

INSTRUMENT

Introduction: - Instrument is a device which can record and indicate various parameters and reading of particular system. Instrument is four types-

- a) Flight instrument.
- b) Eng propulsion & Hyd instrument.
- c) Navigation Instrument.
- d) Miscellaneous Instrument.

FLIGHT INSTRUMENT

Name of flight instrument: -

1.	Altimeter.
2.	VVI
3.	ASI
4.	Attitude Indicator.
5.	S/by Attitude Indicator.

All Flight Instrument located on front instrument panel.

ALTIMETER

Purpose:- It is used to indicate the height of the H/C above the reference point. BELL-212 H/C can indicate from -1000 to +27500 ft.

Principle:- It works on the principle of aneroid barometric pressure. If height increases, pressure will decrease & vice versa.

Pointer:-

Long pointer	No-1
Short pointer	No-2
Triangular pointer	No-3

Barometric scale: - Scale Range 28.1 to 31.0 inch of Hg. Standard sea level pressure being taken 29.92 inch Hg.

Barber pole: It will start disappears from view when Altimeter start operation & it will fully disappear at 16000 ft. It means zero flag disappear from 16000 ft height.

Allowable error: Between pilot & co-pilot +/- 30 ft.

VERTICAL VELOCITY INDICATOR (VVI)

Purpose: It is used to indicate the diving and climbing speed of H/C within a unit time between 0 to 3000 feet/minute and help the pilot to maintain the level flight.

Principle: It works under the static differential pressure/dynamic pressure.

Sensing element: Two very sensitive bellows which expand or collapse with the differential pressure.

VVI has got two others name:

1. Rate of climb Indicator
2. Vertical speed Indicator

Fig:



Indicating part:

Dial: Center position '0'. It is divided into two parts.

Upper scale for climbing.

Lower scale for diving.

1.	Maximum range	=	3500 ft/min
2.	Small division	=	100 ft (0-1000 ft)
3.	Small division	=	500 ft (1000-3500 ft)

Pointer: Only one pointer for both up and down.

Note: Rate of climb for Bell-212H/C is 1000 ft/min.

AIR SPEED INDICATOR (ASI)

Purpose: Air speed indicator is used to indicate the air speed of H/C at any time during forward flight (motion).

Principle: It works on the principle of differential pressure (dynamic pressure). The difference between pitot & static pressure is called dynamic pressure.
Dynamic pressure = Pitot pressure – Static pressure.

Scale: - Single scale is used & calibrated in kts/hrs.

Scale range=0-150 knots.

Small division=5 kts.

1 knot=1.25 miles=1.8 km

There are three color marking (coding) on scale.

1. Yellow =0-25 knts, 100-150 knts.
2. Green=25-100 knts.
3. Red=130-150 knts.

Pointer:- ASI has got only one pointer.

Error:- Allowable error to pilot & co pilot ASI is +/- 5 knts.

ATTITUDE INDICATOR

Purpose:- It indicates the H/C flight attitude relative to the horizontal plane.

Principle:-It works on the principle of pendulous unit & earth gyro.

Earth gyro:- It is used to measure the angular displacement of the H/C in pitching.

Pendulous unit:-It is used to find out the earth plum line & making the gyro spin axis in line in the direction of earth plum line. As a results gyro acts each other.

System component:-

1. Displacements roll & pitch gyro.
2. Rate switching gyro.
3. Attitude indicator.
4. VG first erect switch.
5. TSI (Located in attitude indicator).

Earth Gyro: It is called also transmitter assembly located in left aft electrical compartment (Tarsyn compartment)

Indicator: It has pitching indication, rolling indication, turn and slipping indication, glide slope indication.

- With the help of pitch trim knob dial up to 15^0 and down 10^0 & roll trim knob 15^0 for both.
- Pitch attitude is indicated by the spherical dial motion with respect to miniature A/C.
- Roll attitude is indicated by the motion of the roll pointer with respect to the fixed roll. Scale located at top of the display.
- Horizontal marking indicated the degree of climb or dive.

