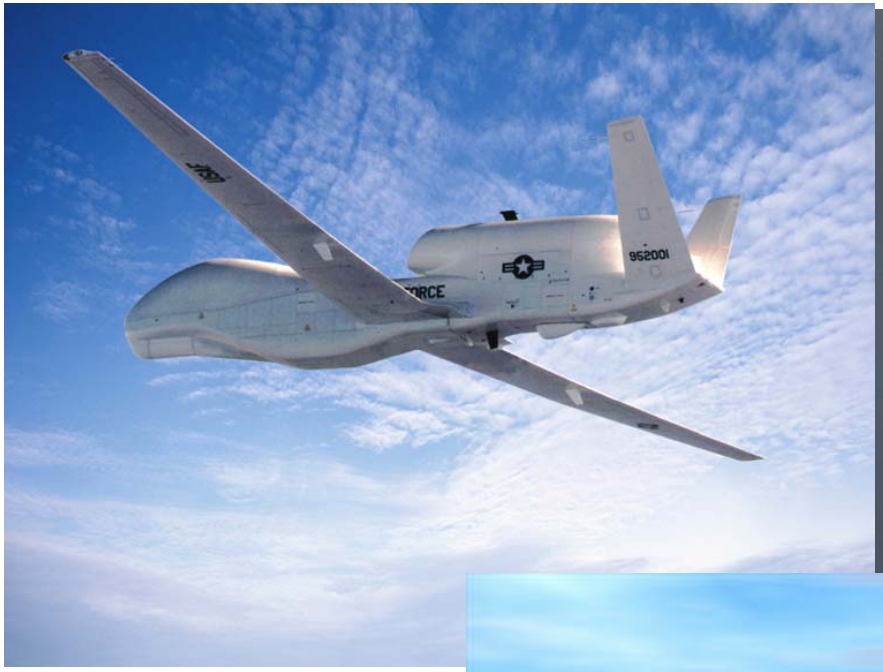
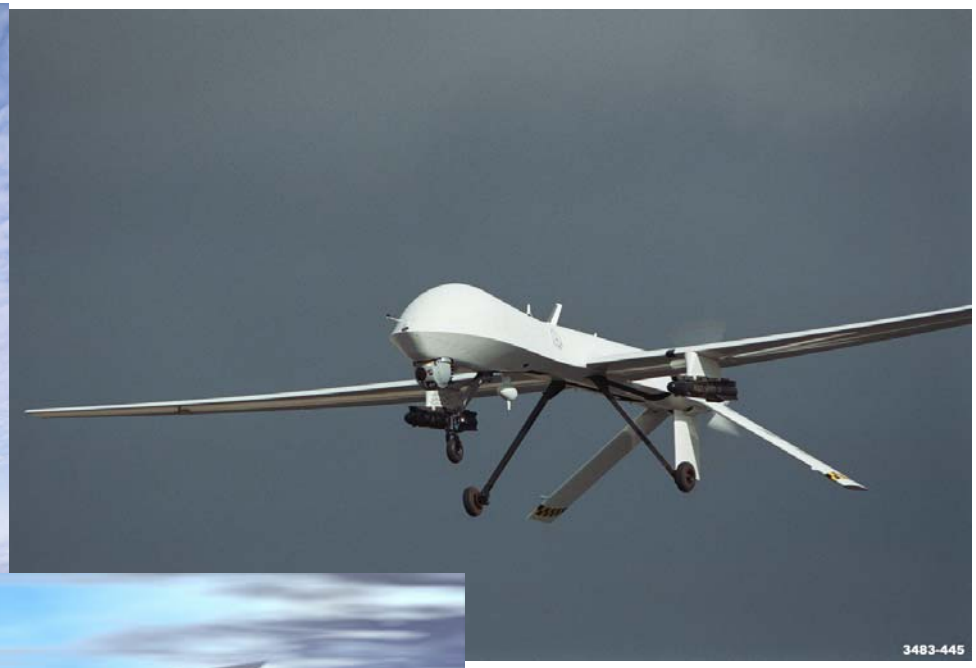
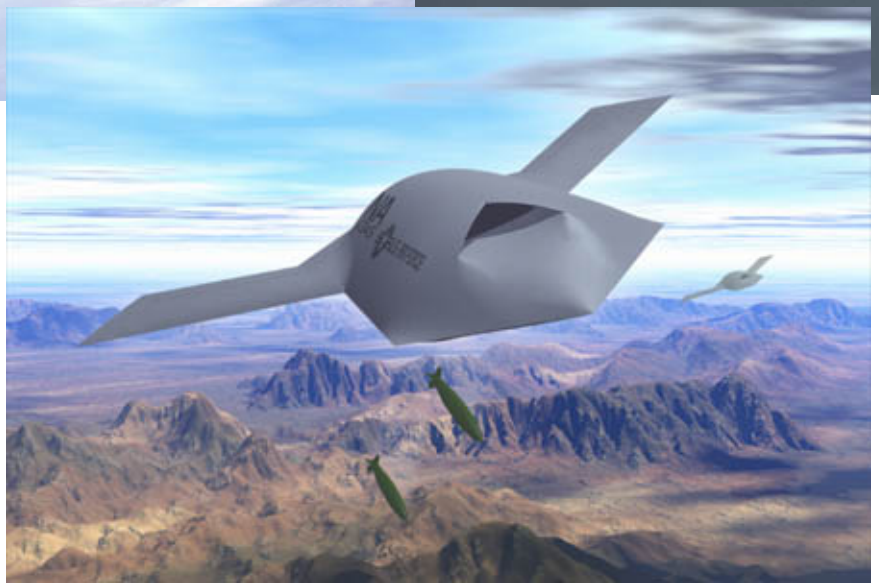
UAVs & 1787







