

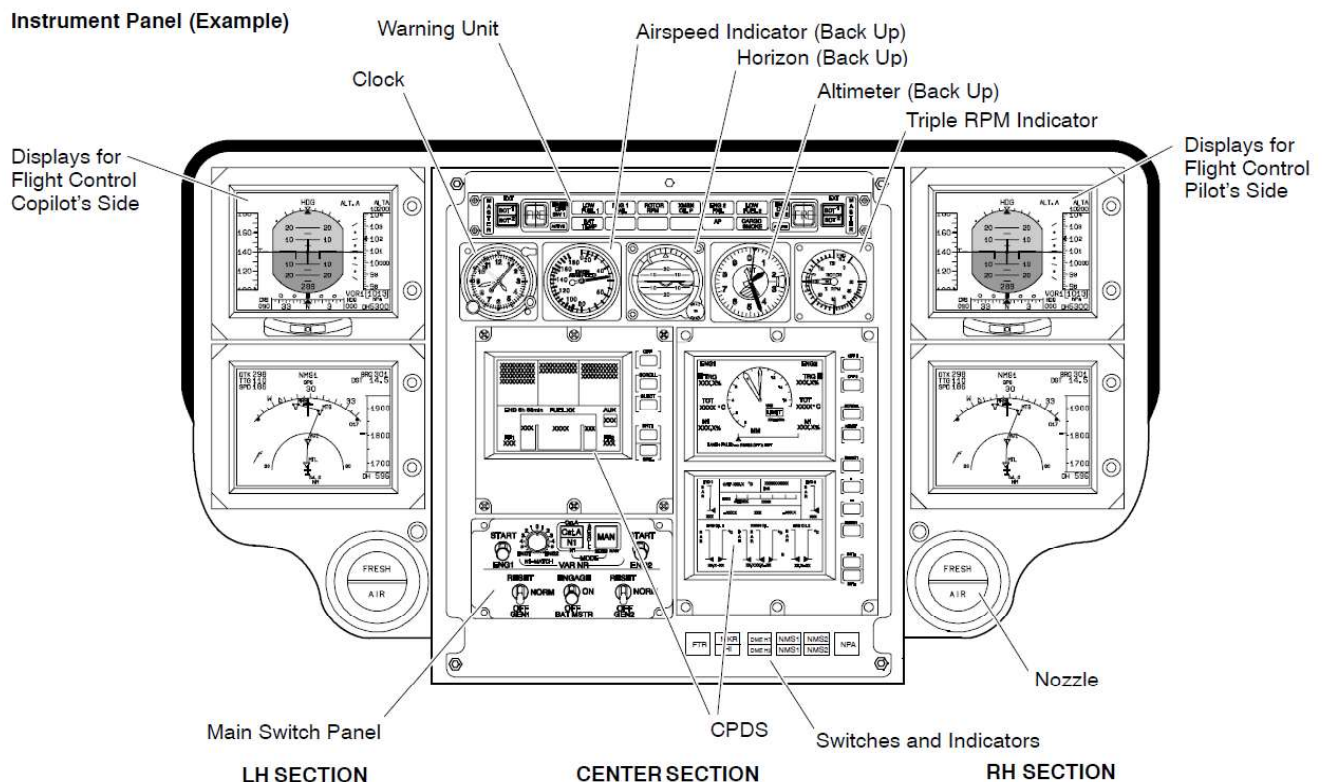
BK117 C-2 (Commercial Name EC145)