UP= Climb

DOWN= Dive.

- Bank (roll) angles are red from the semi circular scale located on upper half of indicator. Face
Upper gray color indicated sky
Lower black color indicated ground.

Pitch angle: The included angle between the A/C longitudinal axis and ground level is called pitch angle.

Roll angle/bank angle: the angle that the aircraft rolls about its longitudinal axis called the bank angle.

Drift: it is defined as any movement of the spin axis in the horizontal plane.

Topple: Which is defined as any movement of the spin axis in vertical plane.

Warning flags: Vertical and horizontal COM bar: yellow color disappears when 28V DC power received.

ATT: Attitude.

GS: Glide Slope

FD: Flight Data

RT: Rate of turn

Above warning flags (red) provide for malfunctioning the system.

When red flag comes it re-farce that malfunction occurs in system or circuit.

Main technical data:-

Power supply: 115V AC1Q/28V DC

Earth gyro: AC= 115V 1Q 400cps.

Errection time: 1 minute, within one minute ATT Flag of (pilot & co-pilot) disappears.

VG fast erect button: Power is 28V DC and pressing duration should be 15 sec.

Warning: ATT Flag disappear but the gyro is not become stable at that time VG fast erect button must be pressed for fast errection of gyro azimuth position.

TURN INDICATOR

Purpose: It is indicate the Hel direction of turn and what rate the Hel is turning. Beside it can indicate the accurate bank angle of the Hel in balance turn. (Co-ordinate rate of turn)

Principle: It works on the principle of contradiction between the gyroscopic moment and elastic moment of balance spring.

Construction: Turn indicator system consists of two rate switching gyro one for each side (Pilot & Co-Pilot) located on right side by, color black. Right one for Pilot & left one for Co-Pilot.

Scale: Scale are marked two color black & white and divided into five sector.

Printer: Only one printer color is white which is controlled by self contained electrically actuated gyro (Rate gyro) indicate which direction and what rate the Hel is turning.

W	B	W	B	W
15	15	15	15	15

Power Supply: 28 VDC

SLIP INDICATOR

Purpose: It is used to indicate the Hel side slipping & skidding.

Principle: It works on the principle of gravity and centrifugal force.

Construction: It consists of curbed glass tube containing white ball independently and fixed with clear liquid such as methyl benzene. When the H/C turns with the perfectly coordinated of all control at that time centrifugal force hold the ball in the center of glass tube if the ball moves off center it indicates that the H/C is yawing or slipping (not making coordinated turn).

Slipping: If the gravity is greater than centrifugal force then the ball will move inward & movement will call slipping.

Skidding: During turning if the centrifugal force is greater than gravity then ball will move outward and movement is calling skidding.

Power supply: No supply.

S/BY ATTITUDE IND

Purpose: It is used in the time of main attitude indicator (Same function of A/H).

Principle: It works on the principle of pendulous unit & earth gyro.

Construction: Roll scale, Roll pointer, pitch dial, miniature A/C, miniature A/C position adjusting knob, casing knob, CB & power switch, CB & Power switch located near two batt CB(Right forward of the central pedestal).

Dial: Two sectors, upper color indicate sky & lower brown indicates ground.

Power supply: 24VDC & it is directly connected to the battery.

NAVIGATION INST

1. St/By compass

Purpose: it is used only when the gyro magnetic compass is failed. It indicate heading with the reference of earth magnetic field.

Principle: it works on the principle of earth magnetic field.

Construction: a bowl filled with compass liquid which is refined petroleum, lubber line.

Compass card: it is graduated 0-360°. Small division 5°. Large division 10°. It is located above the wind shield right of H/C.

Error: $\pm 5^\circ$.

Power supply: 5V DC only for lighting system.

2. Gyro magnetic compass

Purpose: The gyro magnetic compass is designed to provide magnetic heading. Two kinds of meridian related to the earth that true meridian and magnetic meridian.

