

CHAPTER 1

GENERAL

TABLE OF CONTENTS

Long-EZ documentation is available in the sections shown below. Section I consists of this book, plus an appendix of 14 18" x 24" drawings. The contents of all sections are shown in the following:

SECTION	
I	MANUFACTURING MANUAL for basic airframe - includes education on composite materials and construction, plans and construction manual for entire aircraft except engine installation.
IIA	Engine Installation - Plans for O-200 Continental aircraft engine. Includes drawings and installation instructions for the engine, baffling, engine controls, exhaust, carb heat muff and box, engine instruments prop, spinner, cowling and induction.
IIC	Same as IIA, except for the Lycoming O-235 engine.
Owners Manual - Flight and maintenance manual. Includes normal and emergency procedures, weight and balance, check lists, detailed flying qualities descriptions, operating limitations, performance charts, maiden flight test procedures, pilot checkout procedures, and record keeping requirements.	
VI	Landing Brake - Drawings for landing drag device to increase glide angle and reduce float in the flare.

Note: Section I, II, VI and a subscription to "The Canard Pusher" newsletter starting with No. 24 (April 80) are **required** to build a Long-EZ. The Owners Manual is **required** before flying your Long-EZ.

WARNING: These plans are obsolete unless updated by newsletters 24 and on. Do not fail to do this, as it is possible that **mandatory** flight-safety improvements may occur.



TABLE OF CONTENTS

CHAPTER	TITLE
1	Description
2	Bill of Materials
3	Education
4	Fuselage Bulkheads
5	Fuselage Sides

CHAPTER	TITLE
6	Fuselage Assembly
7	Fuselage Exterior
8	Rollover/Seat Belts
9	Main Gear/Landing Brake
10	Canard
11	Elevators
12	Canard Installation
13	Nose and Nose Gear
14	Center Section Spar
15	Firewall and Accessories
16	Control System
17	Roll/Pitch Trim System
18	Canopy
19	Wings, Ailerons/Wing Attach.
20	Winglets/Rudders
21	Strakes - Fuel/Baggage
22	Electrical System
23	Engine Installation
24	Covers/Fairings/Consoles
25	Finishing
26	Upholstry
Appen.	Appendix Drawings 18" x 24"

DESCRIPTION / INTRODUCTION

DESCRIPTION

The Long-EZ is a high-performance, homebuilt aircraft. Its compact external size results in superb performance and economy using low-horsepower engines. Inside, it provides comfort for two, both up to 6'6" tall and 240 lbs, plus two medium-size custom suitcases and 6 cubic feet of strake baggage area - all accessible from the cockpits. Its canard configuration was designed not only for performance, but to provide improved flying qualities and safety as compared to the conventional light plane (see owners manual for complete details on flying qualities and performance). The Long-EZ uses the latest aerodynamic features. It uses the NASA-developed winglet system and modern airfoils.

Its high-lift canard wing has full-span flaps which double as elevator and landing flap. Its rear wing has conventional ailerons mounted inboard for control system simplicity and low adverse yaw. The aircraft has a drag device, called a Landing Brake, to dirty it up, allowing use of runways as short as 1800 ft, with appropriate pilot skill. The glide angle at idle power without the landing brake deployed is only 3.7 degrees. Thus, the brake is required to provide the normal descent control of conventional (less efficient) aircraft.

Yaw control and main-wheel brake systems are combined to further result in major simplification and improved flying qualities. The pilot has simple, one-piece rudder pedals to control rudder and wheel brake to its functions. A cable is run from each pedal to its rudder with a spring returning the rudder to a sealed neutral position. The outward camber of the winglets rudder is such that the rudder breakout force is increased with airspeed. This allows pleasantly low rudder forces at low speed where rudder is needed and higher initial forces at high speed where there is no requirement for rudder control. The rudder pedals are narrow enough to allow the pilot to tilt his feet and move them in front of the pedals so he can stretch out and relax his feet forward during cruise. The rudder cable moves a bellcrank at the firewall such that after full rudder is reached, further motion of the rudder pedal actuates its respective wheel brake master cylinder. This system is less complex than the coupled rudder and toe brake system found in conventional aircraft. Also, it results in less brake wear since it is impossible to apply brake in a given direction without already using full rudder power. An adjustable bungee system provides pitch trim, adjusted by a lever on the left console. Roll trim is via bungee adjustment to the aileron controls.