4.1.1 PFR
4.1.1.1 Attitude Awareness

- All crew stations from which a pilot is to control an air vehicle shall have at least one complete set of PFR data. All PFR displays shall provide full-time presentation of critical flight data, to include climb/dive angle (or pitch and vertical velocity), bank, altitude, airspeed, a prominent horizon reference, and any other parameter that is essential to safe flight in a particular aircraft. **YES**

- All PFR displays shall provide an immediately discernable attitude recognition capability that fosters a safe and effective unusual attitude recovery capability. The PFR display shall provide sufficient cues to enable the pilot to maintain full-time attitude awareness and minimize potential for spatial disorientation. The display shall support the initiation of recovery from unusual attitudes within 1 second with a minimum correct response rate of 95 percent. **YES**

4.1.1.2 Fault Indications
4.1.2 Primary Flt Information

- All PFRs shall provide for the positive presentation of unambiguous and complete fault indications for all primary flight information. **YES**

- The PFR in fixed wing aircraft shall provide sufficient information to effectively execute required maneuvers identified in table I. **NO**

Table 1

Required Information	*Maneuver*										
	Instrument Take off	Climb	Cruise	Fix-to-Fix	Hold	Pene-tration	Arc	Non-Precision Approach	Preci-sion ap-proach	Flt Dir Ap-proach	Cat II/III Ap-proach
Precise Pitch Angle	X										
Climb/Dive Angle[1,2]	X	X	X	X	X	X	X	X	X	X	X
Precise Bank Angle	X	X	R	R	X	R	X	X	X	X	X
Approximate Bank	X	X	X	X	X	X	X	X	X	X	X
Barometric Altitude	X	X	X	X	X	X	X	X	X	X	X
Airspeed	X	X	X	X	X	X	X	X	X	X	X
Heading	X	X	X	X	X	X	X	X	X	X	X
Horizontal Flight Path[3]	X							X	X	X	X
Bearing	S	S	S	S	S	S	S	S	S	S	S
Distance	S	S	S	S	S	S	S	S	X	X	X
Lateral Deviation		X	X		X	X		X	X	X	X
Vertical Deviation						M/G			X[5]	X	X
Flight Director										X	X
Timing					S	S	S	S	S	S	X
Absolute Altitude[6]											X
Angle-of-Attack[4]	X	X	X	X	X	X	X	X	X	X	X
Yaw[4]	X	X	X	X	X	X	X	X	X	X	X
Longitudinal Acceleration	R	R	R	R	R	R	R	X	X	X	X
Speed/AOA Deviation	R	R	R	R	R	R	R	X	X	X	X
Vertical velocity	X	X				X		X	X	X	X

4.1.3 Standby Instruments

- At least one set of critical flight data shall remain available to the pilot(s), without additional crewmember action, following any single failure or probable combination of failures, unless it can be shown that probability of loss or corruption of the primary displayed data is extremely remote. **NO**