True heading: Angle between the north end and of true meridian clock wise to the A/C longitudinal axis.

Magnetic heading: Angle between the north end of the earth magnetic meridian to the A/C longitudinal axis.

Magnetic meridian: Line joining from the poles is called magnetic meridian.

Principle: It works on the principle of directional gyro. It is measured to the angle with A/C yawing axis.

System component: It is a system consists of following Components.

1. DG Unit.
2. Transmitter flux valve
3. Dual remote compensator.
4. HSI
5. NAV AC S/W.
6. Compass control panel.

1. **DG Unit:** It is located in left aft electrical compartment. Dg unit applies the spin axis rigidly in space of space gyro to measure the correct turning of H/C. It cannot measure the magnetic heading in level flight.

Wander: it is two types-

- (i) Real wonder: Real wonder causes due to friction and unbalance.
- (ii) Apparent wonder: Apparent wonder causes due to earth rotation.

2. **Transmitter flux valve:** it is located inside the tail boom of the H/C. it applies the principle of electromagnetic induction to measure the correct magnetic heading of the H/C in level flight.

XMTR valve no 1 for pilot is located forward in the tail boom and no 2 for co-pilot is located aft of tail boom.

Why it is located in the tail boom: to ensure that its mechanism is subjected to minimum possible unwanted magnetic influence. (Soft iron magnetism)

3. **Dual Remote Compensator:** Dual remote compensator located in the left aft electrical compartment. (Tarsyn compartment)

(i) it is applied to amplify the detuning signal in the compass system measured by magnetic pick-up.

(ii) it is applied to correct the compass deviation.

Screw mark: N-S and E-W compensative screw eliminate quadrantal error of compass.

4. **Compass Control Panel:** separate enunciator MAG-DG S/W synchronises S/W for each gyro magnetic compass. Located compass control panel.

5. **Horizontal situation indicator (HSI):** it consists of course indicator, radio indicator and magnetic compass indicator.

(i) Lubber line: it represents centre of the H/C forward. Magnetic heading is read against the upper lubber line.

(ii) Heading Marker: Movable reference marker set to a selected heading with the heading set knob.

(iii) Course Pointer: movable reference point indicates the selected course knob.

(iv) Course Window: the digital course read out set by the course set knob.

(v) Compass Off Flag: it provides indication of compass malfunctioning. Power supplies 115V AC.

(vi) Course Set Knob: Selects course indicated by course pointer and COURSE window digital readout.

(vii) Heading Set Knob: Selects heading indicated by heading marker.

(viii) Compass Card: dial range from 0-360. Small graduation 0.2, large graduation 1.0.

(ix) A/C symbol: represents aircraft in relation to the compass heading.

6. **NAV AC S/W:** it is used to maintain proper phase relationship for synchro circuit in addition to compass system synchro for VOR/LOC/GS.

Power supply: 115V AC 1Q, 400cps/26V AC 1Q 400cps.

Error:

- Tolerance between pilot and co-pilot $\pm 1^\circ$
- Tolerance between compass and stand by compass $\pm 5^\circ$

- Angular difference between the true and magnetic north is variation.
- Angular difference between the actual magnetic headings of aircraft and that indicated by compass deviation.

ENG PROPULSION INSTRUMENT

Purpose of eng inst: eng inst furnishes information about eng behavior during operation.

Name of eng inst: eng inst furnishes information about eng behavior during operation.

Name of eng inst:

1. Eng oil press & Temp Ind.
2. CGB Oil press & Temp Ind.
3. XMSN Oil press & Temp Ind.
4. Hyd Oil Press & Temp Ind.
5. Dual TQ Ind.
6. ITT Ind.
7. Triple tachometer Ind.
8. Gas producer Ind.
9. Fuel press Ind.
10. Fuel Qty Ind.
11. Fuel flow Ind.
12. Fuel consumption counter/ Totalizer.