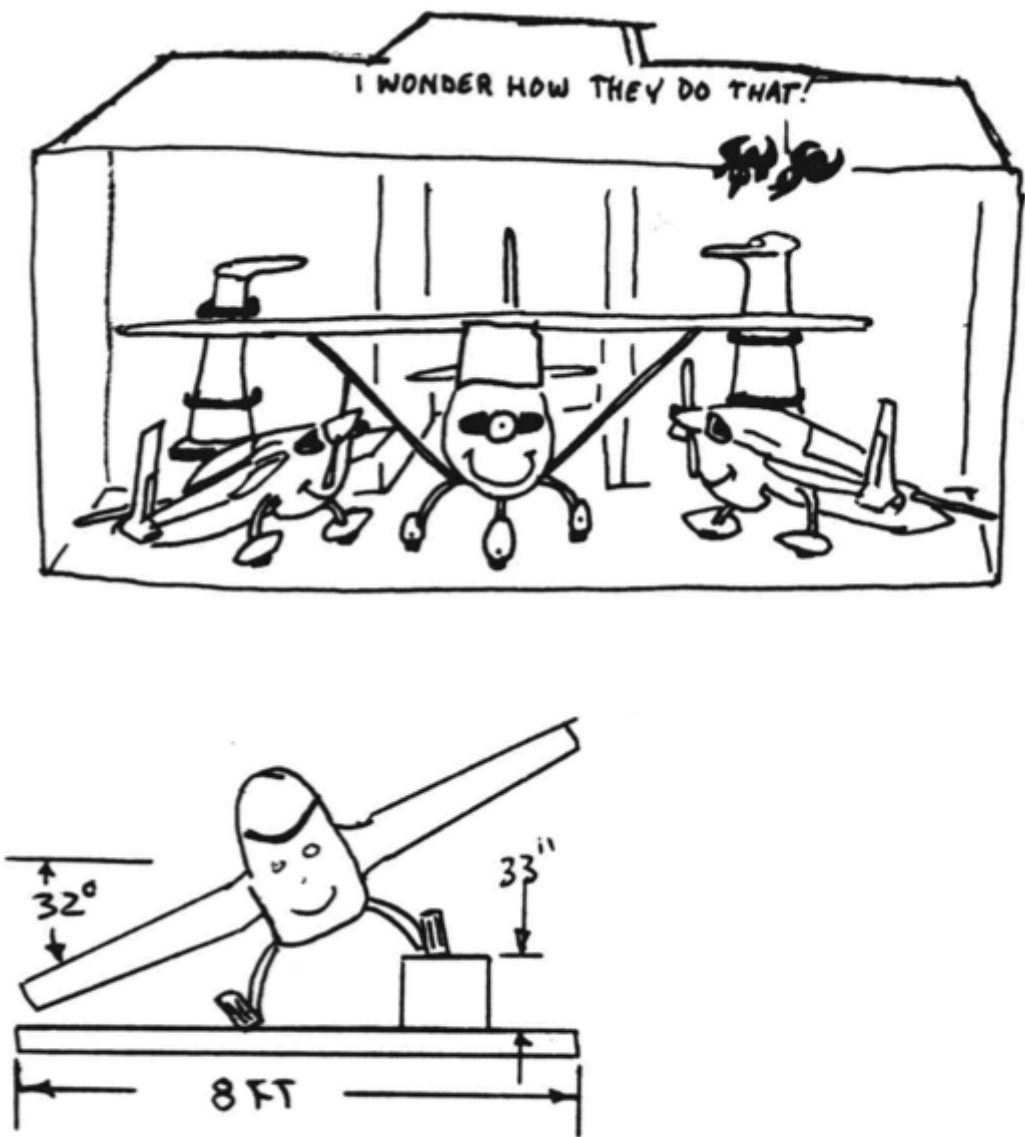
The main landing gear is a one-piece, molded, unidirectional fiberglass strut extending from one axle to the the other. The one-piece design eliminates the excessive leverage loads found in conventional two-piece gear legs. This allows a much lighter structural attachment at the fuselage. The gear and attachment have successfully undergone drop tests to FAR-23 criteria. The gear strut is molded in an airfoil shape. The strut is designed to enter at the top of the wheel pant, rather than at the side, to reduce interference drag. The cruise penalty due to the main gear being fixed, is only 6 knots. Thus, the increase in empty weight, increased cost, and increased maintenance of a retractable main gear is not justified.

