

Kinds of Operations Equipment List (KOEL)

BY THOMAS P. TURNER

I was instructing in a late-model A36 when the Bonanza's glareshield-mounted LOW BUS VOLTS annunciator began to flash. Both the factory load meter and the aftermarket JPI voltage sensor indicated near 28 volts—the alternator was working properly; the annunciator was a false indication.

Following steps outlined in the Section III (Emergency) checklist, my student turned off the alternator switch, then turned it back on in an attempt to reset the voltage regulator and shut off the errant light. But the false sensation recurred.

We were in clear skies flying under visual flight rules (VFR), so there was no immediate threat even if the alternator had actually failed. I asked my student, "Can we safely and legally continue our flight? What if we were in instrument conditions? After we land, if both voltage indicators show proper alternator function, but the light was still illuminated, can we legally take off again?"

Type certificate

Airplanes need certain equipment to fly safely in VMC, at night and in IMC. Each aircraft type is certified to a "type design" that conforms to a document called the type certificate data sheet (TCDS). This is often called the TC, or type certificate, and describes the terms of aircraft certification.

You can find the TCDS for your airplane at www.airweb.faa.gov/Regulatory_and_Guidance_Library/rgMakeModel.nsf/MainFrame?OpenFrameSet.

Be35 (35 through G35)	A777
Be35 (H35 and later), Be33, Be36	3A15
Be95, Be55, Be56, Be58 (except 58P and 58TC)	3A16
58P, 58TC	A23CE

The type certificate numbers
for relevant Beech airplanes.

Each TCDS is a very long and sometimes convoluted document that means a lot to regulators and aircraft manufacturers, but is very unwieldy for use in the cockpit. Yet for an airplane to be considered "airworthy," the pilot is responsible for determining if it conforms to the TCDS requirements for the type of flight to be flown.

FAR 91.7(b): The pilot in command of a civil aircraft is responsible for determining whether that aircraft is in condition for safe flight. The pilot in command shall discontinue the flight when unairworthy mechanical, electrical or

structural conditions occur.

Kinds of operations equipment list

Fortunately, Beech makes this determination easy. In the Limitations section of the pilot’s operating handbook (POH) there’s a table called the Kinds of Operations Equipment List (KOEL). The table “identifies the systems and equipment upon which type certification for each kind of operation was predicated.” In this context, “kind of operation” means VFR day, VFR night, IFR day or IFR night flight. Barons certificated for flight in icing conditions (“known ice”) also include “icing conditions” as a kind of operation.

As a limitation, these tables are legally binding for aircraft operation.

Inoperative instruments and equipment

FAR 91.213(d): A person may take off in an aircraft with inoperative instruments and equipment without an approved Minimum Equipment List provided—(1) The flight operation is conducted in a nonturbine-powered airplane; and (2) The inoperative instruments and equipment are not indicated as required on the aircraft’s equipment list, or on the Kinds of Operations and Equipment List for the kind of flight operation being conducted.

How do we use this table?

Let’s say the pitot heat switch-type circuit breaker gets weak and keeps popping when you turn it on.

SYSTEM and/or COMPONENT	VFR Day				Remarks and/or Exceptions
	VFR Night				
	IFR Day				
	IFR Night				
FUEL EQUIPMENT (Cont'd)					
Fuel quantity indicator	2	2	2	2	-
Fuel flow indicator	1	1	1	1	-
ICE AND RAIN PROTECTION					
Emergency static air source	*	*	*	*	-*Optional
Pitot heater	*	*	1	1	-*Optional

KOEL excerpt from the F33A POH.

A “1” in the column indicates at least one of the device must be working for the kind of operation to conform to the TCDS. The pitot heat is a TC requirement for IFR day and night

flight, so the trip may not be legally flown IFR with the errant pitot heat switch. This may be a bit absurd on that summertime trip to Phoenix, but the airplane does not meet certification rules for instrument flight.

Note that the pitot heat is labeled "Optional," so under these circumstances the trip could be safe. But if pitot heat is installed, the KOEL/TCDS tells us it must be working for IFR.

As a side note, a switch-type circuit breaker that won't remain set should be investigated and replaced as necessary to prevent a possible electrical fire.

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Redundant systems

How about an airplane with multiple, redundant systems? Say you're flying a known-ice Baron and one of the instrument air pumps fails. You depend on instrument air for attitude information (unless you've retrofitted with an electric attitude indicator and/or are flying a G58); the pneumatic pumps are what power the de-ice boots.

SYSTEM and/or COMPONENT	VFR DAY				
	0	VFR NIGHT			
		2	IFR DAY		
			2	IFR NIGHT	
				ICING CONDITIONS	
VACUUM/PRESSURE SYSTEM					
1. Instrument Air System	0	2	2	2	2
2. Pressure Gage	0	1	1	1	1

KOEL for a Baron 58.

According to the TC (reflected in the KOEL), both instrument air pumps must be operable for anything but day VFR flight. Systemically everything is supposed to work on a single-instrument air pump, but I've heard several pilots report they lost a pump and the act of inflating the de-ice boots caused the second pump to fail, leaving them partial panel in icing conditions. The KOEL reminds you to carefully evaluate your options when faced with a systems outage.

Back to the annunciator

The false LOW BUS VOLTS indication provided a "teachable moment" with my student in the A36. Engaging the autopilot, he pulled out the POH and located the KOEL.

SYSTEM and/or COMPONENT	VFR Day				Remarks and/or Exceptions
	VFR Night				
	IFR Day				
	IFR Night				
ELECTRICAL POWER					
Alternator	1	1	1	1	
Battery	1	1	1	1	
Bus Voltmeter	1	1	1	1	
Load Meter	1	1	1	1	
LOW BUS VOLTS					
Annunciator	1	1	1	1	
STARTer Energized					
Annunciator	1	1	1	1	

An A36 KOEL.

Although we could identify proper voltage with the BUS VOLTS gauge and the aftermarket JPI voltmeter, the KOEL tells us even day VFR flight requires an operable LOW BUS VOLTS annunciator. Radios need to work, transponders must reply and the gear will have to go all the way down. Without a “flash in your face” warning, it would be very easy to miss a failed alternator before battery power depleted and blinked out.

Electrical monitoring devices in Beech airplanes are either very small, very far from your instrument scan or both. When I provided Beech-specific simulator training, failures almost always were missed by the pilot for several minutes (even with a working annunciator!).

Under the A36’s TC (reflected by the KOEL), we were obligated to land and have the warning light repaired. You can probably make the case that it’s legal to continue flight to a location where repairs may be made, in lieu of landing right away. But there’s no leeway for dispatching again before repairing the failed component (unless you get a ferry permit), because it is required for the “kind of operation” you’ll undertake.

Safe, but legal?

There are many situations where a flight might be completely safe yet “illegal” under the terms of the TC/KOEL (failed pitot heat at Phoenix in the summer comes to mind). But the rules of aircraft certification give us little flexibility when systems fail. Ultimately you’re responsible for determining whether the airplane is “airworthy.” Use the KOEL to help make that determination, being certain you can defend your decision if something unforeseen happens.