INSTRUMENTATION AND ELECTRICAL

GENERAL

KIS is an aircraft that you will use daily for sport flying and utilitarian cross-country trips. It deserves a gentleman's cockpit ... well upholstered and technically well equipped. If you cannot afford to complete the aircraft when you first build and fly it, proceed in such a manner that future updates can bring the aircraft up to your fullest expectations.

The design concept and layout for any cockpit should be well thought out and must be as close to modem aircraft standards as possible. This is an area of detailing that deserves a builder's patient attention and creativity. Take pride in this job.

The instrument panel and complete aircraft electrical system must be planned together. The number and type of switches and circuit breakers on the panel are dictated by the electrical system. In return the electrical system must support the instrument and radio systems. Read all of this plus portions of other appropriate literature before beginning.

Do to the complexity of the subject matter discussed herein this text does not give detailed instructions or try to comprehensively cover subjects dealt with thoroughly elsewhere. Builders are encouraged to obtain additional texts. Various suppliers catalogues are also invaluable not just as a source of parts but also as a source of user information.

Suggested publications include:
"Sportplane Construction Techniques " by Tony Bingelis
"Firewall Forward" by Tony Bingelis "Trade - A - Plane"
Aircraft Spruce and Specialty Catalogue Wag Aero Catalogue

BATTERY INSTALLATION

The battery will go forward of the firewall when Volkswagen derivative engines are used. It will go either behind the fire wall or behind the passenger seat when heavier engines are utilized.

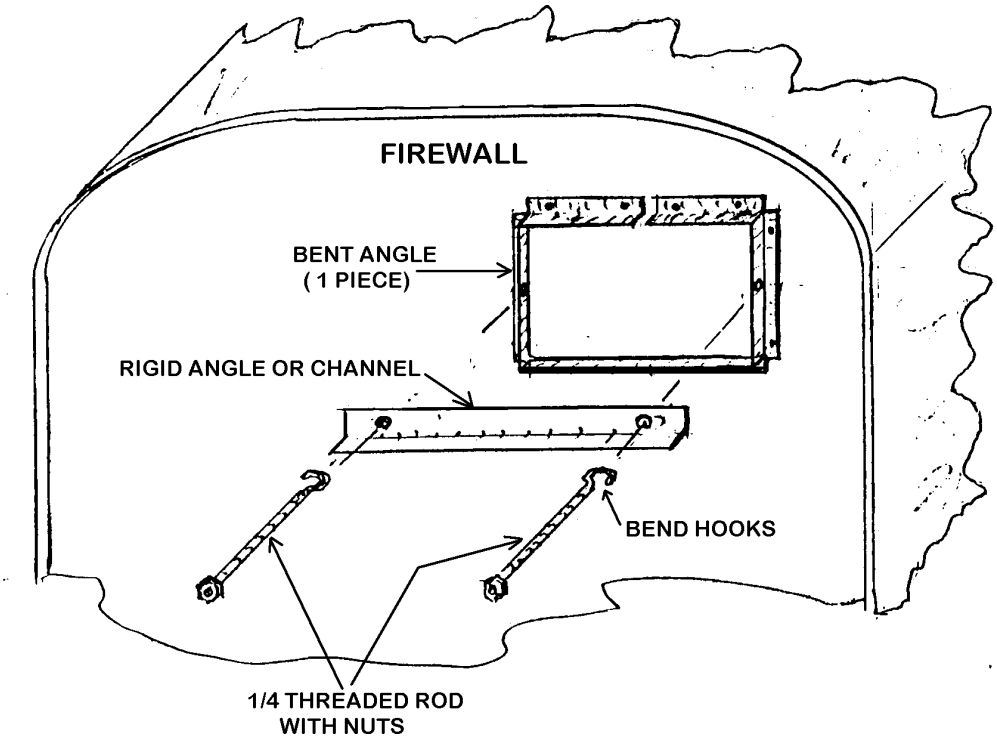
You may not be able to determine the necessary location of the battery pending weight and balance measurements. Therefore it may be necessary to install it late in the building process. Rather than wait until the ship is painted you can make a preliminary weighing anytime after assembly of the wing to the fuselage. The battery can be temporarily mounted based on that data but do not make the installation permanent pending final weighing. (See Weight and Balance Section for details and designer's limits.)

If the battery is to be located inside the fuselage safety considerations dictate use of a battery box. New boxes are available from aviation suppliers and good used ones are available from wrecked aircraft.

The battery or its box must be attached securely to primary airframe components that can withstand the structural loads imposed by a heavy object during crash conditions. A vent tube must be routed overboard.

When attaching the battery forward of the firewall use either a commercially available battery mount or build your own. To make your own just cut and bend a piece of 1 inch aluminum angle and bolt it to the firewall to form a vertical positioning tray slightly larger in width than the battery. Then make up some long threaded rods and a horizontal cross-strap. The threaded rods go through the battery box

verticals and hold the strap and battery securely to the firewall.



