CFI Bootcamp
Pilot Training

Power Hour Lessons

Teaching Instruments Effectively

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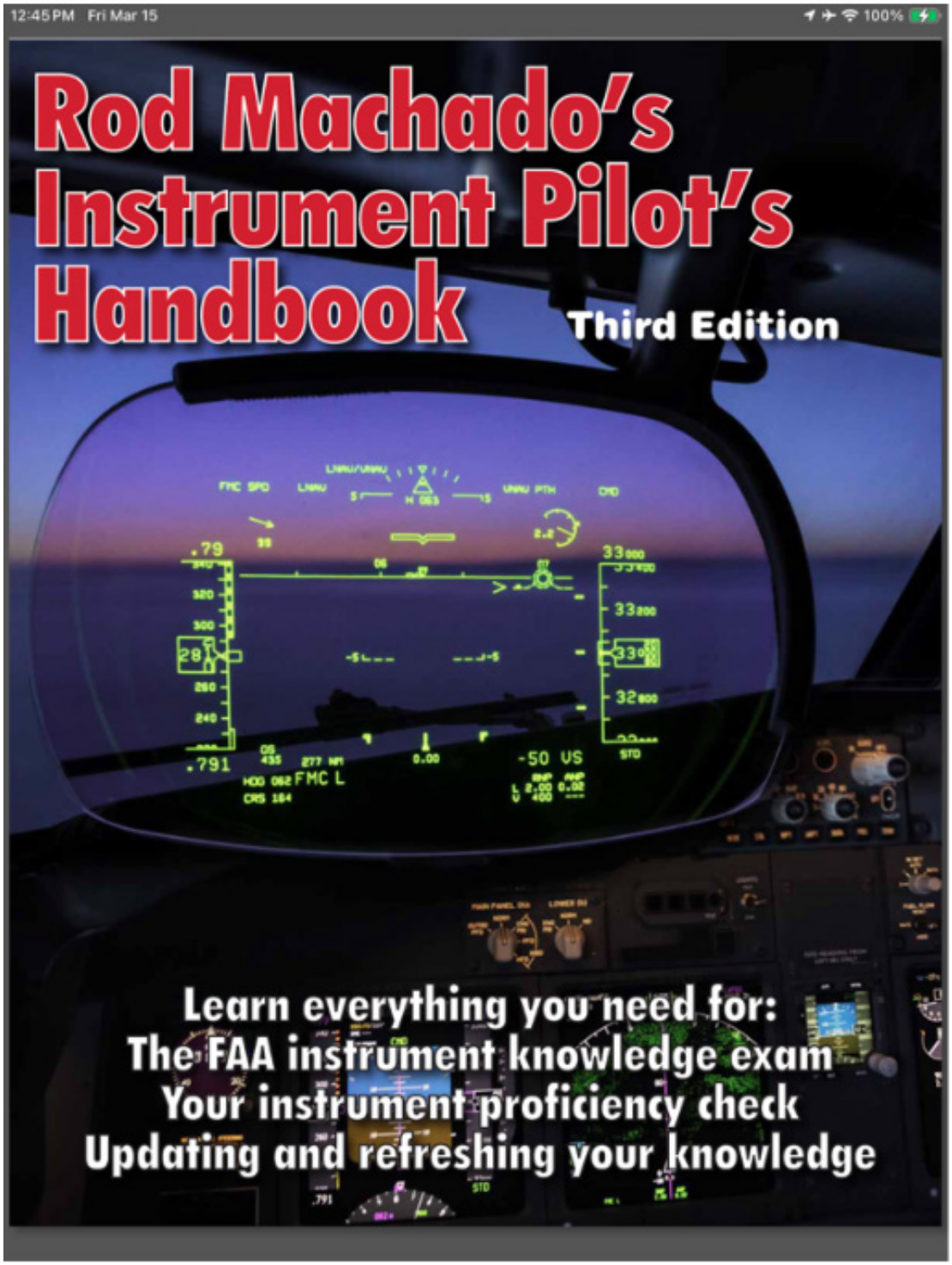
Overview

1. Two methods of airplane control by the flight instruments:
   a. Control/Performance
   b. Primary/Supporting
2. One of the two methods MUST be demonstrated/used on a checkride for Flight Instructor Instrument Airplane.
3. You are not required to demonstrate or use for the Instrument Rating Airplane checckride.
4. Best Practice - Use an AATD and Freeze the altitude.
5. Use the Autopilot First to show how to control the airplane using the method chosen. This models ideal behavior.
6. Scan patterns are:
   a. Selective Radial
   b. Inverted V - To cross-check potentially failed instruments
   c. Big Six
7. The Primary/Supporting method relies on a primary pitch, primary bank, and primary power instrument. Control is made with reference to the primary instruments for each action, such as a constant airspeed climb, straight and level flight, standard rate turn, etc.
8. Control performance uses the attitude indicator as a starting point for all actions. There are control instruments - Attitude Indicator and RPM/MAP. Performance Instruments - Airspeed Indicator, Altimeter, Vertical Speed Indicator and Turn Coordinator. Navigation Instruments - HSI, VOR etc. This method says that for every attitude and power setting some predictable performance will be achieved.



