Blue Book

Remotely Piloted Aircraft Program Development Guide

FIRST EDITION

Funded through a Generous Grant from the Government of Canada's Search and Rescue New Initiatives Fund

Canadian Association of Fire Chiefs | Association canadienne des chefs de pompiers
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Table of Contents

Welcome Message

Dear Colleagues,

On behalf the Canadian Association of Fire Chiefs, the Civil Air Search and Rescue Association, Canadian Emergency Responders Robotics Association and Search and Rescue Volunteer Association of Canada, we are delighted to present the Blue Book, Remotely Piloted Aircraft Program Guide. This manual is a guide for developing an RPAS program in fire or search and rescue organizations.

The book is designed to be relevant to both fire departments and search and rescue organizations for search, rescue, all hazard, emergency operations and fire suppression. Whether your fire department or SAR organization is exploring the opportunity of RPAS operations or whether it is advanced in the domain, we hope you will find useful information in this manual to support your learning and operations. Future opportunities such as beyond visual line of sight operations will be part of the subsequent Blue Book, coming in 2023.

We would like to take this opportunity to thank every member of the committees that worked on this manual. You will get to meet them throughout the manual, and several have taken the time to do a video for you to help explain various sections. We would also like to thank Kate Klassen at InDro Robotics who managed the process and held the pen to get the committees to their overall goal. This manual is in great part due to her substantive and process expertise.

Finally, the project would not have been possible without a generous grant from the Government of Canada's Search and Rescue New Initiatives Fund. Chief Steve Debienne, Chief Scott Wilkinson, Chief John McKearney, Mr. Frank Schurmanns, Mr. Bill Ralph, Mr. Andy Oleson, and Mr. Colin Giles, came together to form the vision for this project along with CAFC's Executive Director Dr. Tina Saryeddine. It continues to be a wonderful adventure.

We wish all users of this manual safe operations as you continue your mission to protect people, property, and the environment. If you have any questions at all, please feel free to contact us through the CAFC's national office, at info@cafc.ca.

On behalf of the contributing organizations, we welcome and encourage you to explore this manual.

Sincerely,

Ken McMullen, President CAFC

Janelle Coultes, President SARVAC

Dale Kirsch, President CASARA

Colin Giles, President CERRA

Acknowledgements

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Introduction

The purpose of this document is as a guide to Fire Departments and Search and Rescue Organizations in the fundamentals of RPAS operations and management at the level of the organization. Efforts were taken to "evergreen" this document as much as possible to retain relevancy over the long-term but, as you may expect with a technology-forward space like this, change will occur. That's part what makes it such an exciting area to learn about!

The intent with this document is to inform, guide, support, expand and enable the incredibly important work that is already being done within your organizations. The goal is to reduce the barriers to adding drones to your set of assets you use to keep yourselves, and others, safe.

It has been a pleasure to learn from and work with the contributing members of the joint committees involved in making this document a reality. Thank you for the opportunity.

Kate Klassen

InDro Robotics

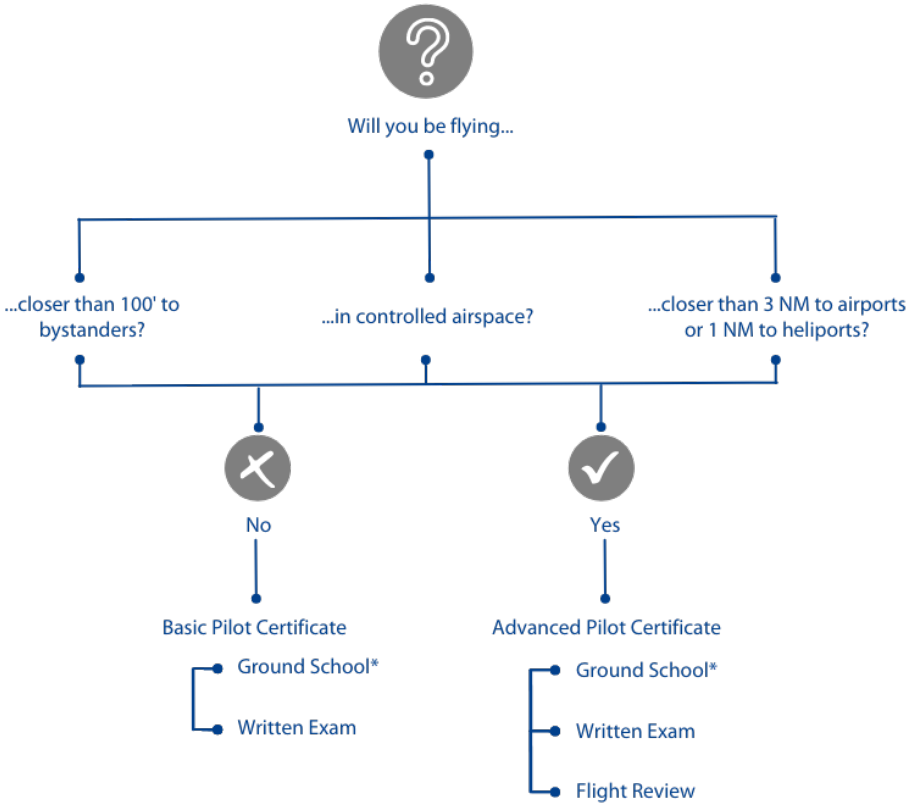
SECTION 1 – Certification

Section 1 Video Summary

Dave Robertson
Fire Chief
South Glengarry Fire Service

Flow Chart

Overview of steps in process to gain certification, guidance toward selecting the correct certification for the operation type and resources



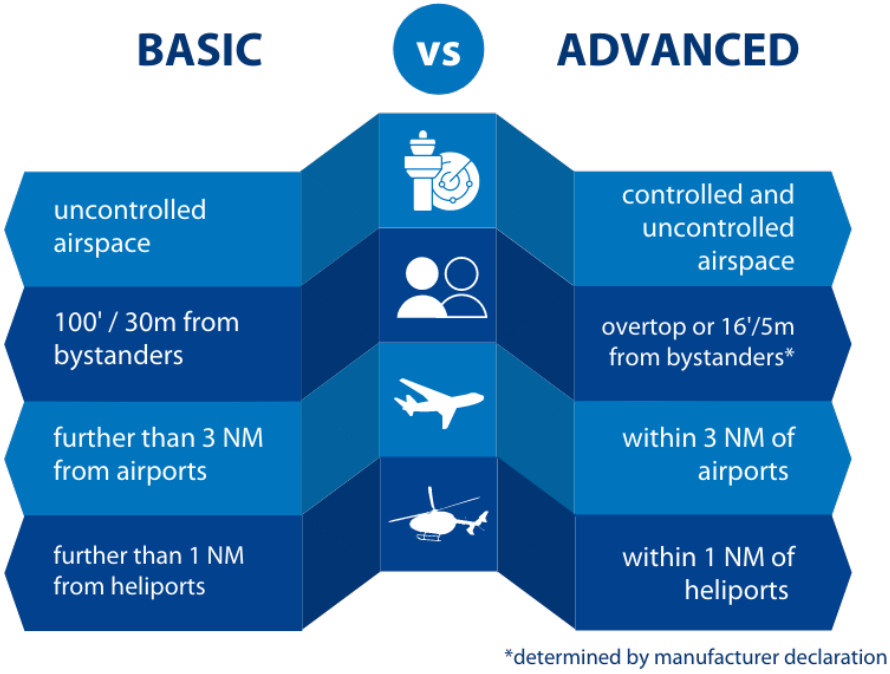
*Optional but recommended

Note: An advanced pilot certification will be required to operate under an SFOC and for future RPAS operational ratings such as low-risk BVLOS

Getting Certified

As of June 2019, with the publication of Part 9 of the Canadian Aviation Regulations (CARs), anyone operating an RPA weighing 250g or more in Canada requires a pilot certificate. Certifications are risk-based, meaning it doesn't matter the intent of your flight, just the risk to others on the ground and in the sky. If you're flying for fun or for work or for research, some combination of those or other reason, a pilot certificate is needed if your drone weighs over 250g. The riskier the environment, the higher the certification level and the more knowledge and skill that is required of pilots. There are three levels of certification in Canada – Basic, Advanced and Special Flight Operation.

The majority of operations will be possible with a Basic or Advanced certification. Special Flight Operation Certificates (SFOCs) are approved on an operation-specific basis and typically require the pilot to also hold either a Basic or Advanced certification as a prerequisite for the SFOC issuance.