Warnings and Cautions

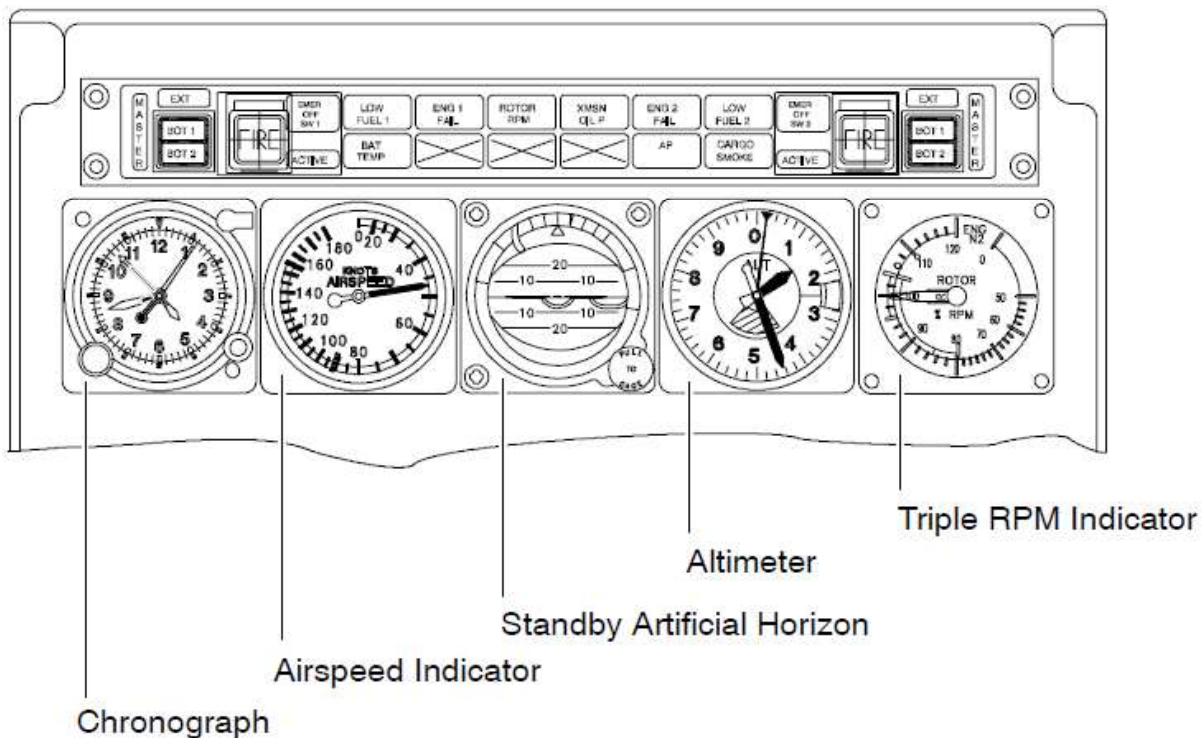
Instrument Panel (typical)

General

The instrument panel contains most of the instruments and some of the control units installed in the helicopter. The configuration of the instrument panel varies according to operators needs and the associated equipment.



Triple RPM Indication



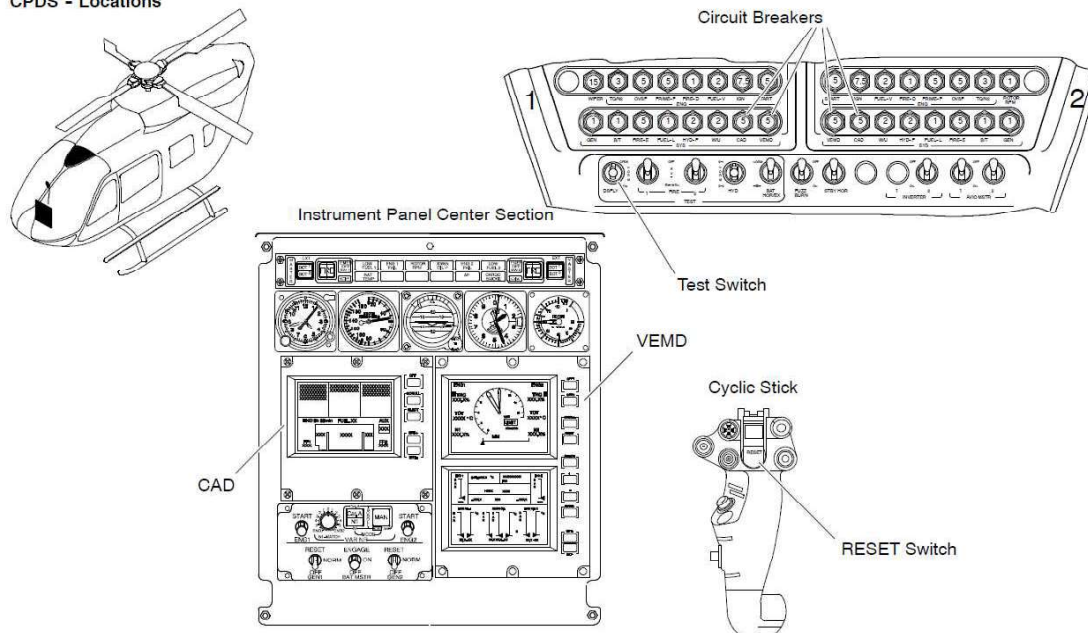
The triple RPM indicator is part of the speed sensing system for the engines and for the main transmission. The indicator has three pointers and indicates