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Primary/Supporting Method

Primary/Supporting Instruments

Fig. 16

	Pitch	Bank	Power
Straight and Level	Primary: ALT Supporting: AI, VSI	Primary: HI Supporting: AI, TC	Primary: ASI Supporting: MP/RPM
Airspeed change in straight and level:	Primary: ALT Supporting: AI, VSI	Primary: HI Supporting: AI, TC	Primary: MP (Primary to initiate airspeed change, supporting when established.) Supporting: ASI (Initially supporting then primary once airspeed is established.)
Entering a level turn (standard rate):	Primary: ALT Supporting: AI, VSI	Primary: AI Supporting: TC	Primary: ASI Supporting: MP/RPM
Stabilized in a turn (standard rate):	Primary: ALT Supporting: AI, VSI	Primary: TC Supporting: AI	Primary: ASI Supporting: MP/RPM
Airspeed change in a level turn:	Primary: ALT Supporting: AI, VSI	Primary: TC Supporting: AI	Primary: MP (Primary to initiate airspeed change, supporting when established.) Supporting: ASI (Initially supporting then primary once airspeed is established.)
Transition from S&L to constant A/S climb:	* If climb is entered from cruise speed, AI is primary and ASI is supporting for pitch. * If climb is entered from climb speed, ASI is primary and AI is supporting for pitch. Primary: AI* Supporting: ASI, VSI	Primary: HI Supporting: AI, TC	Primary: MP Supporting: –
Straight constant airspeed climb:	Primary: ASI Supporting: AI, VSI	Primary: HI Supporting: AI, TC	Primary: MP Supporting: –
Entering a straight constant-rate climb:	* If the climb is entered from cruise airspeed then AI is initially primary for pitch. If the climb is entered from climb airspeed (assumed here), then the ASI is initially primary for pitch until the VSI approaches the desired value, then the VSI become primary. Primary: ASI* Supporting: AI, VSI	Primary: HI Supporting: AI, TC	Primary: MP Supporting: –
Straight, constant-rate stabilized climb/descent:	Primary: VSI Supporting: AI	Primary: HI Supporting: AI, TC	Primary: ASI Supporting: MP/RPM
Constant airspeed descending/climbing turn:	Primary: ASI Supporting: AI, VSI	Primary: TC Supporting: AI, HI	Primary: MP Supporting: –

Primary/Supporting Vs. Control/Performance

Primary/Supporting Instruments Entering a Level Turn from S&L

Fig. 22

The Scan Starts with The AI

Fig. 24

Think about it this way. If you want to enter a climb, a descent, a turn, or any other maneuver that instrument pilots make, you'll simply run through the three steps that I'll give you. You *don't* need to memorize a specific scan pattern for each maneuver you want to accomplish. Imagine having to say to yourself, "OK, I'm going to enter a climb so what's the specific scan pattern required to do this?" or "I'm returning to straight and level flight from a climbing turn so what's the scan pattern for this maneuver?" This would be cruel, like using turtles for speed bumps. I wouldn't want to punish that three pound brain of yours with an exercise that requires as many scan patterns as there are basic flight maneuvers (and there are quite a few, too).

Instead, you only need to remember three steps along with the instrument labeling system I showed you in Figure 13. You'll do the three steps in order every time you want to make a ***major attitude change*** (i.e., climb, descend, turn, enter a climb from a turn, enter straight and level flight from a climb and so on). All three steps together should take approximately 10 to 15 seconds to complete. Figure 23 shows the three steps and the order in which to do them.

I'll speak only of primary instruments in the three-step instrument scan procedure. Any pitch, bank or power instrument that isn't primary becomes a supporting pitch, bank, and power instrument by default.