1. Eng Oil Press & Temp Ind

Purpose: Eng no 1&2 Oil press & Temp dual type Ind registering pressure (psi) and temperature ($^{\circ}\text{C}$) for each eng.

Principle: Pressure system works on auto syn principle and temperature system works on the variable resistance.

Auto syn: it is a means by which the movements of remote device may be conveyed indicators on the instrument panel.

Principle and operation of auto syn: it works as a transformer action. Power supply 26V AC 1Q 400cps. When the XMTR mechanism is moved the ind pointer flows movement.

Variable resistance: Its resistances can be varied by two methods, manually and electrically.

Temp bulb: If the temp increase resistance will be decrease & Indicator reading will be more. If the temp decrease resistance will be increase & Indicator reading will be decreased.

Construction: It consists of Pressure XMTR ,Temp bulb and Indicator .Total XMTR two ,one for each eng located lower left of eng accessory gear box .Power supply 26VAC 1Q 400cps.Temp bulb located by the side of the XMTR .Total no of ind for eng oil temp and pressure is two, one for each eng.

Power Supply: Pressure =26VAC 1Q 400cps.
Temp =28V DC

Scale : Reading $\times 10$
Scale range =0-150 PSI

Small division =10 PSI
Scale numbered 0,50,100,150 PSI.

Color Coding 3 & 3B Eng:

For 3B Eng		
Red	=	40 PSI
Yellow	=	40-80 PSI (RPM 79%)
Green	=	80-115 PSI
Red	=	115 PSI

For 3 Eng		
Red	=	40 PSI
Yellow	=	40-80 PSI
Green	=	80-115 PSI
Red	=	115 PSI

Temperature: Reading $\times 10^0$ C, scale range -50⁰C to 150⁰C, small division 10⁰C.

For 3B Eng			For 3 Eng		
Red	=	0 ⁰ C	Red	=	0-5 ⁰ C
Green	=	0-115 ⁰ C	Green	=	5-107 ⁰ C
Red	=	115 ⁰ C	Red	=	107 ⁰ C

2. CGB Oil Press & Temp ind

Purpose: purpose of gearbox oil press and temp indication system into measure the press (PSI) and temperature (⁰C) of oil in the reduction gear box.

Principle: Auto syn principle and variable resistance.

Construction: One press XMTR, one indicator and one temp bulb.

Temp bulb: It is located lower position of CGB, powered by 28V DC.

Pressure: it is located upper position of CGB powered by 26V AC 1Q 400cps.

Indicator: located on inst panel and it is dual type, power supply for press 26V AC 1Q 400cps for temperature system 28V DC.

Scale: press: reading $\times 10$ PSI, scale range 0-100PSI, small division 10PSI, scale numbered 0,20, 40, 60, 80, 100 PSI.

For 3B Eng			For 3 Eng		
Red	=	40 PSI	Red	=	40PSI
Yellow	=	40-60PSI(below 94% N ₂)	Yellow	=	40-60PSI
Green	=	60-80PSI	Green	=	60-80PSI
Red	=	80 PSI	Red	=	80PSI

Temperature: reading $\times 10^0$ C, scale range (-50⁰C,) – 150⁰C, small division 10⁰C

For 3B Eng			For 3 Eng		
Red	=	0 ⁰ C	Red	=	0 ⁰ C
Green	=	0-115 ⁰ C	Green	=	0-107 ⁰ C

Red	=	115 ⁰ C & above	Red	=	107 ⁰ C&above
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Note: For normal operation check, apply electrical power to the H/C electrical system verify CGB oil temp indicator read approximately ambient temperature with eng cold.

3. **XMSN oil press & temp ind**

Purpose: It is used to measure the press (PSI) and temperature (⁰C) of XMSN oil.

Principle: It works on the principle of auto syn and variable resistance.

System component: One temp bulb, one Ind and one transmitter.

Temp part: Temperature part receives temperature from a variable resistance type bulb(electrical). Located right portion of the upper XMSN assembly, powered by 28V DC.