INSTRUMENT PANEL

While building the fuselage you fabricated and installed the standard instrument panel or installed a pre-molded custom deluxe panel. The mount holes for instruments, radios, switches and circuit breakers could have been made prior to or after installation. There are two ways to mount the instruments to the standard panel. If you are mounting a 3 1/8 inch instrument make a 3 inch hole with a hole saw. Open this to 3 1/8 with a file. Next remove the rear laminate and honey comb core so that the instrument can be mounted to the face laminate from the back. Add close-out glass from the back side of each hole to strengthen the installation.

An alternate method is to take a saber saw and cut out large areas of the panel on the right and left sides where the instruments will go. Make two aluminum plates, one for the right side and one for the left side of the panel. Use a fly cutter to make the round instrument holes in the aluminum and mount the gages on the plates. These plates are then bolted to the main panel or suspended with shock mounts. See cross-section and panel layout drawings.

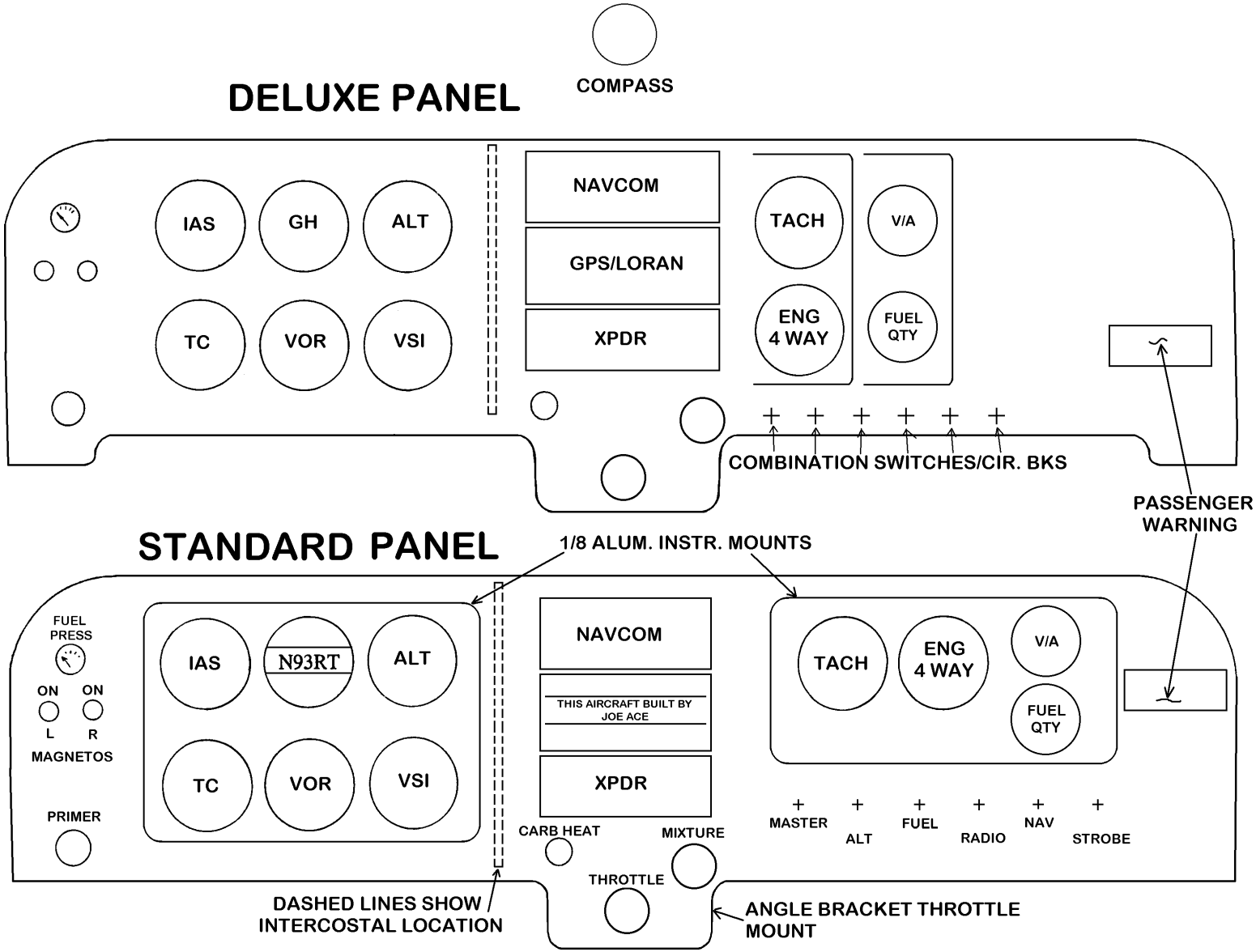
Before deciding exactly how to arrange your instruments, radios, switches and engine controls, study a modern certified aircraft. The Cessna 152 is ideal because it adheres to international standards and was developed so that students would be properly trained. A person acquainted with such a layout can step into any modern certified aircraft and immediately scan the instruments without confusion.