- rotor RPM [%]
- n2 RPM (power turbine speed) of engine 1 [%]
- n2 RPM (power turbine speed) of engine 2 [%]

The indication is given in % of the nominal speed. The indication range is from 0 % to 120 % of the nominal speed. The pointers of the indicator are labeled 1, 2 and R for engine 1, engine 2 and rotor. For easy distinction between engine and rotor RPM, the pointer labeled R is shorter.

Central Panel Display System (CPDS)

CPDS - Locations



General

The Central Panel Display System is an electronic indicating system and presents various parameters of the on-board systems on three screens. Two maintenance connectors are installed to the NON-ESS BUS 2 bracket. The CPDS is supplied with electricity from ESS BUS 1 and 2 via the circuit breakers CAD SYS 1 and 2, VEMD SYS 1 and 2.

The CPDS consists of:

- Caution and Advisory Display CAD
- Vehicle and Engine Monitoring Display VEMD
- test switch CPDS / NORM / W/U
- RESET switch.

CAD (Caution and Advisory Display)

The CAD displays cautions, advisory messages and fuel system indications. If the VEMD fails, the CAD can take over and display selected parameters from it. The display instrument of the CAD consists of a color screen, integrated in the left-hand side of the center section of the instrument panel.

VEMD (Vehicle and Engine Monitoring Display)

The VEMD displays engine and dynamic system parameters. In addition, it can present data relating to on-board systems (e.g. aircraft electrical system, autopilot) and to optional equipment (e.g. cargo hook). If the CAD fails, the VEMD displays selected CAUTIONS. The duplex configuration of the VEMD provides redundancy so that each of the two processing modules are individually capable of taking over all tasks. Both VEMD screens are installed in the right-hand side of the center section of the instrument panel.

Test Switch

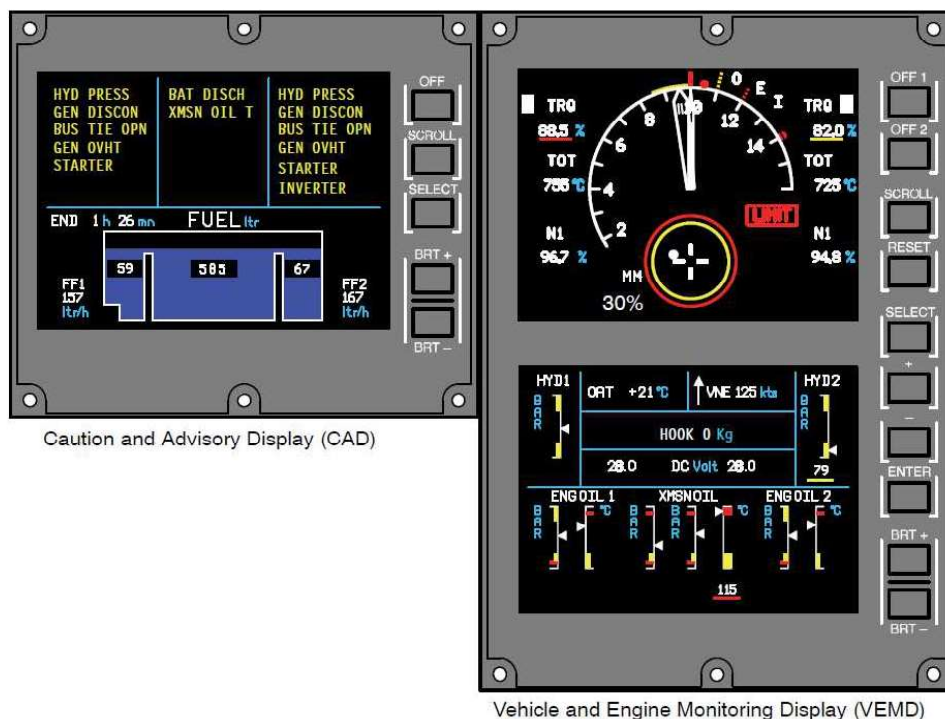
The test switch triggers the CPDS to display the test page with the complete color spectrum and the software version.