Pressure part: Pressure portion indicator receive from XMSN oil press by XMTR which works on auto syn. Located right portion of upper XMSN assembly. Powered by 26V AC 1Q 400cps.

Indicator: Two pointer left for temp and right for pressure.

Scale:

Pressure: Reading × 10 PSI, scale range 0 to 100 PSI, small division 10 PSI

For 3& 3B eng		
Red	=	30 PSI
Yellow	=	30-40 PSI
Green	=	40-70 PSI
Red	=	70 PSI

Temperature: Reading × 10⁰C, scale range (-50⁰C)- 150⁰C, small division 10⁰C.

For 3 & 3B eng		
Green	=	15 ⁰ C-110 ⁰ C
Red	=	110 ⁰ Cand above

Note: For normal operation check apply electrical power to H/C electrical system.

4. **TQ pressure indicating system**

What is TQ: torque is twisting force.

Purpose: The TQ pressure indicator simultaneously displays TQ output of both eng on inner dial and TQ to XMSN (combined TQ of both eng) on the outer dial. The indicator receives TQ indication from Eng-1 and Eng -2. TQ pressure XMTR all indication in percent.

Principle: It works on auto syn principle.

System component: two ind, (one for each side pilot & co-pilot), two XMTR(one for each eng)

Indicator scale:

For 3 & 3B Eng (XMSN TQ twin eng)

Green	=	0-87.5%
Yellow	=	87.5-100%
Red	=	100%(inner scale TQ)

Single Engine (1 &2) TQ					
For 3B Eng			For 3 Eng		
Yellow	=	63.9-79.4%	Yellow	=	63.9-71.8%
Red	=	79.4% (OEI max)	Red	=	71.8% & above

Indicator having three pointer, two long pointer 1 & 2, for single Engine operation and triangular pointer (center pointer) for XMSN TQ both Engine. Small division for Transmission is 2%, Small division single Eng is 1%.

Power supply: 26 VAC 1Q 400 cps

Split: It is the torque difference between No-1 Eng & No-2 Eng.

- The maximum allowable TQ split is 4%

5. **ITT Indicating system**

Purpose: ITT indication system designed to provide the continuous indication of power turbine inlet air temp, received from bayonet type thermocouples mounted between gas producer and power turbine.

Principle:It works on thermocouples principles, when two dissimilar substances are joint together and two ends and one of them heated up an EMF is produced at the hot junction as a result an electrical current continues to circulate in the circuit depending upon the difference of temperature between two junctions and the type of metal.

System components: Indicator, Trim compensator and Thermocouples.

Indicator: The ITT Indicator is moving coil mili volt meter. Located in the cockpit instrument panel, having one pointer for measuring voltage (ITT) produced in the thermocouples and it is calibrated directly in terms of temperature in degree centigrade

<u>Scale: for 3 B Eng:</u>		
Scale graduation	=	0-1090 ⁰ C
Small division	=	600-800 ⁰ C, is 10 ⁰ C, is not uniformly graduated.
Green	=	300-765 ⁰ C (continuous operation)
Yellow	=	765 ⁰ C-810 ⁰ C (5 Minute for takeoff range)
Red	=	810 ⁰ C (Maximum for takeoff)
Yellow	=	822 ⁰ C (Maximum for 30 minute OEI)
Red	=	850 ⁰ C (Maximum for 2,5 minute OEI)
Red	=	1090 ⁰ C (960 ⁰ C, only 2 second for starting)

<u>Scal: For 3 B Eng:</u>		
Green	=	200 ⁰ C-765 ⁰ C
Yellow	=	765 ⁰ C-810 ⁰ C
Red	=	810 ⁰ C

Trim compensator: It is one of the major components of ITT indication system. Located on mounting bracket which is attached to the left & right side of the CGB used to compensate the ITT which are produced by the thermocouples after being compensate and amplify the mili volt conveyed to the indicator through electrical leads.

Note: engine trim value (Temperature of eng metals) which is mentioned in the engine trim data plate. (For individual engine) that is also added with the ITT.