The nose landing gear is a fiberglass strut, molded to the outside contour of the fuselage. The strut fits into a groove in the fuselage, thus a strut door is not required. The gear is retracted/extended by a simple worm drive mechanism. The gear is retracted on the ground after the pilot gets out to allow the aircraft to park with its nose down, resting on a rubber bumper. Kneeled parking is used for several reasons: The aircraft is not as susceptible to upset from high surface winds when parked on its nose, the propeller is raised to a convenient height for hand starting, and the nose bumper provides a chock

so that chocking the wheels is not required for hand starting. Refer to the owner's manual for in-flight and ground operation of the nose gear and for details on tie-down procedure.

The fuel system consists of two, 26-gallon glass/foam/glass-composite fuel tanks, which form wing strakes along the sides. The wing tanks have sumps to provide fuel in all attitudes. Unusable fuel is **very** small. Gauging is provided by directly reading the fuel's coloration in a translucent portion of the tank in the back seat. See Chapter 21 for fuel system details. See the Owner's Manual for its operation.

Each wing and the canard are easily removed to allow compact storage or trailering. Refer to the Owner's Manual for specific procedures for disassembly. While in some cases trailering is the only solution to the crowded airport situation, we feel that the work required to completely disassemble, tie down on a trailer, etc., defeats the high utility of the airplane and results in the pilot not flying enough to stay proficient. We recommend the system shown in the sketch, where only one wing is removed and the airplane is hangared on a non-interference basis with a high wing aircraft. Assembly/disassembly time during this method is only about 15 minutes.



Trailering at a road-towing width limitation of 8 feet requires a 33" high block under a wheel to tilt the airplane.

The composite structure of your Long-EZ provides some important advantages over conventional metal, wood, or fabric construction. It has been tested to loads far in excess of those required for FAA certification. Fatigue margins are higher. Contour is maintained under load, the structure does not "oil can", buckle or distort. It provides excellent insulation and damps noise. It has no hidden joints, no water traps, and is far less susceptible to corrosion. It is easier to inspect, more redundant and easier to repair. It is not susceptible to thermal stress due to temperature changes. Properly protected from UV (see Chapter 25), it has a very long life.

INTRODUCTION

This manufacturing manual has been specifically designed to educate you in the construction materials, their use, and to guide you through each step of assembly in the most efficient manner possible. It is our intent to drastically reduce the non-completion rate common to homebuilt aircraft. * With that in mind, we have:

- 1. Preceded the plans with an education chapter intended to thoroughly acquaint you with the tools and materials and how to use them.
- 2. Laid out the plans in a detailed, step-by-step format to answer the question of "what do I do next?".
- 3. Provided all appropriate information to each step adjacent to the words. Due to binding requirements, the larger drawings are grouped together in an appendix.
- 4. Provided full-size templates where required, to avoid the work and confusion associated with scaling up drawings.
- 5. Set up distributors to provide all materials and the hard-to-find tools.
- 6. Identified the difficult to build items, and made them available (prefabricated and ready to install) from competent manufacturers/distributors.
- 7. Set up our newsletter, "The Canard Pusher." as a continuing plans updating/correcting system.** "The Canard Pusher" also distributes builder tips, etc., as they become available.

* Over 80% of homebuilt airplane construction projects started, are never finished and flown.

** Because plans updates are occasionally of a mandatory nature, a subscription to "The Canard Pusher" is mandatory for those building.

BUILDING SEQUENCE

The nature of the type of Long-EZ structure requires that a part be left alone to cure for a longer period of time than that required to build it. Thus, you will find that when following the step-by-step order, you will often find yourself out of work, waiting for a cure. In most cases you can skip to another

chapter and build another part while waiting. With a little planning and familiarity with the entire manual, you should be able to use all your time productively.

BUILDING TIME

Note that many steps include an estimate of the number of man-hours required and the number of people required. This information was compiled from our experience building N79RA and N4EZ. If you add all these together, you will get a total of about 500 man-hours for section I. This does **not** include (1) studying the plans and rounding up required tools and materials in preparation for a chapter, (2) cleaning up your shop, (3) standing around watching things cure, (4) discussing your workmanship with friends that stopped by to help. Many of you will find that through efficient work practice, you can consistently beat the time estimates on most of the steps.

