## Exercise 4 Effects of Controls

AIM: To teach the effects of controls in forward flight

**T.E.M.: LOOKOUT, Handling of controls between pilots**

Primary Effects of Controls - Conducted with the Governor ON

### CYCLIC
- Controls Main Rotor Disc -- Controls Aircraft Attitude in pitch & roll
- Light – Sensitive – Not Self Centering – Lag between input and movement
- Right Hand, gently hold, rest wrist on knee
- Move, then Centralise
- Rate of Cyclic movement = Rate of Aircraft movement

| CONTROL | PRIMARY EFFECTS | | | SECONDARY EFFECTS |
|---|---|---|---|---|
| Cyclic Forward | Nose ↓ | Airspeed ↑ | MAP ↓ (DUE TO GOVERNOR) | Height ↓ |
| Cyclic Aft | Nose ↑ | Airspeed ↓ | MAP ↑ (DUE TO GOVERNOR) | Height ↑ |
| Turn Left | Nose ← | Airspeed - | MAP - | - |
| Turn Right | Nose → | Airspeed - | MAP - | - |

### COLLECTIVE LEVER
- Increases & Decreases Main Rotor PITCH
- Increases & Decreases Main Rotor THRUST
- Increases & Decreases Main Rotor DRAG
- Left Hand, hold, do not grip tightly

| CONTROL | PRIMARY EFFECTS | | SECONDARY EFFECTS | |
|---|---|---|---|---|
| Lever Up | Height ↑ | MAP ↑ | Nose ↑ | Yaw → |
| Lever Down | Height ↓ | MAP ↓ | Nose ↓ | Yaw ← |

### PEDALS
- Increases & Decreases Tail Rotor PITCH
- Increases & Decreases Tail Rotor THRUST
- Increases & Decreases Tail Rotor Drag
- Balance in flight
- Use toes to control, not leg movements

| CONTROL | PRIMARY EFFECTS | | SECONDARY EFFECTS |
|---|---|---|---|
| Left Pedal | Yaw ← | MAP - | Roll ← Nose ↓ ASI ↓* |
| Right Pedal | Yaw → | MAP - | Roll → Nose ↓ ASI ↓* |

\* Airspeed Indicator reduces because Error caused by disturbed airflow through the Pitot Tube, actual Airspeed does not change

## Exercise 4 Effects of Controls

### Carb. Heat
- There are several variants of the R44, some with Carburettor Engines, some types are fuel injected.
- The Carburettor Engines require CARB HEAT, whilst the Fuel Injected Engines do not.
- The R44 type is indicated by a Placard on the console, Pilots Operating Handbook and Carb. Temperature Gauge.
- Carb. Heat should be used to maintain the Carb. Temperature Gauge Out of the **YELLOW** arc at all times.

### Mixture
- The mixture control regulates the fuel flow to the engine.
- It is located in different places depending on the Type of R44 you fly.
- It is **GUARDED** to prevent inadvertent usage in flight
- It should only be used in flight in accordance with the Pilots Operating Handbook

### Low RPM Horn & Light
- The R44 is equipped with a Low RPM Horn and Light.
- **It is activated when RRPM is at, or below, 97%**
- It must be operable for flight
- If activated in flight the pilot must take immediate steps to restore RRPM
- To restore RRPM Lower Collective Lever and Roll On Throttle

### Hydraulics
- Some types of R44 have Hydraulic assist.
- The Type will be indicated by the HYD switch on the Cyclic, Pilots Operating Manual, or by checking the Hydraulic System.
- The switch should normally be ON before engine start.
- It should not be turned off except for Hydraulics Off training and actual Hydraulic failures
- The Collective Friction is normally only used on ground

### Rotor Brake
- This is to slow the rotor blades after engine shut down
- Excessive pulling force on the rotor brake can damage the Rotor Brake Shoes.
- It must not be used in flight
- You must **not** use the collective to slow the blades after engine shut down