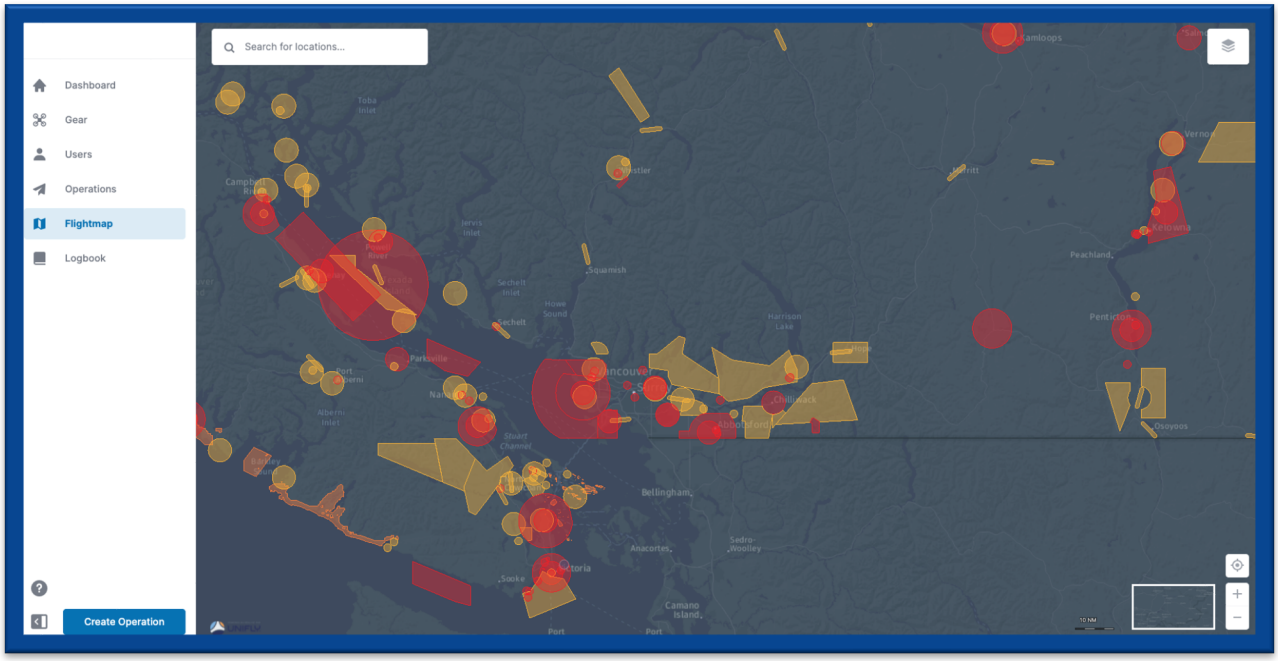


A Special Flight Operation Certificate is for flights

- Above 400'
- By a foreign operator (not a Canadian citizen or permanent resident)
- At an aviation event or advertised event
- Near military aerodromes
- Beyond visual line of sight
- With drones heavier than 25 kgs
- Carrying dangerous payloads
- Operating 5+ drones at once

An Advanced Certification is the route most of those in public service roles take as you don't often have the luxury of choosing a worksite and need to be able to fly in the broadest of scenarios. There can often be members of the public in the general vicinity of operations and being an advanced operator allows you more flexibility in conducting these operations. In addition to the pilot holding an advanced certification, drones also need to be certified to operate in advanced environments. Manufacturers will declare to TC through a process that their RPA are safe to operate in three progressive categories of advanced operations – controlled airspace, near people and over people. Drones that have been modified, even if the base model is declared, cannot fly in advanced environments unless you can demonstrate the modification doesn't impact the declaration or you act as the manufacturer and redeclare it. The process of redeclaring involves the creation of a user manual for the RPA, establishing a maintenance schedule and abiding by all of the CARs directed toward manufacturers. Even if you're certified as advanced, you can't fly your non-declared drone in controlled airspace.

There are many tools available that can help you decide if your flight will be in a basic or advanced environment. NAV CANADA manages the Nav Drone Portal, pictured below, which displays a user-friendly map with coloured layers to identify airspace and proximity to airports and heliports based on your location.



Nav Drone Web Application

TIP!

Be cautious of third party tools, including the flight apps that come with your drone. Their depictions of where is safe-to-fly don't, in many cases, align with regulation. Just because the manufacturer will allow you to "unlock" a location to fly, doesn't mean it's legal for you to fly there. They don't necessarily follow Canadian regulations when establishing their software.

Special Flight Operation Certificates or SFOCs are the method by which TC approves operations for things that fall outside of the basic and advanced environment. They are approved on a case-by-case basis where the operator demonstrates, through the completion of a SORA (Specific Operation Risk Assessment) they have assessed, and mitigated risks present on the ground and in the air. The development of an SFOC requires a detailed understanding of the planned operation, ability to parse through Transport Canada guidance, and generate an organized application document complete with flight area maps, risk assessment tables and aircraft information. Future regulatory developments will focus on making operations that are currently only approved through an SFOC, part of the standard regulatory structure with more "blanket" or standing approvals being issued. The next expected RPAS regulations will cover low-risk Beyond Visual Line of Sight Operations (BVLOS) and aircraft heavier than 25kg.

Note: there is no fee to submit an SFOC application, but this may change in the future

Basic

To hold a Basic Pilot Certification you need to be at least 14 years old and score a 65% or higher to pass an online written exam issued by Transport Canada. You have 90 minutes to answer this 35-question multiple-choice exam completed through the Transport Canada Drone Management Portal for a nominal fee. It is open book, but you can't receive any help from another person while you write, nor can you copy or remove any of the exam text. If you don't pass the exam on the first go, you can pay the fee to rewrite your exam 24 hours later.

Once you've passed, you'll be able to immediately print your pilot certificate (or save the PDF to your devices) and you'll need to keep with you and accessible every time that you fly.

For the first 24 months of flying, your certificate is all that you need to prove you are certified. Every 2 years you need to complete a recency exercise. This is a way to make sure that your knowledge is staying current and is a requirement of all pilots. There are a few ways to maintain your recency

though whatever option you choose, you must carry proof of that recency with you along with your certificate.

Advanced

To hold an Advanced Pilot Certificate you need to be at least 16 years old and score 80% or higher to pass an online written exam issued by Transport Canada. Additionally, you are required to pass an in-person flight assessment called a flight review with a TC authorized Flight Reviewer. The written exam is 50 multiple choice questions which you have 60 minutes to complete and is taken through the Drone Management Portal for a nominal fee. While it is open book, and having notes or other resources available is recommended, you will not have time to look up all the answers. You also can't remove or copy any exam content. If you need to attempt it more than once, you pay the nominal fee again and can rewrite 24 hours later.

TIP!

It's pretty common to write the advanced exam more than once before you receive a passing grade so don't be too hard on yourself if that's what it takes. It's not failing, it's just a different process in order to master the task.

The flight review is a holistic in-person assessment carried out by a Transport Canada authorized Flight Reviewer. The reviewer confirms you have the documents, knowledge, and skill to operate safely in Advanced environments. Once you have successfully completed your flight review, the reviewer will submit the results to Transport Canada online and, after paying your issuance fee, you will be able to download your new advanced certificate nearly instantly from the Drone Management Portal.

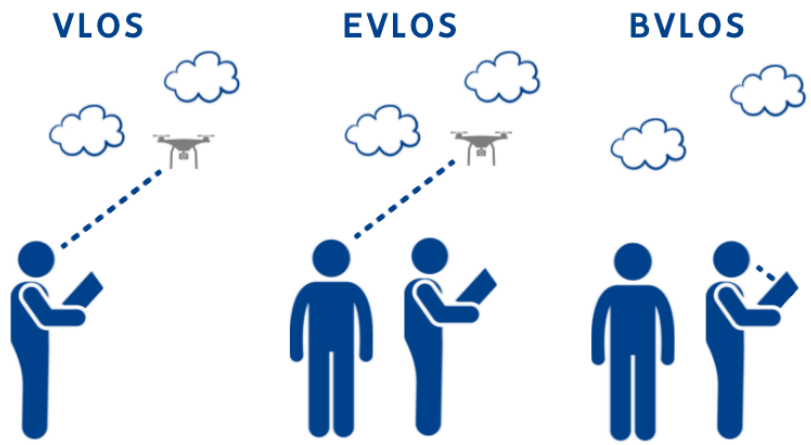
Every 2 years you need to complete a recency exercise in accordance with Transport Canada's Standard 921, and since your flight review counts as one of these recency exercises, it'll be 24 months from the date of your flight review, and you'll need to keep proof of your recency with your certification when you fly.

TIP!

Once you pass the advanced written exam,
you will be issued a basic certification.
This basic certificate enables you to fly your drone in low risk environments,
build skill, refine your standard operating procedures
and gain confidence before you do the second part of the
advanced certification process – the flight review.

BVLOS Authorization

Beyond Visual Line of Sight flying is currently only permissible in Canada through a Special Flight Operation Certification. The certificate issuance is dependent on a Transport Canada review of risk assessment and mitigation prepared by the operator. Depending on the specifics of the scenario, this can be a time-consuming process. There are alternatives, though, and some upcoming regulation that will enable BVLOS use in the future.



VLOS vs. EVLOS vs. BVLOS

- Visual line of sight flying refers to when the pilot has sight of the drone at all times in flight, sufficient to avoid obstacles and scan the airspace for hazards.
- BVLOS means the aircraft is out of sight of the pilot and all other crew members.
- There is a middle ground, dubbed extended line of sight or EVLOS, in which the pilot is in direct and immediate communication with someone else who has the drone in sight. This crew member is typically referred to as a visual observer or VO.