Others may find that they are spending as much as twice the time estimates. If you are spending considerably more time than that shown, go back and study *all* the details in the education chapter. Most slow work is due either to overcautious work habits as a result of being unsure of workmanship, or ignorance of the correct way of doing things.

QUESTIONS?

Please follow the following procedure if you do not understand something and need an answer. First of all, do not be concerned if you do not understand everything the first time you read through the plans. Many things that may not be obvious just reading the drawings, will be obvious when you have that portion of the airplane in front of you or have built a similar part in a previous chapter. Also, we will be able to help you better if you are looking at that portion of your airplane. So, do **not** ask for clarification until you are really working in that chapter. We have found through our VariViggen experience that the majority of questions the homebuilder asks are already answered somewhere in the plans. We have made considerable effort in the Long-EZ manual to make the information Visible. If you do not understand something, study the words in the step, study the sketches and all related sections/views/photos, then look through the full-size drawings that show that portion of the airplane. Check the overview and parts list. If it's a methods-type question, re-read the education chapter for clarification. If the answer is still not found, it may be that the item is covered in detail in another chapter (there is some necessary overlap). Remember, items related to section II (throttle control, oil pressure gauge, etc.) are covered **only** in that section. It is possible that a question related to the operation of a part of the airplane or its maintenance is answered in your owners manual, Also, check your back issues of "The Canard Pusher" (number 24 and on) for plans updates or clarifications. Okay, you have checked everything and you are still stumped. You can do one of three things:

- 1. Ask a friend. Often a description of an item is unclear to one individual and clear to another.
- 2. Write to RAF, leaving room on the paper under each question for our answer. **INCLUDE A SELF-ADDRESSED, STAMPED ENVELOPE** and **INCLUDE YOUR AIRCRAFT SERIAL NUMBER**. We do our best to answer all such questions within two days of receipt. We cannot answer questions regarding the application of non-recommended materials or regarding non-approved modifications. Address: RAF, AIRPORT #13, Mojave, Ca. 93501.
- 3. Call RAF (805) 824-2645.

Also, let us know if you have found a better way of doing something. If we agree, we'll publish it in "The Canard Pusher" so that all builders can benefit. If it is *not* a good idea, we'll tell you why, *if* you include a self-addressed, stamped envelope.

Do keep us up to date on the progress of your project. Send us a black and white snapshot of your airplane for publication in "The Canard Pusher." Photos in the newsletter are particularly beneficial if they are of an area of the airplane that's not clearly shown with photos in the plans. Remember, the primary purpose of "The Canard Pusher" is to support your airplane project.

If you are not a member of The Experimental Aircraft Association (EAA), do join. This is the only organization who looks out for the homebuilder as far as FAA regulations are concerned. Membership in your local EAA can be extremely beneficial both in building your airplane and in meeting people who share your interests. Their monthly publication, "Sport Aviation," is worth the \$25-per-year membership fee in itself. Write to EAA, Box 229, Hales Corners, Wisconsin 53130. EAA often publishes reports on builder's projects - send them photos and some words on your progress.



Many people buy aircraft plans without the specific intent to build an airplane. If you definitely plan to build a Long-EZ from these plans, fill out and sign the license agreement (both copies) in the box below, clip them out, and mail to RAF, Bldg 13, Airport, Mojave, Ca 93501. We will then assign a serial number to your aircraft, and mail copy one back to you. Refer to this serial number when contacting us for any assistance on you project. Builder support is provided only to those holding this license to build a Long-EZ. Use this serial number when registering your aircraft with the FAA.