### Frictions
- The Cyclic and Collective have Friction Controls, the Pedals do not have and Friction Control
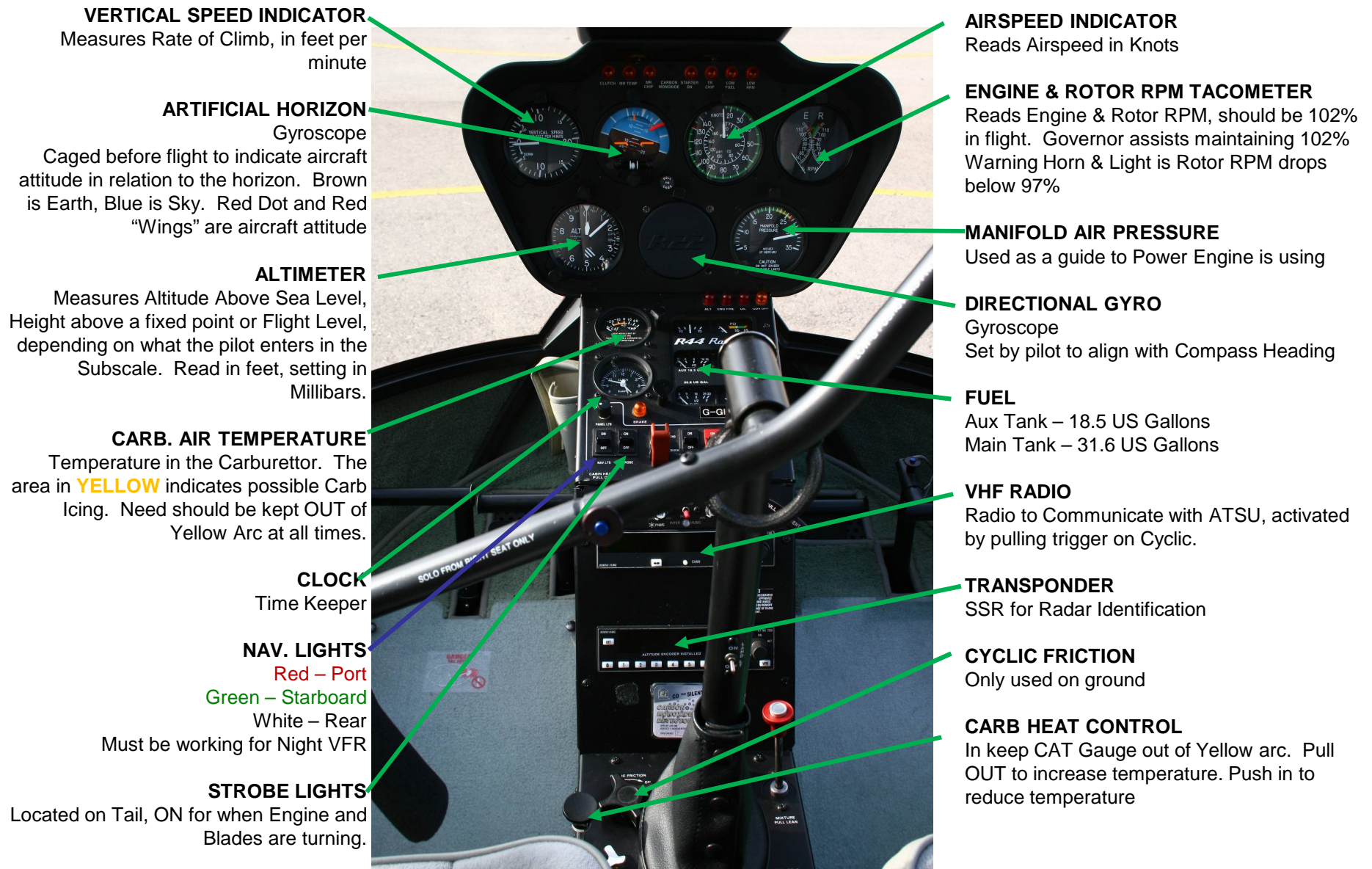- The Cyclic Friction control is normally only used on ground

### Correlator
- Correlator is a mechanical linkage from the Collective Lever to the Engine, as the lever is raised the Correlator increases Engine RPM and MAP.
- When the lever is lowered it reduces Engine RPM and MAP. It is 95% effective, especially between 16" MAP and 23" MAP
- Below 16" MAP the Correlator OVER COMPENSATES
- Above 23" MAP the Correlator UNDER COMPENSATES

