571.02. Even the simplest measuring device (a ruler or a weigh scale, for example) must be calibrated and verifiable.

Specialized testing of materials must be done regularly on aircraft. There are two kinds of materials testing in the engineering field:

1. Destructive testing
2. Non-destructive testing

The first destroys the object being tested. The strength of metals can be ascertained only by destructive testing methods such as crushing, stretching or shearing, but the metal isn't much good for anything afterward. The second is the type of testing normally done on aircraft. This type of testing includes measuring of wear and tear, dye checking for cracks, leak testing of containers, and x-ray or eddy current testing for corrosion. This type of testing may be done only by trained specialists in accordance with the CARs AWM Standard 571.02(3). Sometimes destructive methods are used, and the aircraft is patched up afterward as when a fabric punch is used to test the remaining strength in an aircraft fabric covering, or a steel punch is used to test for hidden corrosion inside a closed tubular steel strut.

571 - Airworthiness Directives:

ADs (sometimes called "AWDs") are mandatory repair instructions from the aircraft manufacturer, sent directly to the aircraft owner. The AME is the person normally requested to take care of the ADs as they're issued, and he is usually able to verify that Airworthiness Directives have been completed. Regardless, **ADs are always the responsibility of the aircraft owner** 571.10(3). AMEs are not duty-bound to verify that ADs are completed, but can do so if requested.

571 - Technical record keeping (Weight & Balance):

Every owner of an aircraft shall keep the following technical records in respect of the aircraft 605.92:

- (a) a **Journey Log** 605.92;
- (b) a separate technical record for the airframe, each installed engine and each variable-pitch propeller 605.92; and
- (c) an **empty weight and balance report 605.92** (See also **AWM Standard 571 Appendix C** for how-to-organize a Weight & Balance report. The FAA publishes detailed technical information on doing the Weight & Balance for various aircraft types in *FAA H-8083-1 Aircraft Weight & Balance*

571 - Weight and Balance:

The empty weight of an aircraft and the position of the C of G shall be entered into a separate Weight & Balance report (to be kept in the aircraft) entered into the weight & balance page of the Aircraft Journey Log AWM 571

Any change to the empty weight of an aircraft requires a new Weight and Balance report and shall be accompanied by a Maintenance Release 571 Appendic C.

573 - The AMO:

A group of AMEs and/or specialists can be approved as an **APPROVED MAINTENANCE ORGANIZATION (AMO)**. An AMO certificate can be issued to authorize the performance of maintenance on aircraft operated in commercial service pursuant to CARs Part IV (flight training) and Part VII (commercial operators), and upon components intended for installation on such aircraft 573. In this case, it is the AMO that has the ability to sign a release, and an AME needs the AMO's approval to sign on behalf of the AMO 573.05.

An AMO is not limited to the maintenance of Part IV (Training) and Part VII(Commercial) aircraft. The AMO may also perform non-specialized maintenance on privately operated aircraft and components.

A specialized AMO can be authorized to perform specialized maintenance on components such as propellers, structures, or engines. However, an AMO that is approved for the performance of specialized maintenance is not limited to such work, and may also perform non-specialized maintenance of any other kind described on its AMO certificate 573.

An AMO with an aircraft rating can undertake non-specialised maintenance, checks, and line maintenance 573. An AMO with a rating in the Engine category may perform maintenance work on an internal engine gearbox (but not an external gearbox). An aircraft propeller nicked to an extent greater than the limits described by the manufacturer must be shipped off to an AMO with a propeller category, not an AME.

591 - Bug Reports:

Transport Canada devotes considerable energy to collecting reports of component defects and failures in the form of **Service Difficulty Reports (SDRs)**. This information is very valuable to other AMEs. It's a key part of the national fleet safety process. The purpose of the Transport Canada's SDR system is to collect, analyse, record and disseminate data concerning those defects and malfunctions which have resulted in, or are likely to result in a safety hazard to an aircraft or its occupants. It is intended to use the reported information to support the regulatory activities required to improve the level of flight safety. The information is relayed back to manufacturers and maintainers in the form of newsletters, safety letters and Airworthiness Directives. The information is shared internationally, which makes it even more effective as a maintenance tool.

605 - Quality Control

Where the manufacturer has not made specific recommendations regarding maintenance or repair methods, standard industry practices are to be used. These practices include, but are not limited to, methods published by Transport Canada, a foreign Civil Aviation Authority, the manufacturer of a similar product, or other practices that may not be published provided they are generally accepted by the Canadian aviation industry. The most often used reference for standard practices is the **FAA's Advisory Circular 43.13 (AC43.13-1B&2A)**. This is a massive 400-page manual of time-tested methods for doing most generic maintenance and repair tasks in small aircraft such as rivetting, patching, splicing, wiring, dope & fabric, etc. (This manual is available from Aero Training Products Inc at www.aerotraining.com).