EVLOS, which is permitted under the CARs Part 9, is often employed as a substitute for pursuing a BVLOS SFOC when the aircraft needs to temporarily be out of sight of the pilot due to distance, terrain or obstructions. The pilot and VO typically use handheld radios, phones, or both to remain in constant communication and must have practiced and effective dialogue to ensure the safety of other airspace users and people on the ground. EVLOS operations do not require additional certification or permission. It is prudent to incorporate additional training for crew, but a basic or advanced certification is sufficient, depending on the characteristics of the operational environment as discussed above.

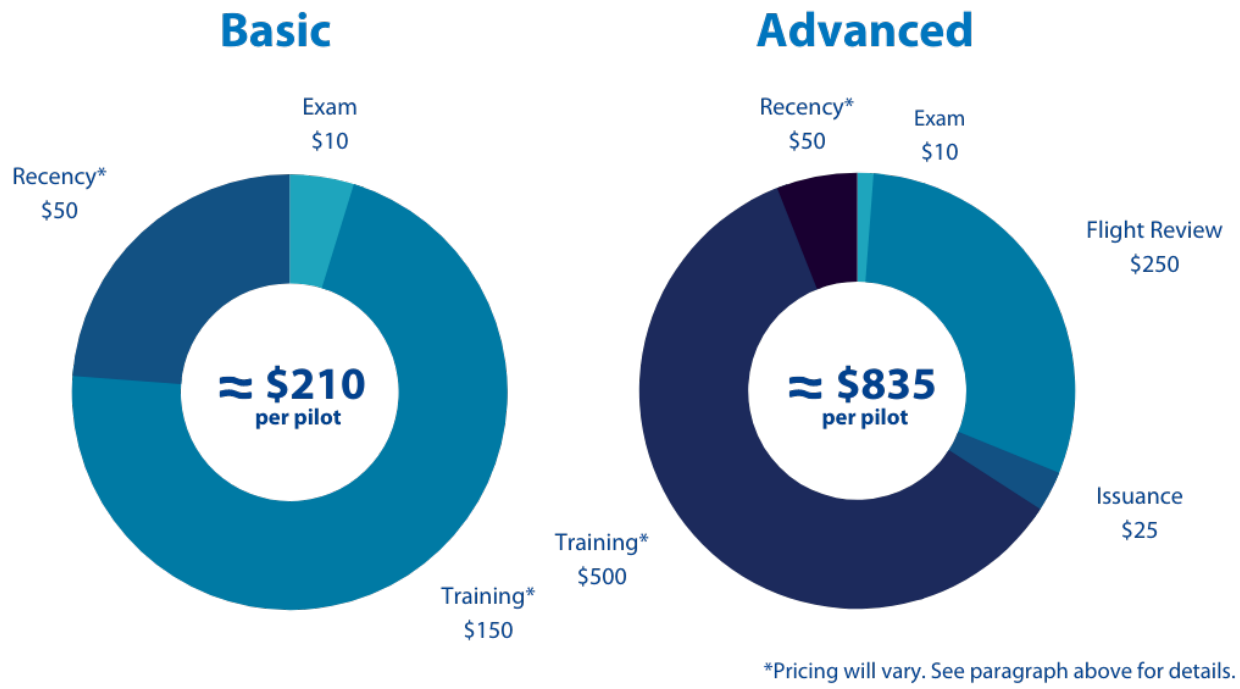
Preparing for Future Certifications

Transport Canada is in a constant process of developing new regulation to enable operations in the ever evolving RPAS landscape. Their mandate is to preserve aviation safety as they look toward the evolution of the Canadian aviation industry. The process generally begins with a Notice of Proposed Amendment with a feedback period that follows. Next comes a first Canada Gazette publication with a draft of the proposed regulations, opportunity for feedback from the public and stakeholders before the regulations are finally published in a second Canada Gazette. Keeping any eye on these publications and taking the opportunity to voice your support or recommendations for change is the way to make your voice heard and ensure the regulations don't unintentionally prevent you from doing the flying you need or want to do.

It is expected that an Advanced Certification will act as prerequisite for pilot certifications and ratings that will follow for higher risk activities in future regulation publications. If you want to fly BVLOS, for example, you will first need to hold an Advanced Certificate. While the details of what other exams, skill sets, documentation and testing will be required, a good "future-proofing" step would be to pursue the Advanced Certification.

Certification Costs

To give an idea of the cost to certify a pilot, the following diagram breaks down the cost into the required and optional but strongly recommended components. Recency costs are not required at the initial certification but will be required on a 24-month cycle for as long as a pilot wishes to maintain their certification. A cost of $50 is indicated, but as indicated below, recency options and therefore costs vary. Training is not required but is highly recommended and course fees will vary but a rough estimate is given.



*Pricing will vary. See paragraph above for details.

Some organizations may elect to self-declare as a compliant training program with Transport Canada, either independently or alongside an already declared organization, in order to reduce the training costs.

Recency

Every 24 months, a recency exercise must be completed to keep a pilot certification valid. This applies to both basic and advanced category pilots. If it has been more than 24 months, a pilot must complete a recency exercise before piloting any RPAS. If recency has not lapsed when the recency-maintaining exercise is completed, it will restart the 24 months from the date the exercise was completed. Standard 921.04 describes the methods by which one can regain or maintain their recency and they include

- Completing the Transport Canada issued self-paced exam (free)
- Successfully completing a Transport Canada exam in the Drone Management Portal ($10)
- Successfully completing a flight review (~$250)
- Completing a RPAS recurrent training program (free to ~$250)
- Participating in a safety seminar endorsed by Transport Canada Aviation (free to ~$250)

For the first 24 months after acquiring a pilot certification, it acts as proof of recency in itself. After that time, you will need to carry proof of your recency maintaining exercise along with your pilot certification every time you fly.

Training and Certification Resources

- CARs
  - The Canadian Aviation Regulations contain, in Part 9, the dos and don'ts of flying RPAS in Canada. These are published by Transport Canada and available free, online.
- AIM
  - The AIM contains a section for RPAS "RPA" that goes into greater explanation and detail on regulations and other RPAS-relevant topics. This document is published by Transport Canada and available for free, online, and is published twice a year.
- TP 15263
  - The Technical Publication (TP) 15263 contains the Knowledge Requirements for Pilots of Remotely Piloted Aircraft Systems 250 g up to and including 25 kg, Operating within Visual Line-of-Sight (VLOS). This is a Transport Canada publication and is available for free, online
- TP 15395
  - The TP 15395 contains the Flight Reviewer's Guide for Pilots of Remotely Piloted Aircraft Systems 250 grams (g) up to and including 25 kilograms (kg), Operating within Visual Line-of-Sight (VLOS). This is a Transport Canada publication and is available for free, online.
- Unmanned - Textbook of RPAS Studies, 3rd edition
  - Aviation Publishers has produced a book based on the highly popular manned aviation book "From the Ground Up" but geared toward remote pilots. It is available through several aviation stores and online for around $80
- Standard 921.04
  - Standard 921.04 is available online through Transport Canada and outlines the recency requirements referred to in CAR 901.56 and CAR 901.65.
- Self-Paced Recency Program
  - One of the above referenced recency options is the Transport Canada self-paced study program
- RPAS 101
  - An educational guide developed in cooperation with Transport Canada and the Aerial Evolution Association of Canada.

SECTION 2 - Program Considerations

When looking to establish an RPAS program, there are several decisions that will guide the steps that follow. These questions are intended to prompt your thinking and will be addressed throughout this section.

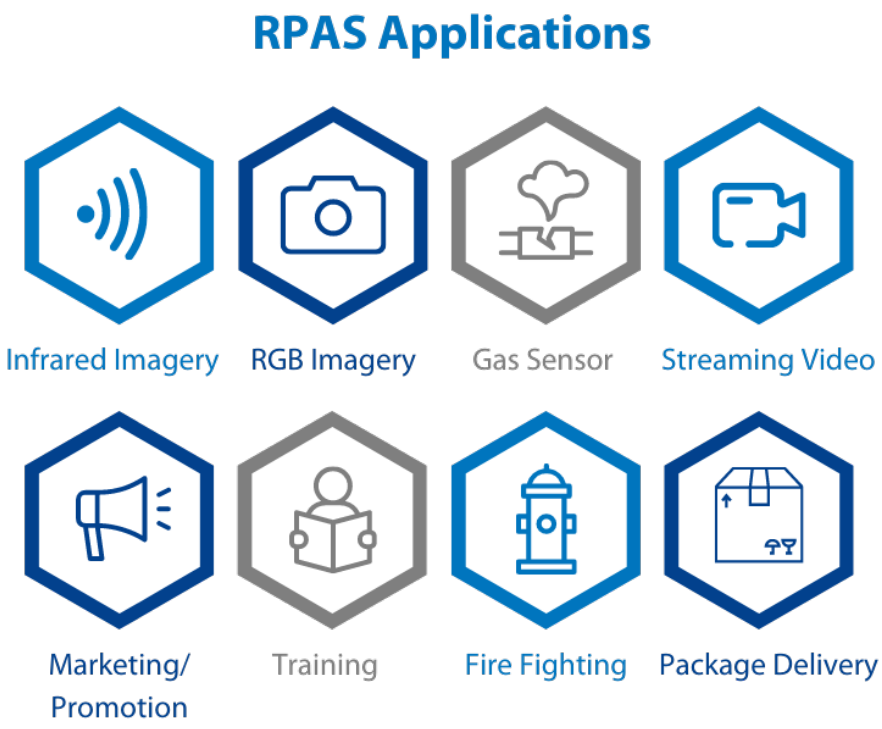
- What equipment is required?
- What will the scope of the response be?
- Where will equipment be stored?
  - If equipment is stored centrally, fewer sets or kits are required. If each pilot or vehicle is to be equipped with a drone and related gear, costs will be greater than if they were stored and accessible centrally. The downside with a central location can be that deployment time is increased.
- How many pilots will be trained?
  - This may be dependent on other considerations, like budget, but at a high level are you looking to mobilize an entire team or start with a couple pilots and build from there? Will you require a piloting crew on every shift?
- Who will be the program champion?
  - This role is often referred to as the Chief Pilot. For RPAS programs to be successful, a singular program champion should be established within an organization. They can be