Placement philosophy for side-by-side aircraft like KIS is to locate the primary flight instruments in front of the pilot. The engine instruments go on the right side of the panel. Radios are stacked in the center.

The drawings on the next page show suggested panel layouts for a KIS aircraft. Potential layouts for both the standard and custom deluxe panels are illustrated. The two illustrated panels are similar in layout except on the right side where the custom panel sculpturing causes some placement differences.

Examining the drawings you will see that the hypothetical standard panel lacks some expensive equipment shown on the custom panel. The gyro horizon and LORAN have been omitted but the spacing is unchanged so that the equipment can be added later.

Builder’s using the custom deluxe ready-made instrument panel may mount their instruments directly from behind. Builder’s who make their panel from the ¼ inch thick pre-marked panel board will have to work a little harder. Note that all the instruments on the left side of the illustrated standard panel are shown mounted on a separate metal panel (.090 aluminum about 8 x 12 inches); those on the right are mounted on a smaller panel. These panels can be shock mounted with special rubber mounts if so desired. Use a saber saw to remove large pieces of the ¼ inch panel in the areas behind the aluminum instrument mount plates.


COMPASS
DELUXE PANEL
IAS
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ALT
TC
VOR
VSI
NAVCOM
GPS/LORAN
XPDR
TACH
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4 WAY
FUEL
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COMBINATION SWITCHES/CIR. BKS
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ANGLE BRACKET THROTTLE
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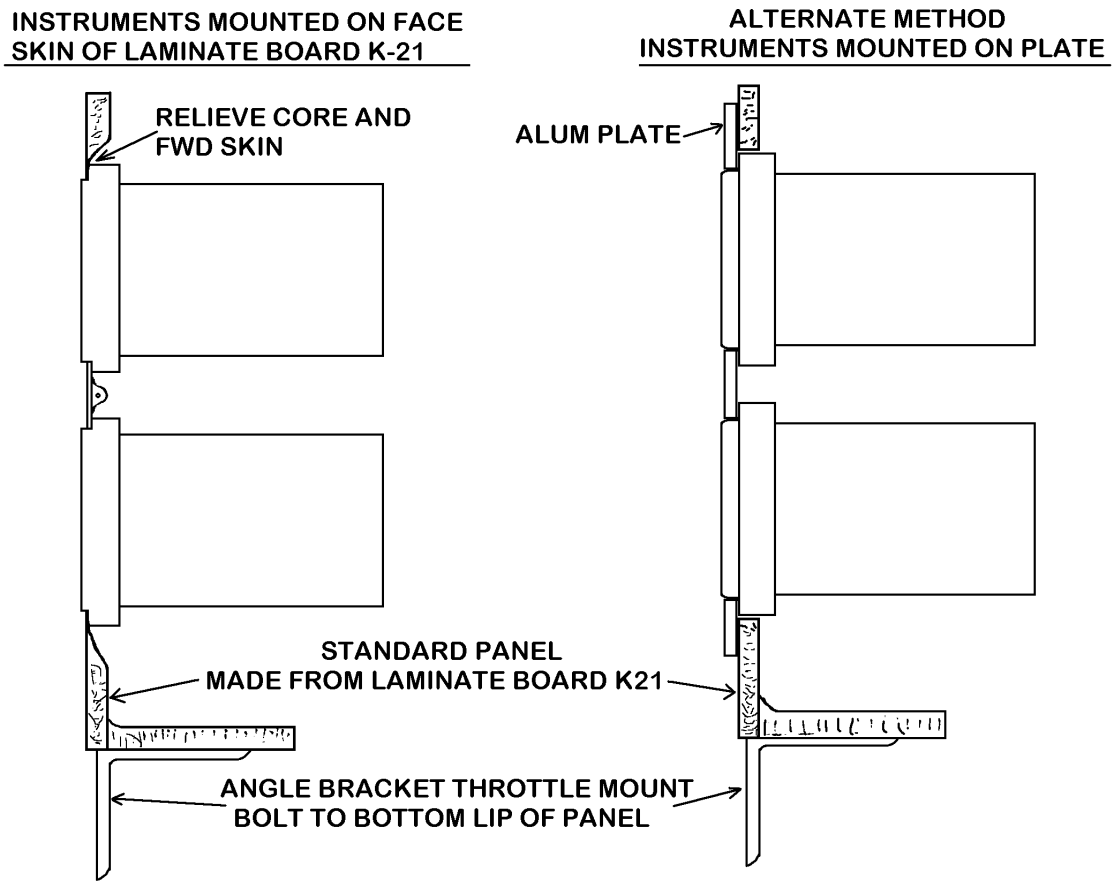

Switches are best grouped together. With the exception of the magneto and start switches all others can often go together in a line. The use of unitized switch/circuit breakers will simplify and improve your installation.