- In fighter, attack, and trainer aircraft, in normal operations, two independent sources of attitude information shall be displayed to the pilot on two separate attitude displays at all times. A dedicated standby attitude indicator can be one of the attitude displays, although it need not necessarily meet the requirements of a primary flight reference (PFR). If a single failure can cause loss of more than two PFR items (e.g., when all PFR data is on a single display), full-time backup display of primary flight information other than attitude shall also be provided. **NO**

4.1.4 Supplemental Flt Data
4.1.5 Non-PFR Data

- Supplemental flight data is not required in the PFR but shall be in the viewing area of the pilot flying the aircraft. For fixed wing aircraft, this includes power indication, altimeter setting (when monitoring barometric altitude), selected course, and mission timing (e.g., time to waypoint, elapsed time, estimated time of arrival, etc.). **YES**

- Additional information included on PFR display(s) shall not interfere with maintaining attitude awareness, recovering from an unusual attitude, or the interpretation of any primary flight information. **NO**

4.1.6.1 PFR ConOps
4.1.6.2 PFR Arrangement

- A PFR operational concept that is logical and easily understood shall be defined and implemented in the design. **YES**

- Head down primary flight information components, whether presented on one or multiple displays, shall be grouped together and shall be visible from the pilot's normal line of sight with eye movement only (i.e., no head movement shall be required). The attitude display shall be centrally located within the PFR cluster. Airspeed information shall be located to the left of attitude information and altitude information shall be located to the right of the attitude information. Heading information shall be located either above or below the attitude information as required by the mission. **YES**

4.1.6.3 PFR Placement

- HUDs shall be centered horizontally relative to the pilot's horizontal line of sight. Vertical placement of the HUD should enable pilots to perform their crosscheck with eye movement only, all head-down PFR components should be placed within +/- 20 degrees (+/- 15 degrees preferred) above or below the normal line of sight and within +/- 35 degrees (+/- 15 degrees preferred) of the centerline. (Normal line of sight is considered 15 degrees below the horizontal line of sight). **YES**
- A primary flight reference shall be presented and fully visible from the normal eye locations at all times. If the HUD or HMD is designated as the PFR, then a head down, supplementary PFR shall be, as a minimum, selectable with a single control input from the pilot. **NO**

4.1.6.4 Multiple PFRs

- When multiple PFR displays are provided, the different displays shall conform to common display formatting, mechanization, and symbology conventions, except where doing so would unnecessarily constrain or degrade the functionality or quality of the displayed information. The formatting and mechanization conventions used on multiple PFR displays shall facilitate an efficient crosscheck across the displays, shall not present conflicting cues regarding flight parameters, trends, rates of change or display scalings, and shall utilize an intuitive data manipulation scheme. **YES**

4.1.6.5 Integrated Display Formats

- When primary flight information and other mission information are combined on a single display, the information components shall provide a level of compatibility to ensure that the integration of information does not detract from the performance of the mission or compromise the safety of the aircraft. Simultaneous presentation of symbology shall not interfere with the immediate and accurate interpretation of critical information elements, mission maneuvers, and tasks.