TO _____

zip _____

Fill in your
NAME & Address

YOU HAVE BEEN ASSIGNED AIRCRAFT SERIAL NUMBER _____

LICENSE AGREEMENT COPY ONE

(This statement is in agreement with EAA policy)

In consideration of payment for the Long-EZ manufacturing manual, Rutan Aircraft Factory Inc., licenses the undersigned to construct, one only aircraft. This set of plans is sold with the condition that the drawings, related manuals, and other material are furnished and intended as a guide only for educational purposes to show typical construction of the aircraft. No warranty, either expressed or implied, is made as to the suitability of the plans or any part thereof for the construction of an aircraft. The plans do not guarantee the performance or the structural integrity of the builders product, and only reflect the design and construction of the prototype aircraft. If an individual or group of individuals constructs an aircraft from these plans or any part thereof and fly the aircraft, which will be licensed in the "Experimental" category by the FAA, they do so at their own risk and without any liability whatsoever on the part of Rutan Aircraft Factory Inc., the designers, his heirs, or any other party or organization. All such liability being hereby expressly waived by the acceptance of these plans by any person and by any person who flies the aircraft. The plans buyer, by acceptance of the set of plans enclosed herewith, agrees to hold harmless the designer for any failure or other dissatisfaction with any aircraft or part thereof built in accordance with these plans. This waiver shall be binding upon the heirs, executors, administrators and assigns of any such person. This disclaimer is stated for legal purposes only and is necessary since the designer has no control over the materials, workmanship, or processes used by the builder. The builder recognizes that flying a homebuilt aircraft is high-risk activity that requires his utmost attention to detail in construction and flight operation in order to achieve a satisfactory level of safety.

For FAA licensing purposes this aircraft will be assigned a serial number by Rutan Aircraft Factory Inc., upon receipt of this statement that the unsigned will begin construction.

Signed _____ Date _____
Plans Owner - Licensee

Signed _____ Date _____
Rutan Aircraft Factory Inc. - Licenser

LICENSE AGREEMENT COPY TWO

(This statement is in agreement with EAA policy)

In consideration of payment for the Long-EZ manufacturing manual, Rutan Aircraft Factory Inc., licenses the undersigned to construct, one only, aircraft. This set of plans is sold with the condition that the drawings, related manuals, and other material are furnished and intended as a guide only for educational purposes to show typical construction of the aircraft. No warranty, either expressed or implied, is made as to the suitability of the plans or any part thereof for the construction of an aircraft. The plans do not guarantee the performance or the structural integrity of the builders product, and only reflect the design and construction of the prototype aircraft. If an individual or group of individuals constructs an aircraft from these plans or any part thereof and fly the aircraft, which will be licensed in the "Experimental" category by the FAA, they do so at their own risk and without any liability whatsoever on the part of Rutan Aircraft Factory Inc., the designers, his heirs, or any other party or organization. All such liability being hereby expressly waived by the acceptance of these plans by any person and by any person who flies the aircraft. The plans buyer, by acceptance of the set of plans enclosed herewith, agrees to hold harmless the designer for any failure or other dissatisfaction with any aircraft or part thereof built in accordance with these plans. This waiver shall be binding upon the heirs, executors, administrators and assigns of any such person. This disclaimer is stated for legal purposes only and is necessary since the designer has no control over the materials, workmanship, or processes used by the builder. The builder recognizes that flying a home built aircraft is a high-risk activity that requires his utmost attention to detail in construction and flight operation in order to achieve a satisfactory level of safety.

For FAA licensing purposes this aircraft will be assigned a serial number by Rutan Aircraft Factory Inc., upon receipt of this statement that the undersigned will begin construction.

Signed _____ Date _____
Plans Owner - Licensee

Signed _____ Date _____
Rutan Aircraft Factory Inc. - Licenser

SN _____ NAME _____
ADDRESS _____
_____ zip _____

Fill in
your
NAME &
Address

The builder of an amateur-built aircraft is the manufacturer; he is responsible for quality control on all parts, all construction, and the conduct of his flight tests. While Rutan Aircraft Factory is not the manufacturer of your aircraft, we do, through these plans and services, provide you with information about how our Long-EZ was built and how we feel is the best way for you to build a safe, reliable airplane. We do encourage you to build the airplane as shown on the plans because we have found that our airplane provides us with reliability and safety, and any problems that we experience with our aircraft are documented and reported in "The Canard Pusher." We have gone to a considerable effort in developing the design, the structure, and the systems, and proving their adequacy with appropriate tests.

If you modify the airplane and then ask us if your modification will work, we cannot give you an answer without conducting the appropriate tests and totally qualifying the modification. This would obviously be quite expensive. Our concern then, is that if your modification is not successful, and causes an incident or accident, this would be attributed to our design, the Long-EZ. Because of this, we must insist that if you modify the airplane with any major change (such as an aerodynamic change, primary structural change, or using a non-approved engine installation), you call your airplane a different name, rather than a Long-EZ. If you make a major change, you must consider yourself involved in *basic aircraft design and development*, an extremely risky business. As such it is not fair to us to be associated with any results of your development. We state this, not to discourage inventiveness and progress, but to release any connection of your new development efforts with our proven design.