well supported with other staff, but a point-person will be critical in the successful establishment and running of an RPAS program.

- How will the program be sustained?
  - Consider ongoing training programs for the months immediately after the initial training and at regular intervals to maintain competence and confidence in the program operations
- How and where will data be stored?
  - In addition to complying with the Privacy Act and other relevant protocols, how and where will images be stored, catalogued, secured, and retrieved?

Types of Programs

Applications



Equipment

Equipment refers to the kit of gear required to successfully complete an RPAS mission. In addition to the obvious equipment of the aircraft, batteries, controller and peripherals, some common equipment includes:

- a first aid kit
- basic tools
- fire extinguisher or fire blanket
- high visibility vest
- safety glasses

- scene lighting
- pylons or flagging tape
- touchscreen gloves to maintain dexterity
- handheld radio
- a binder to contain SOP and certificates.

Storing these kits at a base station allows for better upkeep, tracking and typically fewer kits are required. Mobile-based equipment may allow for faster deployment, but particular caution needs to be exercised when storing batteries in a non-temperature controlled environment. The extreme heat of summer and cold of winter can impact the life, reliability, and safety of the LiPo batteries in the aircraft and controller system.

Sensors

Common sensors used for data gathering and transmission in firefighting and search and rescue organizations include:

- Infrared (FLIR Camera)
  - Used to identify, and in some cases map, heat signatures within a structure or pinpoint sources of heat
- Optical Zoom Camera
  - Allows for a closer look while maintaining a safe distance
- Gas Detection Sensor
  - Commonly employed as a precaution to scan an area before a human is sent in
- Radio Repeater
  - Allows radio communications to be transmitted in previously non-line-of-sight environments
- Spotlights
  - Allows for illumination of a scene
- Radiation Sensor
  - Check for site safety before responders enter scene
- Communication Speaker
  - Broadcast messages to hard-to-access or other groups
- Low-light Camera
  - Allows for high-quality images in low light conditions with details preserved

Aircraft Types

The following aircraft are provided as a reference for their respective class of RPAS. While it is not our intention to show favouritism or underrepresent the varied aircraft types, these will serve as a common ground for understanding. It is unlikely one aircraft will meet all the operational requirements of an organization. It is common to be equipped with a "fleet" or multiples of each aircraft type. A benefit to sticking with a specific manufacturer for your fleet is consistency in the operating system which can eliminate a cause of some pilot errors and make fleet-wide training easier.

FIXED-WING	NOTES
	• Requires room for launch, departure, approach and landing • Larger RPAS may require a launch and landing system such as a catapult or arresting net • Able to glide in the event of a motor failure • Longer flight time than most multirotors • Can cover large areas efficiently • More challenging than a multirotor to learn to pilot manually

MULTIROTOR	NOTES
	• Vertical take-off and landing (VTOL) requires small operational zone • Shorter flight times than most fixed-wing and VTOL fixed-wing designs • Motor system failure can be catastrophic • Can hover and orient/use sensor • Best for new pilots

VTOL FIXED-WING	NOTES
	• Vertical take-off and landing (VTOL) requires small operational zone • Transitions to fixed-wing forward flight at altitude to operate efficiently • Longer flight time than most multirotors, though less than straight fixed-wing • Requires precise pilot planning to manage battery life for high-power tail landing • Can cover large areas • Sensor not typically usable when in hover mode

DJI MAVIC MINI 2	SPECS	NOTES	< $1000
	**Take-off Weight** 249g **OAT Range** 0° to 40° **Flight Time** 31 mins	• Very small, foldable, very lightweight and portable • Camera only payload • Capable aircraft for size • Easy to learn • Makes a good training aircraft • Only need to abide by "don't be a hazard" regulation (CAR 900.06)	

DJI MAVIC MINI 3 PRO	SPECS	NOTES	$1200 - $1500
	**Take-off Weight** 249g **OAT Range** -10° to 40° **Flight Time** 34 mins	• Very small, foldable, very lightweight and portable • Camera only payload • Optional larger battery/longer flight time (47 mins) but will require pilot certification • Makes a good training and operational aircraft • Only need to abide by "don't be a hazard" regulation (CAR 900.06) when under 249g	

DJI MAVIC PRO 2 ENTERPRISE	SPECS	NOTES	$4000 - $8000
	**Take-off Weight** 1100g **OAT Range** -10° to 40° **Flight Time** 31 mins	• Foldable and portable • Payloads include FLIR, optical zoom, light beacon, speaker • Easy to learn • Easy transition from Mini 2 • Requires registration and pilot certification • Not operable in precipitation	

DJI MATRICE 30	SPECS	NOTES	$13 000 - $18 000
	**Take-off Weight** 3.9kg **OAT Range** -20° to 50° **Flight Time** 41 mins	• Removable components for more compact transporting • Payloads include zoom, wide-angle and thermal cameras and a laser rangefinder systems • IP55 rated (operable in some precipitation) • Similar operating system to other DJI products • Requires registration and pilot certification • RPAS-specific training recommended	

DJI MATRICE 300	SPECS	NOTES	$10 000 - $14 000
	**Take-off Weight** 9kg **OAT Range** -20° to 50° **Flight Time** 55 mins	• Removable components for more compact transporting • Varied payload options • Capable of carrying multiple payloads at a time • Similar operating system to other DJI aircraft • IP45 rated (operable in some precipitation) • Requires registration and pilot certification • RPAS-specific training recommended	

INDRO WAYFINDER	SPECS	NOTES	$38 000 - $42 000
	**Take-off Weight** up to 34kg **OAT Range** -20° to 50° **Flight Time** 50 mins	• Removable components for more compact transporting • Varied payload options • Capable of carrying multiple payloads at a time • IP43 rated (operable in some precipitation) • Can be remotely piloted through InDro • Requires registration and pilot certification • RPAS-specific training recommended	

Additional Supporting Equipment

In addition to the equipment outlined above, command vehicles are gaining popularity. As a mobile headquarters for missions, they can range from an SUV with a large screen to stream sensor data to a complete retrofitted recreational vehicle with multiple control stations and streaming locations. These mobile ground stations typically also provide charging, streaming, viewing, and operational areas as well as being a pilot rest area for longer missions.

Mission Objectives

Mission objectives can be varied and yet still accomplished with the same set of equipment and pilot certification. There are some exemptions built into regulation that are helpful to be familiar with. Operations underground or indoors are not subject to CARs regulations as they are not conducted in airspace. This means pilot certification and aircraft registration are not required. Operations with a microdrone, that is one under 250g, do not require a pilot certification or aircraft registration either and can be operated in broad circumstances so long as they do not endanger the safety of anyone in the sky or on the ground and do not enter restricted airspace.

Missions can be divided into categories of manual flight and automatic flight. Automatic flight includes the use of flight modes such as orbit, follow-me, and mapping grid flights. A flight route can be pre-programmed and saved, enabling the aircraft to recreate the same route on subsequent flights. Mapping can be conducted both vertically, as in to map the side of a building, and horizontally, to fly a grid over the ground. Missions could also include outdoor and indoor/confined space flights. Confined space includes operations inside structure interiors, underground, or tunnels.

TIP!

Transport Canada distinguishes between automatic and autonomous flight with the latter not being permitted in the current regulatory structure. As per Transport Canada definitions, autonomy refers to the pilot being unable to provide intervention and where the RPAS is making operational decisions on its own. Automatic flight requires pilot input to establish a flight path that the aircraft then conducts without constant manual inputs from the pilot. Automatic flight allows for pilot intervention.

Manual flights are conducted with the pilot inputting each flight maneuver through the use of the control sticks or tap-to-fly functions on the ground station. This flight type requires less planning and is more rapidly deployable.