RESET Switch

The RESET switch is used by the pilot and copilot to acknowledge displayed cautions. It has the same function as the SELECTkey on the CAD. The switch is installed on the grip of the pilot's cyclic stick and, if dual controls are installed, one is also installed in the copilot's cyclic stick grip.

CPDS

Center Panel Display System CPDS



Vehicle and Engine Monitoring Display (VEMD)

Function of the CPDS

Switch-on Sequence (Power up)

The CPDS is activated as soon as the aircraft electrical system is energized on the ground. An internal self-test and an external self-test are run under the following conditions to establish the functional integrity of the CPDS:

- both oil pressure of the main transmission ≤ 1 bar
- both engine RPM $n1 \leq 50$ %.

While the internal self-test is running, the message TEST IN PROGRESS will be displayed on the CAD / VEMD and the soft- and hardware is checked. After the internal self-test is passed, the external self-test is performed. While the presence of the parameters is verified the message EXTERNAL TEST IN PROGRESS will be displayed on the CAD / VEMD. If an error occurs during the test, INP FAIL will appear at the bottom edge of column MISC and a yellow bar above and below the respective caution will flash. The corresponding caution will appear on the CAD. After 8 seconds, the ACK NEEDED prompt is displayed on the upper VEMD screen. This message has to be acknowledged by the RESET switch on the cyclic stick or the SELECT button on the CAD. During the external test, the wiring of certain sensors is checked with a continuity test (CT). If a failure occurs, the respective sensor is displayed on the CAD as a caution with CT as a supplement.

SYS 1	MISC	SYS 2
ENG CHP CT	XMSN CHP CT	ENG CHP CT
ENG OF CT	XMSN OT CT	ENG OF CT
F FILT CT		F FILT CT

After the external self-test the functional integrity of the peripheral assemblies is tested. After the test has run, the following underlined cautions must be displayed on the CAD:

SYS 1	MISC	SYS 2
<u>ENG OIL P</u>	<u>VAR NR</u>	<u>ENG OIL P</u>
<u>FUEL PRESS</u>	F PUMP FWD	<u>FUEL PRESS</u>
FLI DEGR	F PUMP AFT	FLI DEGR
TWIST GRIP	DOORS	TWIST GRIP
<u>HYD PRESS</u>	EPU DOOR	<u>HYD PRESS</u>
OVSP FAIL	BAT DISCON	OVSP FAIL
<u>GEN DISCON</u>	EXT POWER	<u>GEN DISCON</u>
PITOT HTR		PITOT HTR
		INVERTER

WARNINGS AND CAUTIONS

A **red warning light** on the WARNING PANEL coming on together with a gong signal or dedicated audio signal indicates an emergency condition requiring immediate corrective action.

A **caution indication** on the CAD and two **yellow master caution lights** on the instrument panel indicate malfunction or failure conditions which do not require immediate crew action but the possible need for future corrective action.

The cautions, indicated at the CAD, are divided into three sections, SYSTEM 1, MISC and SYSTEM 2. SYSTEM 1 indicates the operating conditions of the left power plant or the system 1 of a redundant system. SYSTEM 2 provides the same features for the right power plant or the system 2 of a redundant system. MISC indicates the operating conditions of the non-redundant systems.

The yellow master caution lights in the pilot's field of view leads the pilot's attention to the indication(s) on the CAD whenever a caution has been activated there.

Each caution (CAD-indication and master caution light) must be acknowledged by the pilot (copilot) by pushing the RESET button on the cyclic stick grip or the SELECT key on the CAD. When a DECISION height is set and the specific DH audio is heard, this alert must be acknowledged by the pilot flying as well. Acknowledged cautions are indicated in sequence of importance. In case of lack of space on the screen, further confirmed cautions will be stored on additional pages, which will be indicated by the "1 of 2" message on top of the middle column. They can be called up via the SCROLL key. Any new unconfirmed caution overlies the previous caution and is bordered by two flashing lines to draw the pilot's attention to the new caution.