Similar requirements apply to the selection of parts, materials, tools and test apparatus.

605 - Signing it off: *The Maintenance Release:*

When an aircraft has undergone maintenance, a Maintenance Release with respect to maintenance performed shall be completed prior to take off in the affected aircraft 605.85. This is a declaration by the signer (the AME) that, with respect to the maintenance performed, that the work has been done the way it's supposed to be done. The AME promises that the work was done in accordance with the manufacturer's recommendations, or as close to them as possible. Where the recommendations of the aircraft manufacturer are incompatible with those of the engine, propeller, or appliance manufacturer, the recommendations of the aircraft manufacturer shall be used.

Maintenance may be recorded directly into a *Technical Logbook*, together with the applicable maintenance release, or it may be first recorded and certified in the *Aircraft Journey Log*, and then transcribed into the *Technical Logbook* no later than thirty days following the events concerned. Where maintenance is originally certified in the journey log, there is no need for a second maintenance release when the details are transcribed into this log, but the name of the person making the transcription must be entered. Persons who transcribe entries are not responsible for the work described, but only for the accuracy of the transcription.

If an entry made in the *Technical Log* is **signed** and an AME licence number or an *Aircraft Certifying Authority* (ACA) reference and *AMO number* are added adjacent to the signature, the entry constitutes the **maintenance release** required by CAR 605.85, and indicates that the maintenance task described has been performed in accordance with the applicable airworthiness requirements.

Sometimes an aircraft must be flown to make sure that everything is OK before signing the Maintenance Release. For example, after maintenance of a constant-speed aircraft propeller, a pilot will want to test fly the aircraft to make sure that the propeller and all related systems are working OK. In this case, the pilot and the AME will take a test flight before a Maintenance Release is completed.

605 - ADs again:

While in the shop for maintenance, the AME is usually able to verify that Airworthiness Directives have been completed, and may note them at the back of each Technical Log. **ADs are the responsibility of the aircraft owner** but the owner may include this task in with related maintenance work 571.10(3).

Part VI - General Operating and Flight Rules

Sooner or later your aircraft will have to take off - or else it'll be parked behind the barn indefinitely. Airplanes are just too big to ignore for long! The average small commuter plane takes up about 1/4 acre of land space. So let's have a look at what's needed to get airborne. Most of this part of the CARs is directed at pilots, but the AME needs to know what the pilot is looking for when he opens the hangar door and prepares for a day's work.

First of all, an aircraft (except for ultralights and hang-gliders) in flight needs a *flight authority* 605.03 such as a **Certificate of Airworthiness** or a **Flight Permit** and the *flight authority* must be carried on board the aircraft. Sometimes a short-term specific-purpose *Flight Permit* will suffice to move an aircraft from A to B, but generally speaking, a long-term flight authority, or *Certificate of Airworthiness*, is what is needed to do some regular daily flying.

The pilot will also look for an *aircraft flight manual* as required by the applicable standards of airworthiness. The aircraft flight manual shall include all of the amendments and supplementary material. Therefore the pilot will be looking for an amendment list to see if the manual is up-to-date. The pilot will survey the cockpit to find any required markings or placards (are "Spins Permitted" or "Spins Prohibited", for example) 605.04. Pilots will want to see that all required instruments are in place and operating. For day-VFR flight, for example, the pilot will be looking for the following 605.14:

- (a) where the aircraft is operated in uncontrolled airspace, an altimeter;
- (b) where the aircraft is operated in controlled airspace, a sensitive altimeter adjustable for barometric pressure;
- (c) an airspeed indicator;
- (d) a magnetic compass or a magnetic direction indicator that operates independently of the aircraft electrical generating system;
- (e) a tachometer for each engine and for each propeller or rotor that has limiting speeds established by the manufacturer;
- (f) an oil pressure indicator for each engine employing an oil pressure system;
- (g) a coolant temperature indicator for each liquid-cooled engine;
- (h) an oil temperature indicator for each air-cooled engine having a separate oil system;
- (i) a manifold pressure gauge for each
 - (i) reciprocating engine equipped with a variable-pitch propeller,
 - (ii) reciprocating engine used to power a helicopter,
 - (iii) supercharged engine, and
 - (iv) turbocharged engine

If there's any holes in the instrument panel, the pilot will demand to know what's missing and why - especially if it's something from the required list.