Program Level Options and Costs

Different organizations will have different requirements, priorities, and resources to allocate to an RPAS program. The following outline a sample of what various program levels could look like and their associated costs. Budgeting considerations are detailed in Section 3.

STARTER	STANDARD	SCALABLE
• Two Mavic Mini 2 • Two Basic trained pilots • Program Champion (part-time) • SOPs • First Aid Kit • Fire Extinguisher • Operation-Specific Equipment	• Up to two Mavic Mini (trainers and supplementary) • Up to two additional RPAS • Program Champion (part-time) • At least two Advanced trained pilots • SOPs • First Aid Kit • Fire Extinguisher • Operation- Specific Equipment	• All pilots Advanced certified • One RPAS per pilot • Minimum two additional RPAS • Program Champion (full-time) • SOPs • Company Operations Manual • First Aid Kit (per pilot kit) • Fire Extinguisher (per pilot kit) • Operation-Specific Equipment

In all the program levels identified above, support roles such as those to train-the-trainer, conduct flight reviews, provide ongoing operational flight training and to provide organization and community information sessions for buy-in may be desirable. It is helpful if those in levels above the operational piloting team understand the limitations and opportunities RPAS provide.

TIP!

Flight Reviewers must be affiliated with a compliant training organization. Many of these training organizations will be happy to add flight reviewers to their network, which is an easier option than requiring that the affiliated organization create and maintain a compliant training program.

Business Case

Gaining Buy-In

It's important to feel equipped to provide justification for the investment into an RPAS program. With any new technological advancement, there will be those who resist or disagree with the allotment of resources, or the tangible value of an unproven program. Included below are a few guiding principles when engaging a broader audience.

Political Support

Aviation, and transportation in general, crosses political levels which can create confusion in who retains authority and to what extent.

Engagement at a federal level helps to ensure the future creation of RPAS regulations don't accidentally prevent your organization from doing the work that needs to be done. Provincial and Territorial governments have little impact on RPAS regulation. Municipally, cities have been known to enact bylaws that are overly restricting and impinge on federal RPAS regulations. This creates more of a complicating hinderance than an enforceable prohibition. Approaching law makers and enforcement with a solid understanding of regulation, a calm demeanor, and ability to loop in organizations such as COPA and the Aerial Evolution Association of Canada for advocacy support when needed, is recommended.

There are often government grant opportunities available that would support the development of an RPAS program within a public safety organization. This may be worthwhile to look into!

Public Engagement

Education and awareness are your best approaches when dealing with community members who may not appreciate the benefits of RPAS. Demonstrations during open-house events, FAQ resources, routing to RPAS and aviation organizations such as COPA and the Aerial Evolution Association of Canada and sharing stories of how RPAS use has positively impacted their community can help to bring even the most vehement detractors around to your side.

Stakeholder

Between government and public groups, you may have interested stakeholders who need to understand the rationale and approach to RPAS Program Implementation. A similar strategy to public engagement initiatives can be invoked here, focusing on education, and sharing stories of successful RPAS implementations. RPAS use in first-responder and public-safety type scenarios tend to garner media attention and can be used to engage interested groups in your vision. Recording progressive "wins" with RPAS use can help build your case for a more robust program in the future, as well.

Regulatory Environment

Canada has come a long way in terms of RPAS regulation in the past several years. We've gone from requiring an individual permit for every flight operation, to formal regulations addressing the vast majority of RPAS operations conducted across the country day-to-day. It's a constant cycle, though, as by the time regulation has caught up, the technology is miles ahead again.

Transport Canada has outlined their drone strategy to 2025 in a document by the same name. The focuses are:

- Supporting innovation through safety regulations

- Managing drone traffic
- Understanding and addressing drone security risks
- Supporting economic growth
- Increasing public trust in drones

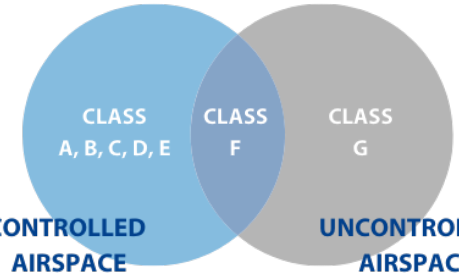
As part of this, specifically we expect to see regulation supporting BVLOS operations in low-risk environments, and provisions to operate RPAS heavier than 25kg outside of the current SFOC process.

In 2021, Transport Canada established CanaDAC – the Canadian Drone Advisory Committee. The intent of the committee is to bring together the RPAS industry, community, and government at all levels to identify priority topics for consideration and actions to keep Canada at the forefront of RPAS internationally. The established priority areas are Societal Acceptance, Research and Development and Advanced Air Mobility. These are intentionally broad topics and focused task groups are working to narrow the scope to actionable deliverables for Transport Canada to execute on.

Transport Canada has its origins in maintaining the incredible safety record that Canada holds and will keep that as a primary focus as RPAS become a more integral piece of the aviation system in Canada.

Airspace Operations

Transport Canada has delegated the management of Canadian civil airspace to NAV CANADA, a private not-for-profit corporation. Levels of service provided by NAV CANADA facilities and airspace usage permission is differentiated by using letters, A through G, to identify classes of airspace. Of particular importance to RPAS operators is understanding what class of airspace exists in the area of operation, as well as nearby and above it.



CONTROLLED AIRSPACE

- Requires NAV CANADA permission prior to use
- Requested and issued through the NAV Drone Portal/App
- Requires an advanced pilot certificate
- Requires an aircraft with a "controlled airspace" manufacturer declaration

UNCONTROLLED AIRSPACE

- Does not require permission from NAV CANADA
- Requires either a basic or advanced pilot certificate
- No aircraft manufacturer declaration required
- Identified as the absence of another airspace class

*controlled and uncontrolled airspace are accessible with a microdrone when it is operated in accordance with CAR 900.06

In addition to the categories above, pilots should be familiar with any restricted or advisory airspace within their area of operation, proximity to Department of National Defense Aerodromes and proximity to the Air Defense Identification Zone. The NAV Drone Portal/App is a great, official resource for this critical information.

SECTION 3 – Budgeting

The information that follows is an attempt to outline the costs, both in terms of monetary and time-resources, associated with establishing and maintaining an RPAS program. Please note that many variables influence the total cost, and the numbers below should represent rough guidelines, not to-the-cent estimates.

Budget Considerations

Use, piloting skill, previous knowledge, number of flights, operation type, and ongoing recency training are just a few of the variables that can affect the total costs of an RPAS program. Do not discount the resource requirements for managing and maintaining pilot skills. An out-of-practice pilot is a hesitant pilot, and a lack of use only exacerbates the problem. Avoid the "dusty drone" syndrome by providing pilots with the opportunity and guidance to develop their skills at regular intervals.

Aircraft

A well-rounded fleet can be made up of multiples of one aircraft type or a wide variety of more purpose-built or specialized aircraft for specific applications. Generally speaking, fixed-wing designs are more expensive as there is a larger market for smaller, capable VTOL aircraft. The pricing below in CAD provides, in some cases, a wide range which is largely dependent on the fixed sensor selections for the RPAS in that category. The lower limit indicates base model pricing.

Microdrone
Multirotor
< $1000

Standard
Multirotor
$4000 - $8000

Standard
Fixed Wing
$8000 - $40 000

Specialized
Multirotor
$10 000 - $14 000

Specialized
Fixed Wing
$4000 - $12 000

Equipment Replacement

Regular equipment replacement is inevitable. Depending on use and upkeep, the following timelines can be anticipated.

If batteries are kept in constant circulation, their lifetimes will be shorter. Anticipate about 100 cycles on most batteries before you'll want to start thinking about their retirement. Whether due to desire to upgrade or damage necessitating a replacement, you can anticipate an average of 36 months of use out of a workhorse drone. Some flight apps will provide battery health information in an advanced menu, so it is good practice to check that regularly.

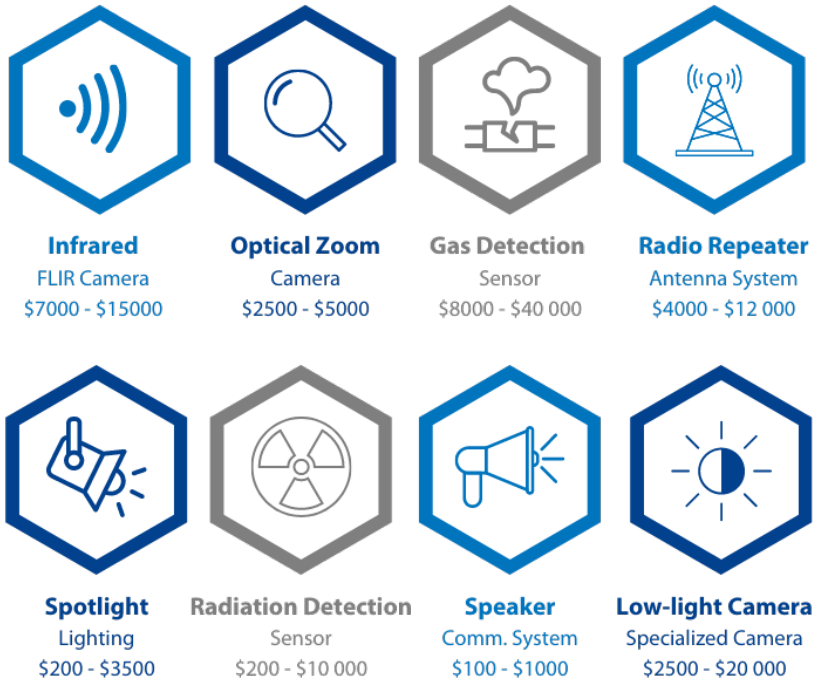
Maintenance

Manufacturers determine the maintenance requirements and intervals as well as what tasks can be done by the owner and which ones need to be conducted at authorized repair facilities. The latter can be a time-consuming process between shipping to a facility, sometimes internationally, waiting for parts to be ordered, installed and then the shipping returns. Depending on the warranty, these costs may be entirely out of pocket.