YES

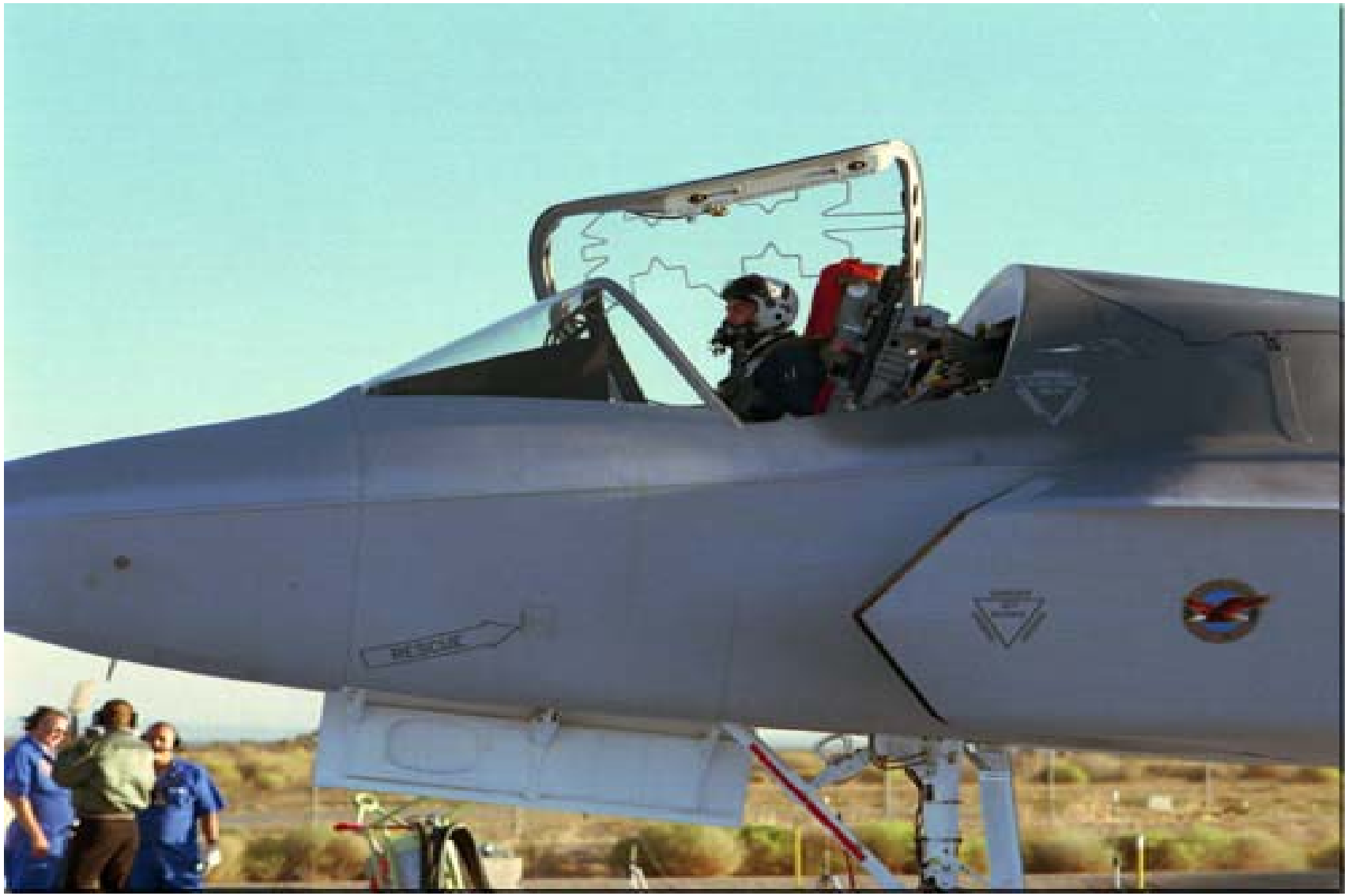
Table 1 Definitions

Required Information	*Maneuver*										
	Instrument Take off	Climb	Cruise	Fix-to-Fix	Hold	Pene-tration	Arc	Non-Precision Approach	Preci-sion ap-proach	Flt Dir Ap-proach	Cat II/III Ap-proach
Precise Pitch Angle	X										
Climb/Dive Angle[1,2]	X	X	X	X	X	X	X	X	X	X	X
Precise Bank Angle	X	X	R	R	X	R	X	X	X	X	X
Approximate Bank	X	X	X	X	X	X	X	X	X	X	X
Barometric Altitude	X	X	X	X	X	X	X	X	X	X	X
Airspeed	X	X	X	X	X	X	X	X	X	X	X
Heading	X	X	X	X	X	X	X	X	X	X	X
Horizontal Flight Path[3]	X							X	X	X	X
Bearing	S	S	S	S	S	S	S	S	S	S	S
Distance	S	S	S	S	S	S	S	S	X	X	X
Lateral Deviation		X	X		X	X		X	X	X	X
Vertical Deviation						M/G			X[5]	X	X
Flight Director										X	X
Timing					S	S	S	S	S	S	X
Absolute Altitude[6]											X
Angle-of-Attack[4]	X	X	X	X	X	X	X	X	X	X	X
Yaw[4]	X	X	X	X	X	X	X	X	X	X	X
Longitudinal Acceleration	R	R	R	R	R	R	R	X	X	X	X
Speed/AOA Deviation	R	R	R	R	R	R	R	X	X	X	X
Vertical velocity	X	X				X		X	X	X	X

Sections

- **Separate section for UAVs or annotate on individual requirements whether applies to UAVs?**
  - ↗**The latter may be the better approach as it reduces "guidance section" duplication**

JSF HMD Issues



JSF

- **No HUD**
- **HMD is a PFR**
- **Standby located on center pedestal**
- **Head down PFR?**

Instrument Panel