### Governor
- The Governor is an electrical system that senses ERPM changes and applies the necessary THROTTLE adjustment to maintain the correct constant ERPM
- The Governor is only used to fine tune the ERPM that the Correlator does not do and maintain a constant 102% ERPM.
- **The Governor switch is located on the end of the Collective. It should always be ON for flight (except in case of training or actual failure).**
- **The aircraft must not be flown with an inoperable Governor**
- **The Governor is only active above 80% RPM**

# Exercise 4 Effects of Controls
## Helicopter Instruments RAVEN II

**VERTICAL SPEED INDICATOR**
Measures Rate of Climb, in feet per minute

**ARTIFICIAL HORIZON**
Gyroscope
Caged before flight to indicate aircraft attitude in relation to the horizon. Brown is Earth, Blue is Sky. Red Dot and Red "Wings" are aircraft attitude

**ALTIMETER**
Measures Altitude Above Sea Level, Height above a fixed point or Flight Level, depending on what the pilot enters in the Subscale. Read in feet, setting in Millibars.

**CARB. AIR TEMPERATURE**
Temperature in the Carburettor. The area in YELLOW indicates possible Carb Icing. Need should be kept OUT of Yellow Arc at all times.

**CLOCK**
Time Keeper

**NAV. LIGHTS**
Red – Port
Green – Starboard
White – Rear
Must be working for Night VFR

**STROBE LIGHTS**
Located on Tail, ON for when Engine and Blades are turning.

**AIRSPEED INDICATOR**
Reads Airspeed in Knots

**ENGINE & ROTOR RPM TACOMETER**
Reads Engine & Rotor RPM, should be 102% in flight. Governor assists maintaining 102% Warning Horn & Light is Rotor RPM drops below 97%

**MANIFOLD AIR PRESSURE**
Used as a guide to Power Engine is using

**DIRECTIONAL GYRO**
Gyroscope
Set by pilot to align with Compass Heading

**FUEL**
Aux Tank – 18.5 US Gallons
Main Tank – 31.6 US Gallons

**VHF RADIO**
Radio to Communicate with ATSU, activated by pulling trigger on Cyclic.

**TRANSPONDER**
SSR for Radar Identification

**CYCLIC FRICTION**
Only used on ground

**CARB HEAT CONTROL**
In keep CAT Gauge out of Yellow arc. Pull OUT to increase temperature. Push in to reduce temperature

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## Safety Notice SN-25

Issued: Dec 1986    Rev: Jul 2012

### CARBURETOR ICE

Avoidable accidents have been attributed to engine stoppage due to carburetor ice. When used properly, the carburetor heat and carb heat assist systems on the R22 and R44 will prevent carburetor ice.

Pressure drops and fuel evaporation inside the carburetor cause significant cooling. Therefore, carburetor ice can occur at OATs as high as 30°C (86°F). Even in generally dry air, local conditions such as a nearby body of water can be conducive to carburetor ice. When in doubt, assume conditions are conducive to carburetor ice and apply carb heat as required.

For the R22 and R44, carburetor heat may be necessary during takeoff. Unlike airplanes which take off at full throttle, helicopters take off using power as required, making them vulnerable to carburetor ice. Also use full carb heat during run-up to preheat the induction system.

On aircraft equipped with the carb heat assist system, the control knob should be left unlatched unless it is obvious that conditions are not conducive to carburetor ice.

Carburetor heat reduces engine power output for a given manifold pressure. Approximately 1.5 in. Hg additional MAP is required to generate maximum continuous power (MCP) or takeoff power (TOP) with full heat applied. The additional MAP with carb heat does not overstress the engine or helicopter because power limits are still being observed. Since the engine is derated, it will produce TOP at lower altitudes even with full heat. However, avoid using more heat than required at high altitudes as the engine may reach full throttle at less than MCP or TOP.

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## Safety Notice SN-31

Issued:  Dec 96

### GOVERNOR CAN MASK CARB ICE

With throttle governor on, carb ice will not become apparent as a loss of either RPM or manifold pressure.  The governor will automatically adjust throttle to maintain constant RPM which will also result in constant manifold pressure. When in doubt, apply carb heat as required to keep CAT out of yellow arc during hover, climb, or cruise, and apply full carb heat when manifold pressure is below 18 inches.

Also remember, if carb heat assist is used it will reduce carb heat when you lift off to a hover and the control may require readjustment in flight.

# Effects of Controls – Common Errors

- Using Cyclic to climb / descend
- Using Collective to accelerate / decelerate
- Looking inside too much – horizon!