A heuristic of 10% of the cost of the drone can be anticipated to be spent per year in repairs and upkeep. This would cover events such as maintenance, a hard landing, gimbal jam, water, sand or dust ingress or a drop.

Payloads

RPAS payloads make up the bulk of the cost of the RPAS particularly when those sensors are interchangeable and not structurally built-in to the aircraft itself, and therefore the aircraft pricing. The ranges in CAD below provide base model at the lower limit with more specialized options making up the higher limit.



With the R&D taking place in sensor and aircraft development, technological advancements may help to bring costs down while increasing options and capability.

On average, payloads will last longer than the system that carries them. They will likely remain functional beyond their usefulness, in that an upgrade will be on the market before the sensor needs replacing. Gimbals do well with basic maintenance to preserve their life but are difficult to repair if broken. It's usually more worthwhile to replace a damaged gimbal to gain the new warranty than try to fix. Other payloads with moving parts such as a winch, dropper, grabber, or sampler all have shorter lifespans and higher maintenance requirements due to the weight on the moving parts.

Staffing

Aside from the obvious role of "pilot", there are additional staffing support roles to consider when allocating resources to the RPAS program.

Program Champion – a program champion is a point-person for the RPAS Program. This role is sometimes referred to as a Chief Pilot, though this can be more administrative than a piloting role, specifically. Their role requires an understanding of RPAS regulations, opportunities and limitations,

an ability to liaise with external stakeholders (NAV CANADA, Transport Canada, City Government, Police, City Council) and maintain documentation records. They may also be responsible for training, certification, and recency tracking.

Visual Observer – a visual observer is a flight crew member who is briefed and/or trained to assist the pilot. As the name implies, this is primarily through helping maintain line of sight but can also include activities such as bystander control, checklist assistance and operation management. Trained pilots often provide VO functions for other pilots

Support Personnel – Equipment that is used in an on-call environment must be maintained in an operation-ready state. When most RPAS batteries are left unused for more than a few days, they begin to discharge to maintain their health. Someone will need to be designated to change or charge flight batteries every day. Firmware (software) updates will be pushed to the drone operating system from the manufacturer. These updates should be installed as soon as safely able to ensure the aircraft is operating on the most recent system. The updates do not come out at specific intervals, but instead need to be checked before flight.

Certification and Training

Recency

Once certified, pilots need to retain their recency by completing a recency exercise every 24 months, minimum. The options for recency exercises range from free to hundreds of dollars.

- Transport Canada Self-Paced Exam – Free
- Basic or Advanced Online Written Exam - $10
- Safety Seminar/Recency Program - $50-$150
- Flight Review - $250

While they all achieve the same goal, there are benefits to the costlier options in that they tend to provide more personalized and valuable learning opportunities. That said, there is nothing wrong with opting for a low cost recency maintaining exercise.

Currency

Staying legal by operating in accordance with recency regulation is very important. It is arguable that equally vital to the success of an RPAS program is keeping skills current. While there can be overlap between the two, currency focuses on operational skills such as following SOP, operating the RPAS and maintaining confidence and competence with operational tasks. As there is no Canadian standard for training, the NFPA 2400, a US RPAS standard, is a good stand-in.

Insurance

Insurance products cost is based on the number and size of aircraft, number of and experience of the pilots and sometimes even the operational environments. Rates vary and there are no specific Transport Canada-mandated minimums. While some large organizations elect to self-insure, it is prudent to assess your risks and insurance options.

Additionally, it can be tempting to rely on personal aircraft for use in fire or search applications, but be aware of the insurance coverage implications. You could be held personally liable if your RPAS is the cause of an incident involving a person or property. Do you know the limits of your personal coverage, if you have any? Do you have a replacement arrangement if the operation results in the loss of your RPAS? The effort to confirm these arrangements prior to their urgent requirement is well worth it.

Hull

Hull insurance doesn't typically make sense for RPAS under $2000 because the premiums and deductible cost roughly as much as a new drone. For larger and more expensive RPAS, you may wish to seek an insurance quote on aircraft and payload replacement before opting for a self-insured route.

Liability

Liability insurance should be considered mandatory and many standard liability policies contain an anti-aircraft clause that would make RPAS exempt from coverage in the event of an incident. Don't assume you have sufficient coverage.

Some policies can be purchased for durations less than a year, though a year is most common, and usually run in the range of $500-$1500 for a couple of aircraft and pilots.

Recording Storage

Cloud storage options are typically SaaS platforms with monthly or annual rates amounting to $150/year for 1TB (terabyte). A NAS is around $300 for 10TB. More information can be found on storage types and best practices in Section 4 under Data Management.

SECTION 4 - Program Structure and Operations

Position Needs

The roles or positions needed within an organization to support an RPAS program will depend on the size and scope of the operations. A management structure can involve roles such as

- Operations Manager
  - This person is responsible for the control of operations and standards. They will maintain the operations manual as well as ensuring crew abide by training, certification, recency, currency, regulatory and operational standards. In smaller programs, this role can be maintained by the chief pilot.
- Chief Pilot
  - The chief pilot develops and implements standard operating procedures, training programs, supervises flight crews, manages equipment, delegates responsibilities to other crew members and actions on any occurrence reports.
- Pilots and other crew
  - These operational roles include the pilot in command (PIC), visual observers (VO), payload or sensor operator (PO/SO) and ground crew personnel to assist with site security or other operational needs.

Throughout this document a program champion has been referenced. This support role provides the backing for the program and can be lumped in with the responsibilities of the Operations Manager or Chief Pilot.

Deployment

RPAS can be employed to support a wide variety of operations. The first step in deployment should be to determine the mission types that are intended to be flown as this will have the greatest impact on equipment, personnel, policy, and procedure requirements.

RPAS flight and control station batteries will begin to discharge as a battery-health preservation tactic if they remain unused for a period of time. This is largely manufacturer dependent though some allow for operator adjustment. It is also unsafe to leave batteries on their charger unattended. For an RPAS to remain operationally ready, it needs to be regularly charged, checked for updates, and inspected. These requirements may impact the chosen deployment model. Though the readiness level is lower with a central storage or access point, it is less practical for distributed, individual kits to be kept ready for flight, particularly if they are not stored in a temperature controlled environment. The temperature limitations apply to storage as well as flight times.

Typically, it will be the Chief Pilot's role to maintain flight gear at an operational level, exercising control over the dispatching and maintenance of all required equipment. This responsibility can be delegated however, with training, to individual pilots if a distributed model is preferred. Ensure insurance policies extend to provide protection to individual property if this is the route selected.

Considerations

Privacy

Privacy is one of, if not the highest, concerns of the general public regarding RPAS. The Canadian Aviation Regulations don't address any RPAS-specific privacy prescriptions or prohibitions. As Canadians, pilots would be expected to abide by federal, provincial, and territorial privacy regulations such as PIPEDA and any sector-specific statutes. Additionally, organizational policies may impose stricter limits than are provided elsewhere.

These policies should cover the storage and deletion of data acquired during operations including timelines, who is able to handle the data and how you limit access to others as well as maintaining the integrity of the data if it is to be used as evidence.

The CSA Group document referenced in the resources section at the end of this document contains further details on privacy recommendations on data management.

Streaming Recordings

Many commercial off-the-shelf RPAS have integrated live streaming options from the onboard sensor to a remote device or social network platform. While any streaming platform that is RTMP compatible will be supported these proprietary systems are not the most reliable nor will they stream over a

cellular connection. Several standalone platforms exist for mobile transmission with specific functionality and security for use in first responder and public safety scenarios.

Regulatory Compliance

RPAS operations in the first response community qualify for special permissions issued via Special Flight Operation Certifications or SFOCs. These must be applied for and pilots operating under the SFOC should hold an Advanced Pilot Certification. When operating in a first response application, including search and rescue, these SFOCs can permit operations in scenarios not permitted by CARs Part 9 including above 400' and BVLOS. While these applications were possible with a regular SFOC application, the benefit comes in the processing and issuance of the SFOC where greater flexibility is written in to the SFOC conditions than would be given to non- first responders.

Due to the nature of the work in "being in the public eye" it's important to maintain a high standard of compliance to set the bar for other operators within the departments and in the general public as well.