Here's the big picture of the three steps in action:

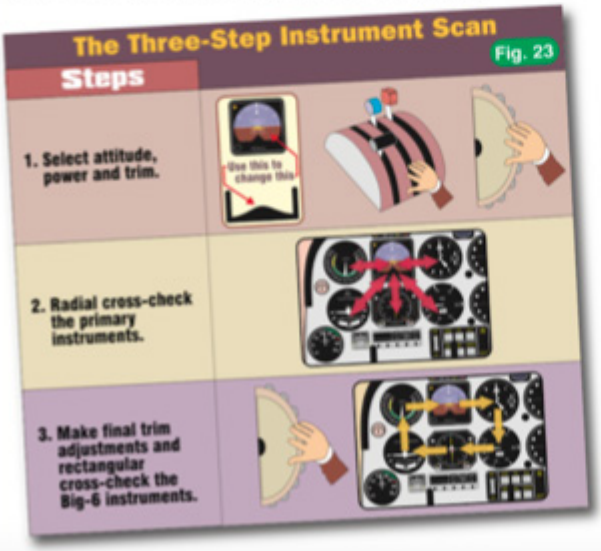
Begin any major attitude change by placing the airplane in the new attitude, adjust the power and trim if necessary, all the while checking that no instrument has failed or is reading erroneously.

Radial cross-check the primary instruments, making small corrections on the attitude indicator if necessary.

Make a final trim adjustment, and then monitor all six flight instruments to maintain the new attitude.

The specific details and reasons for each of the three steps follow.

The Three-Step Instrument Scan Fig. 23

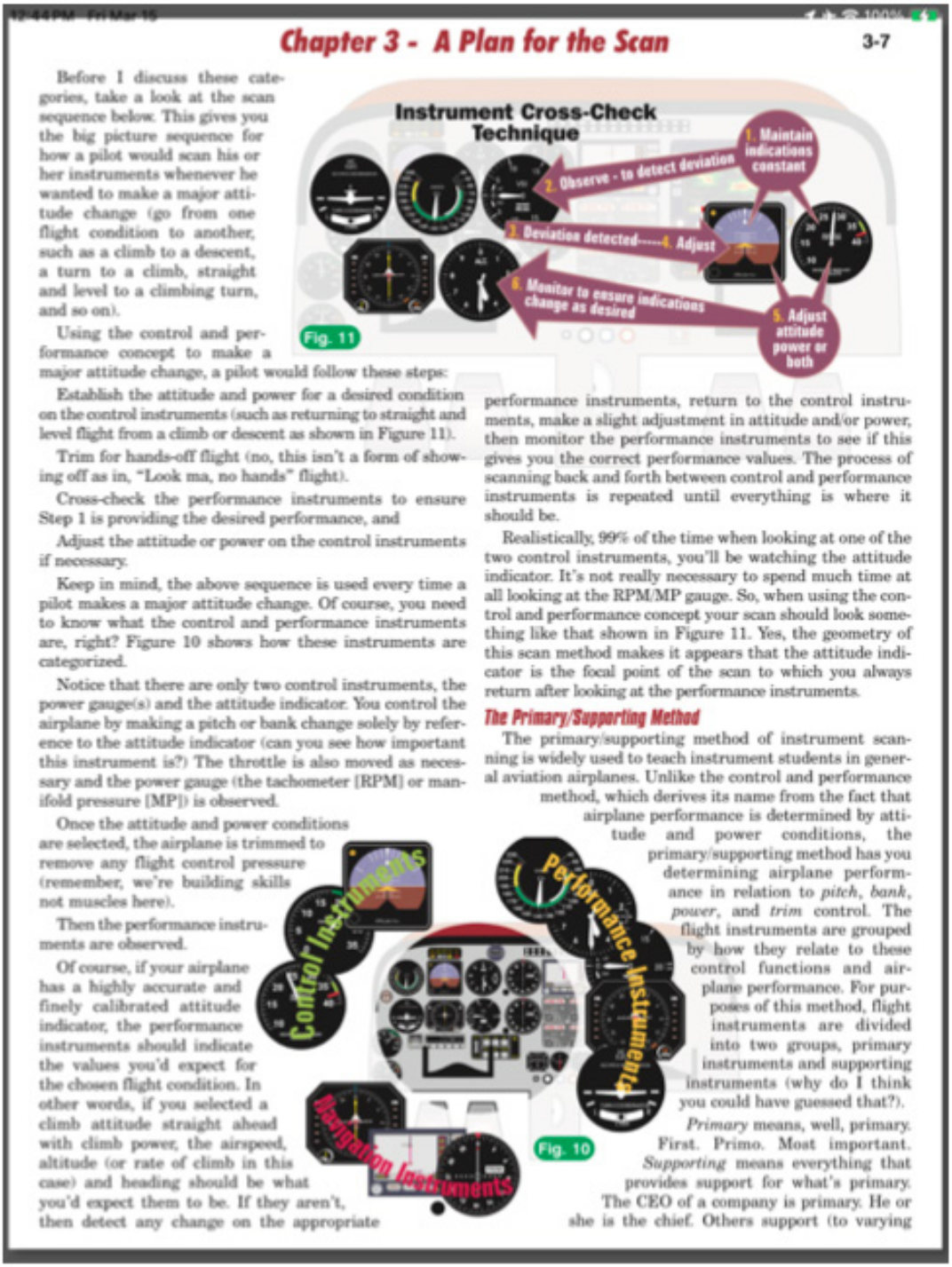


Step 1 of the Three-Step Scan

The first step in the three-step scan is to select the *attitude*, *power*, and *trim* conditions for the new flight attitude and confirm the correct operation of the attitude indicator. This first step is executed by focusing *solely* on the attitude indicator. That's why it's labeled START as shown in Figure 24 (hopefully, someone won't try and start the engine by tapping on this instrument). Select the attitude that your experience says will provide the flight conditions you're after. You don't have to be perfect, just reasonably close.