Most of us at times forget and leave the master switch on when leaving the aircraft. The result is frustration and a damaged battery. An on-off key lock such as those sold in automobile stores like Pep Boys will help minimize this problem when installed as a master switch in the solenoid circuit. Consider using such a switch.

Use new, near new, or yellow-tagged instruments and radios only. It is unacceptable to build a beautiful new aircraft and put old looking and possibly unserviceable equipment in it.

Many builder's get their instruments and engine at the same time by buying a "totaled" aircraft. Unfortunate this often leaves the builder with ancient looking gages. If this is your situation find a copy of Trade A Plane and investigate having the instruments rebuilt before installation. You want your panel to look and function like a new airplane.

RADIOS

In view of the fact that KIS is a cross country aircraft you will do well to spend some dollars on radios. A hand-held communications transceiver may be adequate to get you in the air but

sooner or later you will need adequate electronics. Your particular needs and desires will dictate exactly what to install. Thoughts pertinent in the United States on the matter follow:

Nav-Coms vs Com only:- VOR is being relegated to lesser use with LORANS and OPS taking over. The VORs are still good to fall back on for navigation tasks. VORs are also useful when duplexing with FAA en route FAA Flight Service Stations. The Narco MK 12D and King/Bendix *KX155* will remain effective utilitarian radios for years to come. Regardless of whether selecting Corn-only or Nay-Corn type units try to get one with flip-flop frequency handling.

LORAN vs GPS:- These devices have relegated VOR to be a backup navigation system. GPS is most promising and has rapidly overtaken LORAN in popularity. If you are not buying a new radio then there may be good values in used LORANs.

Transponders:- The day has come when we must have a transponder to go where we want to go. Install a transponder and altitude encoder. The encoder can be mounted on the intercostal near the radio stack. (At the time of preparing this text no guidance is possible on mode “5” type units.)

Emergency Locator Transmitters:- These are required for aircraft carrying two or more persons. Used ELTs are available cheap. Beware of battery cost when buying a unit. The best place in a KIS for the ELT is in or be hind the baggage area. Secure it well.

Radios are normally not just cantilevered from the panel. Their trays are supported at the back end. Mechanical support can come from brackets attached to the single intercostal. If this doesn’t work out add another intercostal on the right side of the radio stack and appropriate cross pieces.

ELECTRICAL & WIRING

The two Bingelis manuals listed at the beginning of this section are essential reading before starting electrical wiring. Read these and/or have an expert aviation electrician or experienced homebuilder help.

Plan .... think .... plan! First make a complete schematic. Don’t worry if your drawing is rough looking. Determine what wire sizes will be required for the various sub-circuits. Calculate the fuse or circuit breaker capacities at the same time.

Part of the planning and preparation includes thinking out how the wiring will be bundled and routed. Military type wiring bundles should be routed along rigid paths where they can be neatly laced and lashed down to the airframe or instrument panel every few inches. Be sure that noise-carrying wires from the magnetos are routed as clear as possible of other wiring.

One of the first steps will be to install special nylon support straps along your wire bundle paths. This type of strap has a pad that can be bonded to a structure. The paths will lead to and from terminal strips, grounding studs, switches, circuit breakers, and so forth. It may be necessary to install special shelves or intercostals just to facilitate the wiring.

Wiring (and things like the fuel primer line) coming through the firewall must not be suspended in air to get to the instrument panel. Route them across the firewall and then aft along the fuselage side or aft along the intercostal. The wiring can thus be mechanically supported or constrained all the way.

If possible provide extra breakers, switches and routed wires to places where power will be required later. For example, you may know that you will add radios in the panel or even strobe lights in the wing tips.

Solderless crimp fittings are essential. The best are the aviation type fittings and matching ratchet crimp tool that creates a double crimp. One crimp holds the wire mechanically at the insulation; the other makes the metal-to-metal electrical joint. If these fittings are not available to you then use standard home hardware crimp fittings such as those found at radio shack or the hardware store. If using hardware store crimp fittings it is a good idea to support and insulate all terminations with shrink tubing. Shrink tubing support is a must if you elect to solder fittings in lieu of crimping.

PLACARDS

Mark the function of all switches and circuit breakers. Engraved plaques or use decals to mark the panel functions as shown on the lower panel in the drawing. Use special colored decals to mark the engine and flight gages to indicate service limitations. KIS limitations such as design airspeeds are specified in the Table of Specifications.