Policy and Procedure Needs and Development

In setting out to develop a program from scratch, there are certain fundamentals that need to be in place where other components can grow as the program does. Essential processes include checklists for normal and emergency procedures as well as a risk-assessment called a site survey. The specifics of these are likely included in a ground school program or can be found in CARs 901.23 and 901.27 and expanded upon in the AIM. Links to the CARs and AIM are found at the end of section one. Additionally, there needs to be a process to log flights and maintenance, and to track occurrences like incidents and accidents. Many subscription logbook programs exist, such as Drone Logbook or Airdata, but a basic spreadsheet – either print or electronic – can work as well.

Nice-to-have policy and procedure documents include a RPAS Operations Manual, Safety Management System and dispatching program, but may only be necessary once your program grows beyond a few pilots.

Regardless of the process used, it's essential that all pilots follow it, logging flights, maintenance and incidents. The log will only be as good as the data that goes into it so it works best to involve the pilots who will be using the program in the program selection and ensure the process isn't onerous. Some systems will even sync with the recoded drone's flight data to simply entry. NAV Drone, if used for every flight regardless of airspace permission requirements can also work as an aircraft flight log, though it is a bit restrictive in terms of tracking other important information like incidents and maintenance.

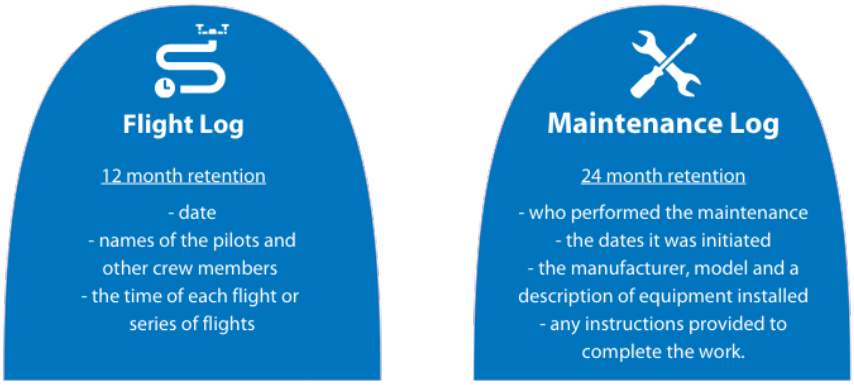
Ensure the expectations for pilots are clearly defined and that the data entry is being confirmed on a regular basis to ensure consistency and compliance.

Unions and Labour

Challenges can arise when roles are assigned based on seniority over fit or aptitude for the role. Clearly outlining the training, currency and recency requirements can help ensure only those truly interested in an ongoing piloting role pursue the available opportunities.

Records Management

Transport Canada requires two logs to be kept per RPAS – one for maintenance and one as a flight log. Though summarized below, CAR 901.48 outlines the requirements for each record-keeping document. If the RPAS ownership is transferred, maintenance records should be transferred to the new owner as well.

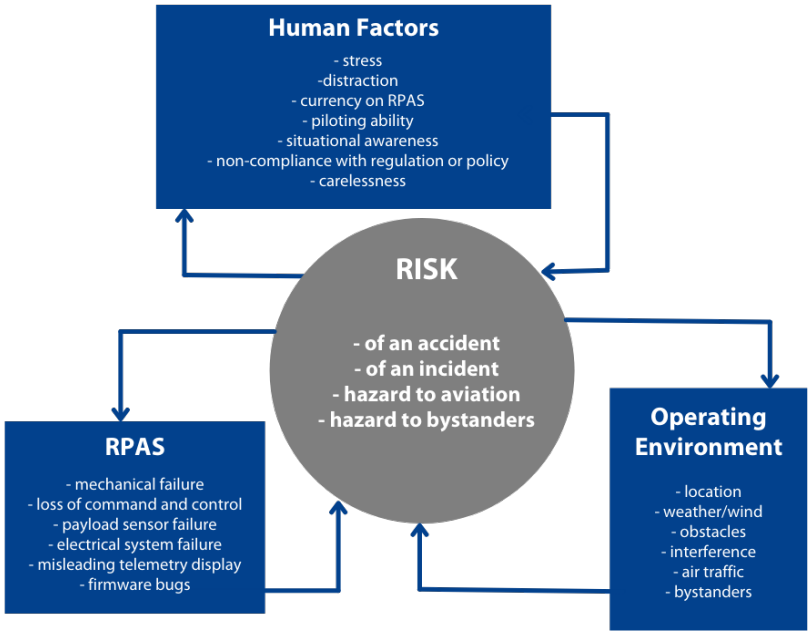


Entries in a maintenance log must be kept for 24 months from the date of entry (a rolling 24 months) while flight logs must be retained for 12 months.

Risk Management

RPAS operations, regardless of the experience level, location, aircraft used or any other factor, have the common goal of managing risk to an acceptable level for the flight. These are not hard limits, but rather an ability for the crew to be trained and capable to assess an operational environment, themselves, and their aircraft to determine if the known risks can be mitigated, accepted, or reduced in order to conduct the flight safely.

The diagram below highlights some considerations when assessing risk in various categories. To manage the risks that are present, the organization should accept and promote a culture of learning, sharing information, and that safety is the highest priority.



Data Management

The general rule with storing recorded data is 3 – 2 – 1; three copies of your data, two on-site in different storage locations, and one off-site. If cloud-based storage systems such as Dropbox, Google Drive or Box are insufficient for your needs, a NAS (network attached storage) device is a good option. A NAS connects to a network, enabling other devices on that network to, with appropriate security layers in place, access files. You can use multiple disks within the NAS to act as redundancies to prevent data loss.

It's good practice to start with a standardized file naming system from day one so you're able to search for and find files you're looking for in the future.

Data management requires active and consistent effort to prevent it from becoming unmanageable. If you wish to retain data for future reference, plan on "dumping" data – that is, moving it from the aircraft's SD card to a computer location - on a daily basis, performing a weekly back up of that data, and purging unneeded data monthly to prevent overwhelm.

Management of flight data other than payload sensor data is covered under the Records Management title above.

Maintenance

Most commercial, off-the-shelf RPAS do not allow for much activity in the way of maintenance in a traditional sense. There are no fluids to change and no tires rotations to do but preventative maintenance activities are recommended and typically issued by the manufacturer in the aircraft flight manual. Some operators will elect to establish their own maintenance schedule based on manufacturer recommendations. These tasks are identified as "elementary" and aside from cleaning

and inspecting the RPAS, one is limited in the work that can be done while still maintaining the manufacturer warranty. More involved maintenance tasks often need to be conducted by manufacturer authorized repair facilities, so you will need to factor in the downtime for shipping, repair, and return shipping.

In addition to maintenance of the physical RPAS components, there are firmware updates issued by the manufacturer intermittently. When these updates are published, they should be installed, tested, and documented. It is important following a firmware update to install each battery and run them through a start-up cycle to allow for any updates to be passed along to the battery firmware too.

Insurance

Insurance products vary and have no specific Transport Canada-mandated minimums. While some large organizations elect to self-insure, it is prudent to assess your risks and insurance options. Be sure to read the provided policies to ensure there are no tricky clauses that would exempt the insurer from paying out in commonly flown scenarios. There have been instances where insurance is more restrictive than what the pilot or aircraft are federally certified to do.

Hull

Hull insurance refers to the provides physical damage coverage. This would include things such as drone loss like in a crash, theft, flyaway and disappearance and often has a deductible. Sometimes manufacturers will provide "care" policies at the time of purchase that act as hull insurance, replacing the RPAS in the event of a malfunction or other loss. Hull insurance doesn't typically make sense for RPAS under $2000 because the premiums cost nearly as much as a new drone.

Liability

Liability insurance provides coverage against physical or property damage to a third party entity caused by drone operations. Liability limits range anywhere from $100,000 to $5,000,000 and may be mandated to be in that higher range for operations on city property or that owned by some corporations. Consider this insurance mandatory and note that most general liability policies will have an aircraft exclusion, which would apply to your remotely piloted aircraft as well. Policies prices will vary with aircraft, number of insured, qualifications of those insured, locations and liability limits. Getting a few quotes is recommended as prices can vary widely. Some policies can be purchased for durations less than a year, though a year is most common, and usually run in the range of $800-$1500 for a couple of aircraft and pilots.

SECTION 5 – Training

Bill Hammond
Deputy Chief

Greater Napanee Emergency Services

Transport Canada has not mandated any required training for RPAS pilots, but they have published a guide of knowledge requirements expected of both basic and advanced pilots operating aircraft in VLOS between 250g and 25kgs (TP15263). Knowledge requirements for other operating weights and environments are anticipated as regulations permitting these operations come into force. Pilots can self-study, use previous knowledge, take part in purpose-built training courses, or some combination of those activities to equip themselves with the required knowledge.

Training on aviation theory is commonly referred to as Ground School. Training organizations that have self-declared to Transport Canada as teaching to the standards are listed on Transport Canada's website. At a minimum, the school needs to offer a 20-hour advanced ground school to meet the declaration requirements, though other shorter programs may also be offered.