It is always possible that a warning light or caution indication will come on unnecessarily. Whenever possible, check the light or indication against its associated instrument to verify that an emergency condition has actually occurred.

General

The warning unit accommodates ten warning lights. They appear red when illuminated and black when inactive. Each warning light simultaneously initiates a gong.

Audio Warnings

There are four kinds of audio warnings. They have different priority and some of them can be suppressed by the switch CAD AUDIO RES (located on the cyclic stick). But they recommence indicating with each new malfunction indication. The following exist in order of priority:

- **Continuous tone**

The continuous tone has a frequency of approx. 2400 Hz and cannot be suppressed. This tone is only activated by the signal ROTOR RPM $\geq 110\%$

- **Pulsed tone**

The pulsed tone has a frequency of approx. 600 Hz and is generated with a 5 Hz rhythm. can be suppressed. The pulsed tone is activated when ROTOR RPM $< 95\%$.

- **Gong**

The gong is generated every three seconds and can be suppressed. The gong is activated as soon as any warning light illuminates. In the case of ROTOR RPM only if the value of $\geq 106\%$ is exceeded.

- **Warning bell**

Can be suppressed and is activated by fire warning. When there is a rotor RPM warning simultaneously with a fire warning, the warning unit produces the acoustic warning signal for rotor RPM only.

RESET Switch

The RESET switch is used by the pilot and copilot to acknowledge displayed cautions. It has the same function as the SELECTkey on the CAD. The switch is installed on the grip of the pilot's cyclic stick and, if dual controls are installed, one is also installed in the copilot's cyclic stick grip.

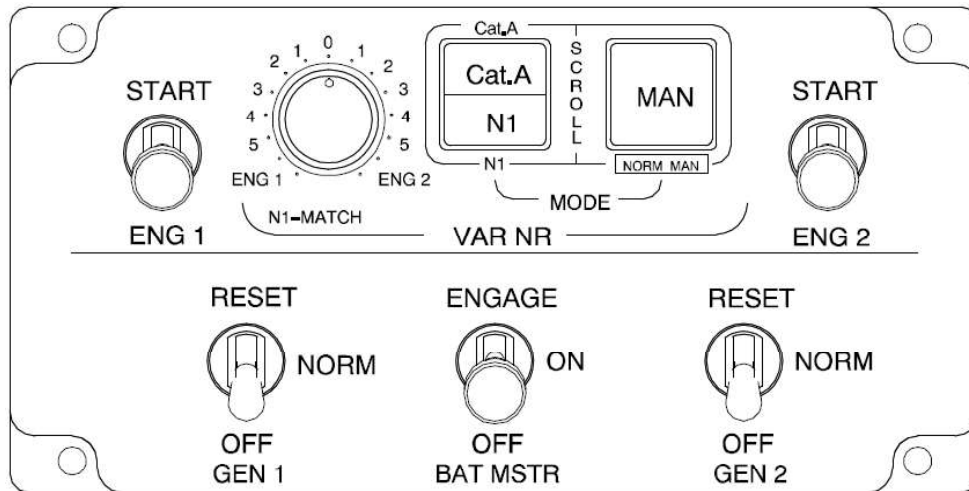
CPDS Cautions

The following CPDS cautions can be displayed on the CAD or VEMD.