- If trim value increases ITT will be decreased.
- If trim value decreases ITT will be increased.

Thermocouple: bayonet type. Two dissimilar substances.

(i) Alumel “-“ve terminal marked A/L, looks thick.

(ii) Cromal “+”ve terminal marked C/R, looks thin.

Total 8 pair of thermocouples for both PT6T-3 and 3B eng.

Operation: when eng running the ITT comes in contact with the thermocouples a potential difference created across the hot and cold junction. This EMF is supplied to indicator and that will move the pointer.

Power supply: 28V DC.

6. **TRIPLE TACHOMETER (N₁&N₂)**

Purpose: Triple tachometer indicator simultaneously resisters Eng-1 & Eng-2 power turbine and main rotor RPM in percentage.

Principle: Triple tacho meter indicator system works on self generating principle.

System components: Indicator and tacho generator. Indicator is self starting synchronous motor.

Indicator: Having three pointer, UP=Rotor speed(R) center= No-2 Eng(2), lower No-1 Eng(1). Two scale in one indicator, outer scale for Eng RPM and Inner scale for rotor RPM.

Inner scale(Rotor scale)		Outer scale(Eng-2 scale)	
Scale range	= 0-120%	Scale range	= 0-120%
Small division	= 2%	Small division	= 2%
Red	= 91%	Red	= 97%
Green	= 91%to 104.5%	Green	= 97% to 100%
Red	= 104.5% & above	Red	= 100% & above

Generator: Power is provided to the tachometer indicator by three tacho generator mounted on Eng-1 & 2 and transmission respectively. Tacho generator is a three phase AC generator. Proportional to the Eng-1&2 and rotor

Construction: It consists of a permanent magnet rotor around which is three phase stator winding. The rotor shaft is mounted in ball bearing. The one end of the shaft is squared which fit into the engine gear box. The electrical connection from the three stator windings as taken to the receptacle on the generator body.

7. **GASPRODOCUER TACHO INDICATOR**

Purpose: Eng-1&2 gas producer tachometer indicating system resister percent of RPM of Eng-1&2 gas producer speed.

Principle: Gas producer indicating system works on self generating principle.

System component: Indicator and tacho generator.

Indicator: One indicator for each eng located in cockpit engine instrument panel. Indicator having small indicator inside it for linner percentage of RPM. It has one pointer to indicate the gas producer turbine or compressor turbine in percentage.

Scale for 3B Eng: Reading x %, small division 2%, large division 10%. Scale range.....

Green	=	61%-101.8%(continuous operation) 61%-100.8%(" ")
Red	=	101.8%-103.4% (2.5minutes for OEI) 100.8%-102.4 %(" ")
Red	=	103.4% (Maximum OEI) 102.4% (" ")
<ul style="list-style-type: none">• 12% minimum for opening throttle during start• Flight idle RPM		

Note: Two triangular marks are given in the N₁ indicator

For 3 Eng		
Green	=	55%-100%
Red	=	100%
Maximum 101.5%not to exceed for 10 second		

Generator: Gas producer generator (Tacho) one for each eng. It sends voltage signal to respective indicator proportional to the engine 1&2 gas producer speed.

8. FUEL PRESSURE IND SYSTEM

Purpose: Engine1& 2 fuel pressure indicating system is used to measure the fuel pressure of No1&2 Eng (PSI)

Principle: Auto synchro.

System components: Two XMTR & two indicators.

Fuel pressure XMTR: Receives pressure from No-1&2 engines. Located LT& RT side compartment.

Indicator: On cockpit inst panel.

Scale range: 0-50 PSI. Small division 1PSI. Green= 4-35 PSI, Red= below 4 PSI &above 35 PSI.

Power:-26V AC 1Q 400cps.

9. FUEL QUANTITY INDICATING SYSTEM

Purpose: Fuel quantity indication system provides reading of the fuel supply quantity in total pounds as determined by position of fuel quantity selector switch (Lt, Rt & total).