Training can be provided online or in person. The only in-person requirement associated with certification is the flight review assessment process. There are pros and cons to the acceptable training options as outlined in the following graphic.

While ground school training is the most common and highest priority, other courses exist such as flight skill training, radio operator certification, sensor-specific training, application-specific training, or procedures training.

Additionally, many schools will offer a recency course for pilots to return and take each 24 months following certification.

When choosing a training organization, consider:

- Course fees
- How long the school has been in existence
- The qualifications of the instructor
- Experience as a pilot (crewed or remote) does not necessarily equal quality instruction
- Availability/frequency of the course
- Discounted training options for groups
- Training schedule/delivery method
- Industry reputation

Competency Requirements

Pilots

Pilots must demonstrate competency initially through gaining certification in accordance with the level of certificate pursued. Pilots must also, every 24 months, complete a recency exercise to keep their certification valid. Proof of the recency exercise and certification must be kept with the pilot while conducting an operation.

From a regulatory perspective, a pilot does not need to gain "type" certification. A basic or advanced certification allows an RPA pilot to fly fixed-wing, helicopter, or multi-rotor style RPA. Additionally, a flight review successfully conducted on a multirotor also enables the pilot to operate fixed-wing or any other type of RPAS. As an organization, you may choose to impose additional requirements above and beyond the federal minimums such as operation-specific training, flight hour minimums before acting as part of an operational crew, or hours as part of a crew before acting as pilot.

Visual Observers

There are no specific mandates for visual observer training or required knowledge and there is no federally issued certification for a VO. Rather than designating or training additional staff, certified pilots within an organization will often act as VOs for another certified pilot. It is important that a visual observer understands their role, responsibilities, risks involved in the operation and how to communicate effectively with other crew.

Visual observers operating on Extended LOS flights should receive emergency procedure training, and additional communication training including on primary and secondary communication systems to ensure the flight safety in abnormal scenarios.

Other Crew and Support Roles

Other crew roles that may be required, depending on the operation site include

- Ground support crew
- Payload/sensor operator

Similar to Visual Observers, there are no specific training mandates or required knowledge for these pilot support roles. However, for these roles to be helpful and contributing, it is important they

receive, at minimum, a briefing on their role, responsibilities, risks involved in the operation and how to communicate effectively with other crew. Where ground support crew may perform a relatively straightforward crowd control function, payload operators will likely need skillset training and opportunities to practice and refine their craft.

RPAS Operation Awareness Training

It may be valuable, depending on the organization structure, for an information session for all members to understand what the RPAS program

- does and doesn't do
- brief overview of regulation
- types of aircraft operated
- common operational scenarios

This can help create buy-in to the program, dissuades misinformation from spreading, allows for new and creative applications to be brainstormed and helps create program ambassadors.

Training Records

Individual training records should be maintained by the program champion. They should include, as applicable:

- name of trainee(s)
- date(s) of training
- type of training
- duration of training
- expiration of training
- certification received

There is no formal structure or regulatory requirement supporting this record keeping, but a best practice of 24 months is recommended. Many apps are available help with this process such as FlySafe, Drone LogBook and AirData.

Section 6 – Equipment

Types

Airframe types are broadly categorized into fixed-wing, multirotor and VTOL fixed-wing types. Within those designations, fixed-wings can be traditional aeroplane style with a fuselage and tail section or, as in the diagram below, more of a flying wing design. Multirotors are distinguished by the number of rotors they have with quadcopter indicating four rotors, hexacopter indicating six, octocopter eight. In addition to the categories below, we also see helicopter-style single rotor RPAS and ornithopters – those RPAS that fly like birds through a flapping motion.

The notes section below highlights some pros and cons of each design.

FIXED-WING	NOTES
	• Requires room for launch, departure, approach and landing • Larger RPAS may require a launch and landing system such as a catapult or arresting net • Able to glide in the event of a motor failure • Longer flight time than most multirotors • Can cover large areas efficiently • More challenging than a multirotor to learn to pilot manually

MULTIROTOR	NOTES
	• Vertical take-off and landing (VTOL) requires small operational zone • Shorter flight times than most fixed-wing and VTOL fixed-wing designs • Motor system failure can be catastrophic • Can hover and orient/use sensor • Best for new pilots

VTOL FIXED-WING	NOTES
	• Vertical take-off and landing (VTOL) requires small operational zone • Transitions to fixed-wing forward flight at altitude to operate efficiently • Longer flight time than most multirotors, though less than straight fixed-wing • Requires precise pilot planning to manage battery life for high-power tail landing • Can cover large areas • Sensor not typically usable when in hover mode

Considerations

When selecting an RPAS to build your drone program around, it is easy to encounter decision fatigue when faced with the multitude of options. While you want to do your best to consider use cases now and in the future, a "done is better than perfect" mindset can be helpful as the experience of operating and learning will provide you with insight into what you actually need and use operationally. Starting small and growing into larger and larger aircraft is a reliable approach – you can always find uses for smaller aircraft for training, high-risk environments, and testing.

Canada is home to some very diverse operational environments so factors like capability in mountainous terrain, wind tolerance, temperature limits, portability and disposability will vary in importance depending on where you're flying.

Payload Options

Not all RPAS have interchangeable payload options. Generally, enterprise-grade RPAS have varying payloads for purchase to suit a variety of applications whereas commercial off-the-shelf RPAS are typically locked in with a specific sensor. This makes enterprise options more future-proof in that as new technology is developed, it can, to a point, be backwards compatible to previous platforms.

If the RPA has an interchangeable payload bay or connector, it is critically important to follow manufacturer guidance on maximum weights, space, and centre of gravity limitations. An unbalanced payload can cause unpredictable aircraft behaviour in flight and significantly reduced flight time and performance capability, particularly on multirotor platforms.

Training Requirements

Aside from certification training requirements, some RPAS manufacturers may suggest or enforce platform-specific training. The more complex, large, and expensive the RPAS is, the more likely there will be purpose-built training to support learning safe operation techniques before it's delivered to be used operationally.

Payloads, or the processing of the data they collect, may also require training. Many processing platforms provide basic training along with their subscriptions or licenses, but more advanced applications can require investment.

Recording/Streaming Ability

Many COTS RPAS have built-in systems for streaming video wirelessly, primarily for social sharing, or via wired connection for those on site. They have the benefit of being integrated into the system but are not generally reliable nor do they function over cellular. Other third party systems can be employed to allow any user with a link and an internet connection to pull up and view data the RPAS is collecting. Some systems allow remote requests for flight changes in real-time. Edge-computing allows for real-time data processing, creating an actionable data product while the drone is still in the air.

Appendix

Glossary

BVLOS – Beyond Visual Line of Sight
Operations where the RPAS crew (pilot and visual observers) do not have line of sight on the drone to maintain operational control of the aircraft, know its location, and be able to scan the airspace in which it is operating to detect and avoid other aircraft or objects. The detect and avoid function is provided through another means.

CARs – Canadian Aviation Regulations
The body of federal regulation applicable to aviation activities in Canada.

COTS – Commercial Off the Shelf
RPAS that are available for purchase a big box stores and similar retail environments and inventoried on shelves for purchase.

DMP – Drone Management Portal
Transport Canada's online platform through which RPAS registration and pilot certification exams are available, among other functions.

EVLOS – Extended Line of Sight
When a pilot cannot maintain VLOS and a crew member performs the LOS functions, the operation is deemed to be conducted within extended line of sight.

RPA – Remotely Piloted Aircraft
Also known as a drone, this initialism refers to the airborne component of the RPAS.

RPAS – Remotely Piloted Aircraft System
Includes all components needed for flight, including the aircraft, ground station and link.

TC – Transport Canada
The federal regulating body for, among other things, aviation including RPAS.

VLOS – Visual Line of Sight

Unaided visual contact at all times with the remotely piloted aircraft that is sufficient to be able to maintain operational control of the aircraft, know its location, and be able to scan the airspace in which it is operating to detect and avoid other aircraft or objects.

VO – Visual Observer
Flight crew members used to assist the pilot in maintaining line of sight with the RPA.

VTOL – Vertical Take Off and Landing
Aircraft capable of departing and arriving straight up and down, requiring a small launch and recovery area.

Reference Publications

- NFPA 2400
- CSA 15:12
- TC/AEAC RPAS 101
- NAV CANADA NAV Drone Portal

Member Resource Directory

- CAFC – Organizational Directory for RPAS Contacts
  info@cafc.ca
  1-800-775-5189

- Kate Klassen – Regulatory and General RPAS Information
  kate@indrorobotics.com
  604-366-8211

- Transport Canada – General Inquiries
  TC.RPASInfo-InfoSATP.TC@tc.gc.ca

- Transport Canada Centre of Expertise – SFOC Application Information
  TC.SATPCentredexpertise-RPASExpertisecenter.TC@tc.gc.ca
  1-800-305-2059

- NAV CANADA – General Inquiries
  service@navcanada.ca
  1-800-876-4693