The big question here is whether it's reasonable to focus your attention on only the attitude indicator when changing attitudes. After all, the attitude indicator could fail and lead you astray (like scanning

Control Performance Method



Before I discuss these categories, take a look at the scan sequence below. This gives you the big picture sequence for how a pilot would scan his or her instruments whenever he wanted to make a major attitude change (go from one flight condition to another, such as a climb to a descent, a turn to a climb, straight and level to a climbing turn, and so on).

Instrument Cross-Check Technique

1. Maintain indications constant
2. Observe - to detect deviation
3. Deviation detected
4. Adjust
5. Adjust attitude power or both
6. Monitor to ensure indications change as desired

Fig. 11

Using the control and performance concept to make a major attitude change, a pilot would follow these steps:

Establish the attitude and power for a desired condition on the control instruments (such as returning to straight and level flight from a climb or descent as shown in Figure 11).

Trim for hands-off flight (no, this isn't a form of showing off as in, "Look ma, no hands" flight).

Cross-check the performance instruments to ensure Step 1 is providing the desired performance, and

Adjust the attitude or power on the control instruments if necessary.

Keep in mind, the above sequence is used every time a pilot makes a major attitude change. Of course, you need to know what the control and performance instruments are, right? Figure 10 shows how these instruments are categorized.

Notice that there are only two control instruments, the power gauge(s) and the attitude indicator. You control the airplane by making a pitch or bank change solely by reference to the attitude indicator (can you see how important this instrument is?) The throttle is also moved as necessary and the power gauge (the tachometer [RPM] or manifold pressure [MP]) is observed.

Once the attitude and power conditions are selected, the airplane is trimmed to remove any flight control pressure (remember, we're building skills not muscles here).

Then the performance instruments are observed.

Of course, if your airplane has a highly accurate and finely calibrated attitude indicator, the performance instruments should indicate the values you'd expect for the chosen flight condition. In other words, if you selected a climb attitude straight ahead with climb power, the airspeed, altitude (or rate of climb in this case) and heading should be what you'd expect them to be. If they aren't, then detect any change on the appropriate performance instruments, return to the control instruments, make a slight adjustment in attitude and/or power, then monitor the performance instruments to see if this gives you the correct performance values. The process of scanning back and forth between control and performance instruments is repeated until everything is where it should be.

Realistically, 99% of the time when looking at one of the two control instruments, you'll be watching the attitude indicator. It's not really necessary to spend much time at all looking at the RPM/MP gauge. So, when using the control and performance concept your scan should look something like that shown in Figure 11. Yes, the geometry of this scan method makes it appears that the attitude indicator is the focal point of the scan to which you always return after looking at the performance instruments.

The Primary/Supporting Method

The primary/supporting method of instrument scanning is widely used to teach instrument students in general aviation airplanes. Unlike the control and performance method, which derives its name from the fact that airplane performance is determined by attitude and power conditions, the primary/supporting method has you determining airplane performance in relation to *pitch*, *bank*, *power*, and *trim* control. The flight instruments are grouped by how they relate to these control functions and airplane performance. For purposes of this method, flight instruments are divided into two groups, primary instruments and supporting instruments (why do I think you could have guessed that?).

Control Instruments
Performance Instruments
Navigation Instruments

Fig. 10

Primary means, well, primary. First. Primo. Most important. *Supporting* means everything that provides support for what's primary. The CEO of a company is primary. He or she is the chief. Others support (to varying

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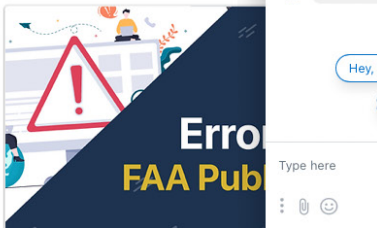

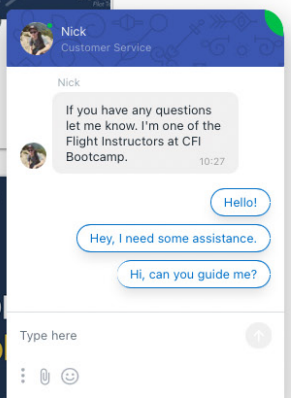

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