Principle: It works on capacitance principle. (The capacitance of a capacitor of fix dimensions is depend upon the dielectric constant of the substance between the plate.fix dimension= plates are set at a fixed distance apart in a container.)

System components: It consists of the following components-

1. Capacitor probe
2. Simulator
3. Selector switch
4. Indicator.

Capacitor probe: Capacitor probe (fuel quantity gauge probe) act as a tank unit installed in fuel cell. Which have a variable value depending on the dielectric between the plates. Variation of capacitance can be achieved by changing the dielectric between the plates. Dielectric = insulation between the plates. When the container (fuel cell)is empty the dielectric between plates is air termed empty capacitance. When fuel is added to the tank the air displaced and tank unit capacitance will increase from empty to a higher capacitance value. In Bell-212 hel the total number of capacitor probe is 05 without 45 kit fitted. If 45 kit fitted then number of capacitor probe become 07.

Definition of capacitance: Capacitance is the ability /property of a capacitor to store electrical energy/electricity into it capacitor are two types-fixed & variable.

Variable capacitor: Variation of capacitance can be achieved by three factors-

1. Varying the effective area of the plates.
2. Varying the distance between the plates.
3. Changing the dielectric between the plates.

Fuel cell & position of capacitor probe: Fuel system consists of five fuel cells two are self sealing and three non self sealing. Two forwarded fuel cells located horizontally under the cabin floor. Capacity for each cells are 44 US gallons. Three aft cells located vertically aft of the cabin head. Capacity outer two 33 US gallons for each and middle cell 66 US gallons.

Total quantity: $44+44+33+66+33 = 220$ US gallons= 1409 Lbs
(Note: - 1Liter= 1.72 Lbs, 1 Gallon=3.7854Liter)

Fuel Capacity: With additional cell 44 kit (small tank) fitted fuel capacity become 1700Lbs (260US gallons each kit capacity 20US gallon) with 45 kit (large tank) fitted fuel capacity become 2600Lbs (400US gallon each kit capacity 90US gallon)

Simulator: Simulator is switch box which are used to complete the indicating circuit when additional cells 45 kits are fitted.

Selector switch: Selector switch are used to provide for checking fuel quantity in left &right fuel cell. It has got three positions (Lt, Total & Rt). Left & Right positioned are used for checking the fuel quantity of left and right fuel cells. (less than 270lbs or

more than 300lbs). When the selector switch set to total position (centre) will indicate total quantity of fuel in the hel.

Indicator: In model Bell-212 hel for indicating fuel quantity two types of indicator are used. Scale range from 0-1900& 0-2900lbs.

Indicator 0-1900 Lbs: One small division = 100 Lbs.

Indicator 0-2900Lbs: One small division = 50 Lbs.

Power supply: 26V AC 1Q 400cps.

Fuel low level warning: Fuel low level warning light will illuminate when

1. If there is little or no fuel in the cells at that time low level fuel switches will be closed and caution lights will illuminate.
2. If cell have less than 10% of the basic fuel at that time fuel low level switch will be closed and fuel low level warning lights will be extinguished.
3. When either 'fuel low' light illuminates inter connect switch should be 'OPEN'. This will be allowed fuel quantity in lower tanks equalized.

FUEL FLOW INDICATOR & TOTALIZER/ CONSUMPTION COUNTER SYSTEM

Purpose: It is used to indicate the rate of fuel flow per hour.

Principle: impeller type (propeller can be done by the fuel flow)
System components; it consists

1. Fuel flow XMTR
2. Signal conditioning unit
3. Indicator
4. Totalizer

Fuel Flow XMTR: fuel flow XMTR produce voltage signal (milivolt) by the propeller movement which are done by the fuel flow throw the XMTR and produce voltage signals may conveyed to the signal conditioning unit through electric cables.