There are similar requirements for more advanced operations (for example, *VFR-Over-The-Top*, *IFR*, etc) in Sub-part 605. The AME is expected to be familiar with the many different sets of requirements.

Pilots also check for seat harnesses 605.22, fire extinguishers, passenger information placards, oxygen tanks, and any other required, but movable, items 605.06.

The pilot will look to see that the aircraft is being maintained according to a *Maintenance Schedule* (written into the front of the Journey Log) 605.86. If a pilot finds a defect during flight, the defect will be written into the Journey Log. At the start of each day, the pilot will check that previous defects have been fixed. The notation in the *Journey Log* will be followed by a signed *Maintenance Release* if it has been fixed 605.85. The pilot will carefully read all entries in the Journey Log to make sure that the aircraft is ready to go to work.

The pilot doesn't see the *Technical Records* for the aircraft - only the *Journey Log*. If a pilot wants to see the Technical Records, no problem. They're safely stashed in the hangar 605.93, and they're always available for looking at. It's rarely necessary for a pilot to see the Technical Records since everything the pilot needs to know is in the Journey Log.

Canadian Aviation Regulations 605 (Technical records):

Technical records shall be neat and tidy! Every person who makes an entry in a technical record shall make the entry accurately, legibly and in a permanent manner 605.93. The entry shall be signed and dated. Electronic data entry shall comply with Section 103.04 and the Aircraft Equipment and Maintenance Standards. The owner of an aircraft shall ensure that all of the necessary measures are taken to protect the technical records for the aircraft from damage and loss. Every person who brings into use a new volume of an existing technical record shall make the entries relating to the preceding volume that are necessary to ensure that an unbroken chronological record is maintained (usually the last two entries from the previous volume are copied into the beginning of the new volume).

605 - Permanent Records

Every owner of an aircraft shall keep the following technical records in respect of the aircraft 605.92:

- (a) **a journey log 605.92;**
- (b) **a separate technical record for the airframe, each installed engine and each variable-pitch propeller 605.92;**
and
- (c) an empty weight and balance report 571

Record-keeping must be neat 605.93! "Every person who makes an entry in a technical record shall make the entry accurately, legibly and in a permanent manner" 605.93 Each entry must identify the person who made the entry, and be dated. Entries must not be erased or obliterated with "white-out". Errors must be crossed out, yet remain legible.

Whenever you bring into use a new volume of an existing technical record, you ought to repeat enough entries from the preceding volume to ensure that an unbroken chronological record is maintained. This usually means that the last two entries from the previous volume are repeated on the first page of the new volume.

All technical record keeping for ultra-simple aircraft like gliders can be done within a Journey Log alone. No separate component logs or airframe log is required.

CAR 605.96 contains a link ("Schedule II") to a table detailing how to complete the technical records. Go to:

<http://www.tc.gc.ca/aviation/REGSERV/CARAC/CARS/cars/605e.htm>

Temporary Records 605

Inspection records are usually temporary - it's only necessary that they're kept until the next inspection. After that time, they can be discarded.

Error corrections & Mistakes 605:

Where a person alters an entry on a technical record for the purpose of correcting the entry, the person shall do so by striking out the incorrect entry in such a manner that the underlying information remains legible, and inserting the correct entry together with

- (a) the date of the alteration;
- (b) the reason for the alteration, if it is necessary to clarify why the alteration was made; and
- (c) the person's name and signature or employee identifier or, where the record is kept as electronic data, the person's user code or equivalent security designation.

Where a correction referred to in subsection (5) is being made to a technical record that is maintained as electronic data, the correction shall be made in a manner that does not render the original data inaccessible. In accounting, this is called a "reversing entry"

Managing Maintenance 625

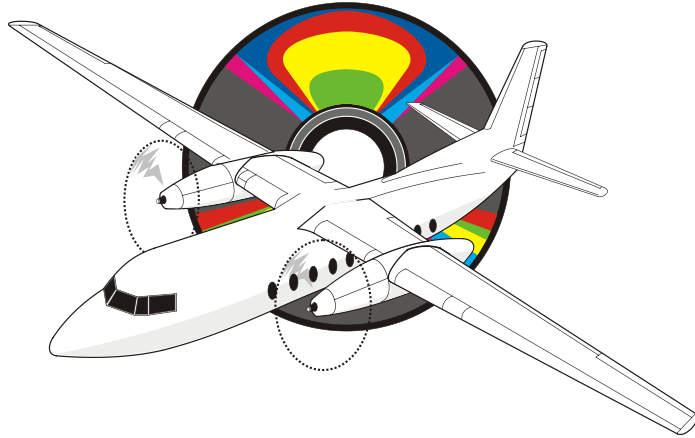
Small private aircraft have considerable flexibility in their scheduled maintenance of the various components. For example, an engine may be operated for as long as it seems to be working OK. An acceptable maintenance schedule template for small aircraft can be found in **Appendix B** of CAR 625.86. Since there's no leeway in some of these matters, AMEs are expected to be knowledgeable on all matters regarding maintenance schedules. This information is freely available on the internet, and the AME is urged to memorize the whole lot! For example, an AME is expected to know that a small aircraft can be maintained by the standard Appendix B only if it does NOT have a constant speed propeller. If the aircraft has a constant speed propeller, that item must be added to the Appendix B template being used.