No.	SYS 1	MISC	SYS 2
1	ENG OIL P	XMSN CHIP	ENG OIL P
2	ENG CHIP	XMSN OIL T	ENG CHIP
3	FUEL PRESS	VAR NR	FUEL PRESS
4	ENG SPLIT	ROTOR BRAKE	ENG SPLIT
5	FLI FAIL	CPDS OVHT	FLI FAIL
6	FLI DEGR	F PUMP FWD	FLI DEGR
7	FUEL FILT	F PUMP AFT	FUEL FILT
8	ENG O FILT	F PUMP JET	ENG O FILT
9	TWIST GRIP	F QTY DEGR	TWIST GRIP
10	TRAINING	F QTY FAIL	TRAINING
11	FUEL VALVE	BLEED AIR	FUEL VALVE
12	F VALVE CL	DOORS	F VALVE CL
13	PRIME PUMP	EPU DOOR	PRIME PUMP
14	HYD PRESS	BAT DISCON	HYD PRESS
15	OVSP FAIL	BAT DISCH	OVSP FAIL
16	GEN OVHT	EXT POWER	GEN OVHT
17	GEN DISCON	SHED EMER	GEN DISCON
18	INVERTER	HOR BAT	INVERTER
19	FIRE EXT	YAW SAS	FIRE EXT
20	FIRE E TST	CAU DEGR	FIRE E TST
21	BUSTIE OPEN	CAD FAN	BUSTIE OPEN
22	STARTER	VEMD FAN	STARTER
23	PITOT HTR	MM EXCEED	PITOT HTR
24	ENG PA DIS	XMSN CHP CT	ENG PA DIS
25	ENG CHP CT	XMSN OT CT	ENG CHP CT
26	ENG OF CT	HTG OVTEMP	ENG OF CT
27	F FILT CT	P0 DIS	F FILT CT
28		INPUT FAIL	
29		T0 DIS	

Cautions with the letters CT at the end indicate negative continuity test of the respective caution circuit only. If the CAD or one VEMD screen fail only a degraded Caution list is available on the remaining screen.

VAR NR Mode Selector



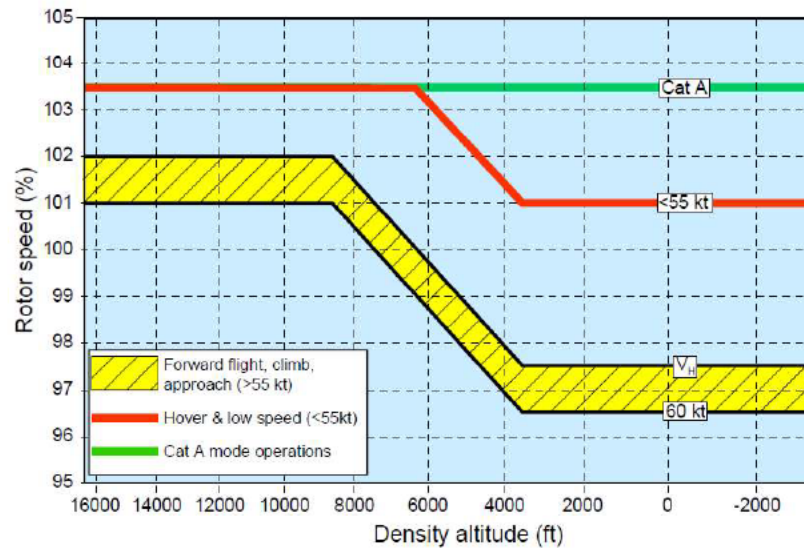
The variable rotor speed and torque matching system controls the rotor RPM as a function of air density and air speed within a given limit. Additionally, the torque of both engines is matched automatically. The mode selector contains two illuminated sequence push buttons and one N1 MATCH knob. The push button is used to select the desired mode. Available modes are:

- **MAN**
- **NORM**
- **Cat.A**
- **N1**
- **Cat.A / N1**

The N1 MATCH knob is used to match the n1 RPM, this function is available with the N1 or the Cat.A / N1 modes.

- Reduces pilots work load by providing automatic torque matching
- Reduces noise and improves performance by varying rotor speed as a function of airspeed and air density
- Improves performance and rotor speed margin in CAT A mode Variable rotor speed
- The NORM mode varies the rotor RPM between 96.5 % and 103.5 % as a function of air density and airspeed.
- At speeds below 55 kts the rotor RPM is controlled between 101% and 103.5 %. Above 55 kts the VARTOMS reduces the rotor RPM and controls it between 96.5 % and 102 %. The torque of both engines is matched automatically.

VARTOMS adjusts the rotor speed according to the density altitude and airspeed as indicate in the diagram.



Digitally signed by: Roland
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DN: CN = Roland Vietzke -
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Aeronautic Defence and Space
Company OU = Employees
and Contractors, AHD
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Roland Vietzke
Air Safety Investigator