Signal conditioning unit : signal conditioning unit one of the major component of fuel flow indicating system. It has got two junction point (J1& J2) through junction J1 voltage signal (mili volt) enters to the signal conditioning unit from XMTR and after being amplified that signal go to fuel flow indicator& consumption counter through J2
Totalizer (consumption): totalizer is used to indicate the consumption of the fuel. It shows in digit.

Power supply: required power supply is 28V DC for system.

HYDRAULIC PRESSURE AND TEMPERATURE INDICATOR

Purpose: Hydraulic instrument furnish information about hydraulic behavior (press& temp) during its operation.

Principle: Pressure portion works on auto synch principle. Temperature works on variable resistance principle.

System component:

1. Hydraulic pressure transmitter
2. Temperature bulb
3. Indicator.

PRESSURE TRANSMITTER: Indicator receive pressure reading from two hydraulic pressure transmitter. Located in the pylon compartment (no-1)and in the first hale hole (no-2). Powered by 26V AC 1Q 400 CPS.

TEMPERATURE BULB: Indicator receive temperature reading from two temperature bulb. Located in the hydraulic reservoir. Powered by 28V DC.

INDICATOR: Indicator having two scales, one for temperature. Graduated in degree (⁰) and another for press. Graduated in PSI. It also has two pointers for temperature & pressure.

POWER SUPPLY: For pressure 26V AC 1Q 400 CPS.
For temperature 28V DC.

Scale range: pressure reading into 100PSI

Scale range	:	0-1500PSI
Small division	:	100 PSI
Scale numbered	:	0

Red	=	600 PSI
Yellow	=	600-900 PSI
Green	=	900-1100 PSI
Red	=	1100 PSI

Temperature reading into ⁰C

Scale range	:	(-50 ⁰ C) to 150 ⁰ C
Normal operating Range	:	(+0 ⁰ C) to - 88 ⁰ C
Red	:	88 ⁰ C

MISCELLANEOUS INSTRUMENT

1. Hel clock
2. OAT
3. Eng hour meter

Clock

Helicopter clocks are 8days type clocks with added stop watch feature for elapsed time. The clock has a sweep-second pointer and a minute-totalize pointer to indicate elapsed time up to one hour. A control knob on the case starts the pointers when pressed, stops both the pointer when pressed a second time and rests both pointers to clock 12 o'clock position, when pressed a third time.

OUTSIDE AIR TEMPERATURE INDICATOR (OAT)

Purpose: The bi-metallic probe type free air temperature or outside air temperature indicator is used to indicate the temperature of free air / outside air in degree centigrade/ degree Fahrenheit.

Principle of operation: A helical spring wound with a strip of two dissimilar alloys welded together will wound or unwound if subjected to change in temperature. Because the alloys have different co-efficient of expansion and contraction.

General description: Indicator mounted at top of right wind-shield. The bi-metallic probe portion is exposed to outside temperature through the wind shield and is protected by a sunshield.

Indicator data: The indicator provides a direct reading of outside air temperature in degree celcius and Fahrenheit. Having one pointer for both the scale and two scales in one indicator. Out scale for degree centigrade and inner scale for degree Fahrenheit.

Scale in Fahrenheit			Scale in celcius		
Scale range	=	-95 ⁰ F to 120 ⁰ F	Scale range	=	-70 ⁰ C to 50 ⁰ C
Small division	=	5 ⁰ F	Small division	=	2 ⁰ C

ENGINE HOUR METER

Purpose: It is used to record the cumulative number of hours that the engine has operated at flight revolutions per minute (RPM).

General description: Engine hour meter is mounted on right side of pedestal near the floor. Hour meter clock mechanism is calibrated in hours. With the engine running and rotor RPM above 90.6% the hour meter will operate (also CGB oil pressure 40 PSI). With the loss of eng oil pressure (below 40 PSI) or rotor RPM bellow 90.6%, the hour meter will cease the function.

System components: It consists of

1. Indicator
2. CGB oil pressure switch
3. Hour meter relay
4. Circuit breaker.

Power supply: 28V DC.