Appendix C (625.86) contains schedule information for specific components such as rotorcraft components or constant speed propellers. The AME can select what is needed and add these items to an Appendix B.

Transport aircraft are so big and complicated that the maintenance of these machines needs to be planned and managed by groups of AMEs. A **Maintenance Review Board** is the body who creates a maintenance schedule for a heavy or complex aircraft 625. A Maintenance Review Board can consist of airline managers, AMEs, and factory representatives. Each of these persons has some insight into the management of the maintenance. The maintenance of large transport aircraft will be done with the approval of the Minister in accordance with Appendices C and D of CAR 625.86.

Heavy transport aircraft will need much more detailed and sophisticated maintenance schedules than those offered in Appendix B. In this case, Appendix D suggests a framework for sorting this out with the Minister. The operator (i.e. your airline) must make a plan for a revised maintenance schedule and submit it to the Minister for approval. For a big airplane, this can be a mountain of work!





Part VII - Maintaining an Airline:

706 - The Maintenance Control System

When operations get beyond a certain size, and public passengers become involved, the management of maintenance becomes hugely more complicated. In order to cope effectively, the airline is required to implement a **Maintenance Control System 706**. This applies regardless of the size of the aircraft or the numbers. Now, instead of looking for a simple "Maintenance Release" in the Journey Log, the Pilot in Command of an aircraft needs to determine serviceability of an aircraft in accordance with procedures specified in a **Maintenance Control Manual 706**.

706 - Dispatching Aircraft

An air operator shall include in its maintenance control system technical **Dispatch Procedures 706.06** to ensure that aircraft are not operated unless they are

- (a) airworthy;
- (b) appropriately equipped, configured and maintained for their intended use; and
- (c) maintained in accordance with the air operator's **Maintenance Control Manual (MCM)**.

706 - Maintenance Control Manual

A *Maintenance Control Manual* will be a "living" manual in that it'll be constantly worked on and improved (hopefully!) by everyone concerned. Therefore each copy of a *Maintenance Control Manual* needs to be amended promptly so that everybody is working off "the same sheet of music". This usually means "within 30 days" of the approval by the Minister of any amendment. The Minister sends his boffins around regularly to check that the paperwork is being up-dated promptly. They look at the approved manuals, and then check all the field manuals to see that they're identical. If they're mismatched, the airline is grounded until everything is matched up again. For an airline, this is a major disaster.

The *Maintenance Control Manual* of an aircraft operator **MUST** be made available to all persons performing maintenance on the operator's aircraft! This particularly applies when an aircraft is moved to a remote location (after all, this is what airplanes do). Your airplane could be assigned to a 6-month charter in Africa, for example. If maintenance is performed on a Canadian aircraft located outside Canada, the air operator shall ensure that the person doing the maintenance is approved by the laws of a state that has an agreement with Canada. This could mean, for example, that you'd need to find an FAA-certified A&P to supervise the work on your airplane while it's in Africa if a Canadian AME can't get over there to do the job.

Offences and Penalties:

Both pilots and AMEs make mistakes. Sometimes they're genuine mistakes ("inadvertent offences"), but sometimes they're intentional. These are called "advertent" offences.

In most cases, the penalties assessed are usually small "administrative" penalties. These are penalties assessed by the Minister's office (Transport Canada) under Part 1 of the CARs. Monetary penalties are intended to promote compliance with the CARs. The offender can either pay the penalty, or face a licence suspension. Appeals are rare since the offender usually has a full and complete hearing.

Even experienced and knowledgeable AMEs make mistakes:

April 25, 2003:

The owner of a Piper PA-28, recently purchased in the United States, asked an aircraft maintenance engineer (AME) delegated by the Department of Transport to inspect his aircraft in order to obtain an airworthiness certificate and conduct a 100-hour inspection. The AME certified that the aircraft was fit and safe for flight, when in fact several components were not in acceptable or safe condition in accordance with the Canadian Aviation Regulations (CARs). The AME was fined \$250, and his licence was suspended for 21 days.