We are particularly concerned about the trend among the amateur builders to use high performance homebuilt airplanes as *flying testbeds* for brand new, unproven engine developments. Initial flight testing of a new powerplant, even though it is "well proven" in a car, snowmobile, motorcycle, test stand, etc., is an extremely risky operation. These tests should be done on an airplane like a Piper Cub, Aeronca Champ, etc., for two reasons: 1. The slow-flying, light wing loading types are much more forgiving for forced landings in in the trees and 2. the accident you may have is not just another statistic, it is a *homebuilt* accident, the results of which can have an effect on the overall regulations governing the building and flying of amateur-built aircraft. The U.S.A. has the most lenient regulations for homebuilts of any country in the world and we can keep those regulations if we, through caution, common sense, and self-policing, retain our excellent safety record.

So, if you have a strong desire to try your idea of a turbo-injected rotary watzit or your geared-razzle dazzle, good, do it, but first put it in a Piper Cub (FAA will apply appropriate restrictions during your tests), fly it 1000 hours, keep strict maintenance/failure records, get the right *attitude* toward reliability for an *aircraft* powerplant and then, when you're convinced it is good, install it in a homebuilt aircraft. In this way, maybe we can finally get a good, low-cost powerplant without giving EAA a bad name and without forcing tighter restrictions on the operation of homebuilt aircraft.

FAA LICENSING PROCEDURES

This procedure applies in the U.S.A. only. The FAA has a definite procedure for registering and licensing homebuilt aircraft. There is nothing complicated about it but they insist that you follow each step carefully.

1. Contact your local FAA engineering and manufacturing district office or FAA general aviation district office. Tell them you are building a Long-EZ homebuilt. Give them the following information:
 - 3-view (copy or clip from plans back cover)
 - Aircraft serial number (obtain from RAF see page 1-9).
 - Aircraft registration number, if available (see step #2).
 - Approximate date of completion
 - Engine-type you plan to use

FAA will then answer you, and give you an idea of how much notice they want for them to inspect your airplane, tell you where the approved test areas are, etc.

2. This step is optional, and applies only if you want to reserve a specific registration number (the number you will paint on the tail). You can ask for all numbers, numbers followed by a single letter or numbers followed by two letters. They are preceded by the letter "N." (For example, N7EZ, N4EZ, etc.). Be sure to give them your second and third choice, in case the number you want is already taken. Send \$10 to reserve your special number. Address: FAA Aircraft Registry, Box 25082, Oklahoma City, Ok. 73125. Do not register your aircraft yet, you don't need to pay registration fees, property taxes, etc., until your airplane is ready to fly.

3. When you are ready for inspection__*, contact your local FAA office. Be sure you have an airframe log book (available from a distributor) so that FAA can make an inspection entry.

4. To prepare for your final inspection, be sure you have the "N" number painted. It must be at least 3" high and in block letters with **contrasting colors**. The "Experimental" sign (2" high letters) on the canopy frame, the ID plate and passenger warning plate mounted (available from a distributor), and have an airframe log book and an engine log book. Before final inspection, fill out an application for registration (FAA form #AC8050-1), a notarized affidavit that you built the airplane from parts that you bought yourself, and include \$5 registration fee. Send those three things to the FAA Registry, Box 25082, Oklahoma City, Ok, 73125

5. After you have made a final inspection of your aircraft, run the engine, conduct low speed taxi tests, etc., (see owners manual), contact your local FAA office and tell them you are ready to fly. They will have you fill out an application for airworthiness (form #8130-6), inspect your airplane, and issue you an airworthiness certificate and a list of operating limitations, that will restrict you to an unpopulated area for your initial test period (40 hours). When you have completed your initial test period, contact FAA to get your operating limitations amended so you can fly outside your test area.

* Refer to education section - inspection is done to major areas (wing, canard, winglet, fuselage) **after** the glass is applied, but **before** the area is painted with any primer, etc., so the glass structure can be inspected. The FAA office has been supplied with the same inspection criteria that you have described in your education section.