Regulation: CAR 571.02(1);

Penalty: \$250 monetary penalty PLUS 21 days licence suspension

*Regulation: paragraph 7.3(1) of
the Aeronautics Act*

The following incident is an example of how poor record-keeping is viewed by Transport Canada. The central focus of the airworthiness process is the record of logged maintenance work:

April 26, 2003:

An aircraft maintenance engineer (AME) failed to ensure that the details required by Chapter 571 of the Airworthiness Manual, were entered in the technical record for the aeronautical product, in respect of the task performed; and [failed to ensure] that the technical record was accurate with respect to any outstanding elements of the work performed. The engineer was sanctioned with a licence suspension.

Regulation: CAR 571.03

Penalty: 3 days licence suspension

This is another example of poor record-keeping. In this case, the omission of AD information puts all downstream users (for example, operators and/or pilots) of the aircraft at risk:

May 28, 2003:

Following an annual inspection on a Cessna 172, an aircraft maintenance engineer (AME) who had been assigned responsibility for completing the ADs did not enter several airworthiness directives (AD) in the aircraft journey log.

Regulation: CAR 605.96(1)

Penalty: \$150 monetary penalty

The next example sure could use some additional explanation! It's hard to figure out how an airline AME could be working with the wrong tools, and not following factory procedures!

September 20, 2003:

An airline transport pilot operating an Airbus 319 felt some vibrations during takeoff. He noticed that the air brakes were floating approximately 4 in. above their normal position when retracted. The pilot had to return to land, and experienced problems controlling the aircraft on approach. During the investigation, it was determined that an aircraft maintenance engineer (AME) had conducted maintenance work on the air brakes without following the standard procedure and without using the right tools.

Regulation: CAR 571.02(1)

Penalty: \$250 monetary penalty

The reader will notice that most AME offences arise out of the Airworthiness Manual section of the CARs. For pilots, airworthiness issues arise more out of CARs Part VI (Rules of the Air) than Part V.

Some Sample Airworthiness Offences by Pilots:

This incident shows that it is the owner of an aircraft that is responsible for Ads, and that it is a serious offence to neglect the duty to complete and record Ads:

March 28, 2003:

The owner of a Cessna 337 was fined \$5,000 for having flown his aircraft when the airworthiness directives had not been carried out.

Regulation: CAR 605.84(1)

Penalty: \$5,000 monetary penalty

Pilots usually bung-up the airworthiness of an airplane by running into something hard. This example of a pilot-induced airworthiness problem illustrates the typical reaction of a bungling offender about to be caught red-handed! Although it may not appear to be so, a 30-day licence suspension is a pretty stiff penalty in the aviation business. A 30-day suspension, for example, could almost bankrupt a small airline. In this case, the aircraft insurance was probably invalidated, and the pilot was likely sued for the damage. The licence suspension would be enough to show that the pilot was to blame for the entire mess.

October 17, 2000:

A Cessna P337H, being operated by a private pilot, was damaged after a precautionary landing on a highway. The pilot then took off again without having the damages inspected by a competent person, thus rendering his flight authority invalid. In addition, during the investigation, it was found that the pilot did not have the rating on his licence required to fly this aircraft.

Regulation: CAR 605.03(l)

Penalty: 5 days licence suspension

Regulation: CAR 401.03(l)

Penalty: 25 days licence suspension

Perhaps this pilot figured he could start his own airline:

August 1, 2002:

A student pilot operated his Cessna 180 several times with passengers on board, without holding a private pilot's licence. He also conducted maintenance work on his aircraft without making the required entries in the aircraft's journey log, and without obtaining the signature of an aircraft maintenance engineer (AME) to certify the work.

Regulation: CAR 401.03(l)

Penalty: \$1,500 monetary penalty

Regulation: CAR 605.85(l)

Penalty: \$200 monetary penalty

The following is an example of an inadvertent error. The pilot probably assumed that it wasn't necessary to note a malfunctioning transponder in the Journey Log:

October 8, 2003:

A commercial pilot operating a Cessna 401, conducted two flights when the transponder was not working and the defect was not entered in the aircraft's journey log, as required in the Canadian Aviation Regulations. The pilot was fined \$70.

Regulation: CAR 605.94(l)

Penalty: \$70 monetary penalty

The above group of offences shows that pilots usually run into airworthiness problems by way of CARs 401 and 605.

A free interactive exam tutorial is provided at www.aerotraining.com to allow you to test your knowledge of this material:

<http://www.aerotraining.com>

All FAA publications listed are available from Aero Training Products at the above website or at 800-567-3221

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