REVISION	CHANGE	APPROVED	DATE
1	Published release	JTS	27/11/2025

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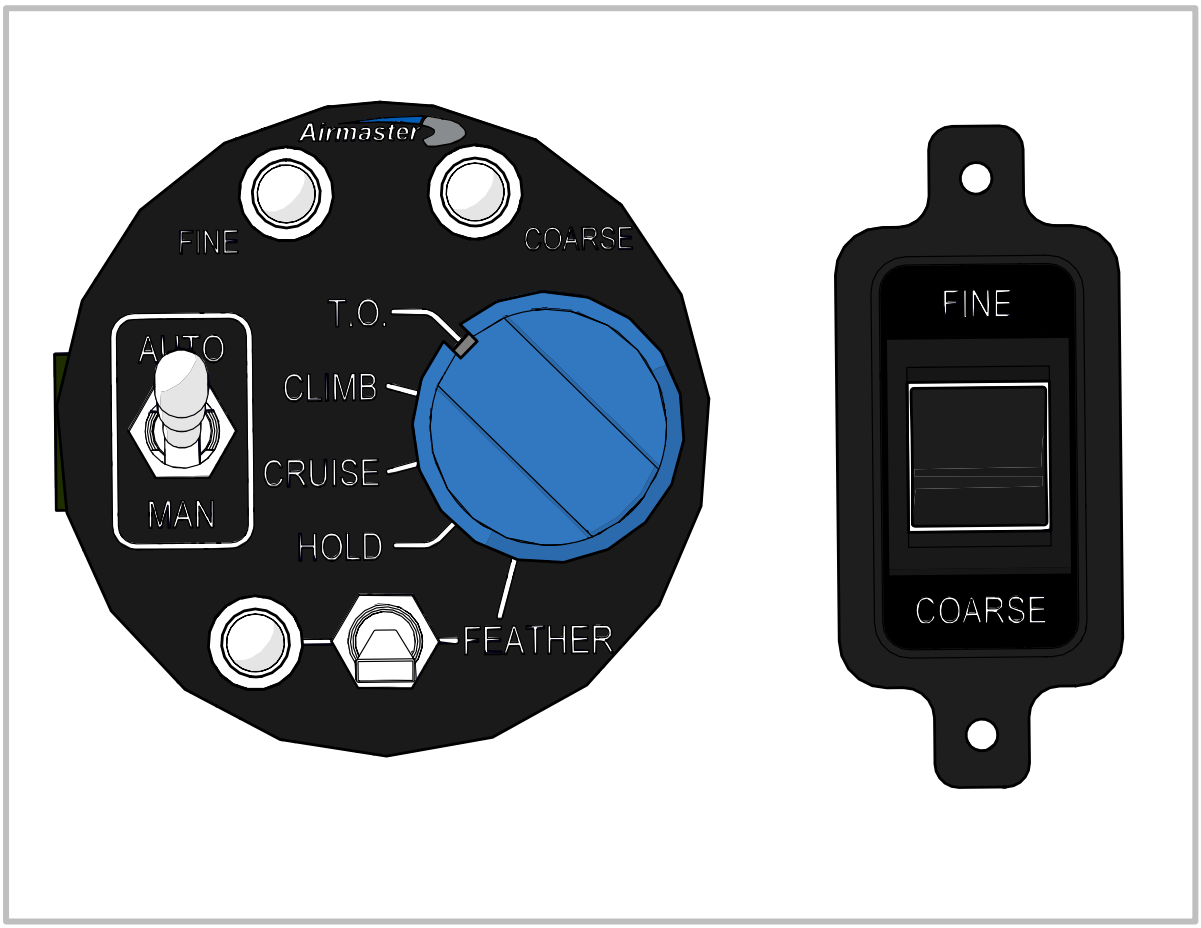
ASI-6-1-2

PROPELLER CONTROLS & FUNCTIONS

GUIDE



SUBJECT:	
Operation of Controller	
ASSEMBLY NO:	**APPLICABILITY:**
A0110x or A0170x	All propeller models

1. TOPIC

1.1 Introduction

This document covers the controls and functions of the Airmaster AC200 and AC300 ‘SmartPitch’ controller used to operate the Airmaster propeller system.

2. PROPELLER CONTROLS

2.1 Description of Controller

The AC200 and AC300 controller are digital governors developed for use with the Airmaster propeller system.

The controller is supplied with the propeller’s control system assembly (AC-xxx), which also includes the manual control switch. Together, these components enable cockpit-based control of propeller pitch, supporting constant speed function, in-flight adjustable pitch function and (optional) special pitch functions such as feathering, reverse, pre-rotation or remote facilities.

While the functionality, controls and operation of both AC200 and AC300 controllers are similar, they are not interchangeable:

- The AC200 controller is designed for use with DC versions of the Airmaster propeller system.
- The AC300 controller is designed for use with digital servo-drive (DSD) versions of the Airmaster propeller system.

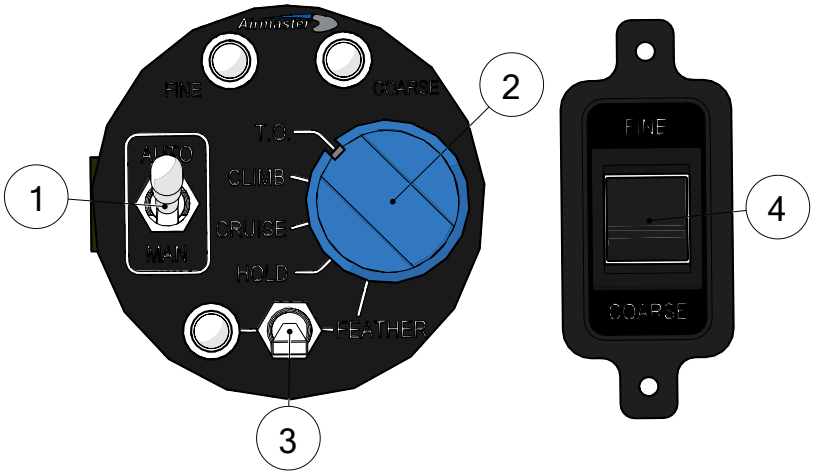


Figure 1. *Propeller Controls (AC200 feathering controller shown) and Manual Control Switch.*

[1] Control Mode Selector

[2] Control Setting Selector

[3] Engage Switch (Option)

[4] Manual Control Switch

2.2 Controls

2.2.1 Control Mode Selector

The control mode selector is a latching switch located on the left side of the controller front panel. It is used to toggle between automatic and manual pitch control modes:

- **AUTO (Automatic Mode):**
  Enables constant speed control where the propeller maintains a preset target RPM based on the selected control setting (i.e. T.O, CLIMB, CRUISE or HOLD).
  Special pitch functions (e.g. feather or beta) are also activated in automatic mode (if applicable).

- **MAN (Manual Mode):**
  Bypasses automatic functions and therefore constant speed control will not occur (the control setting selector becomes inactive). Propeller pitch is directly controlled by the pilot by exercising the manual control switch (FINE / COARSE).

> ⓘ *Note* *Manual mode can be used as a fall back in the event of a controller failure.*

Figure 2. *Control Mode Selector (AC200 feathering controller shown).*

2.2.2 Control Setting Selector

The control setting selector is a rotary switch located on the right side of the controller front panel. It is used to select a desired constant speed setting or special pitch function (e.g. feather or beta, if applicable). This knob is blue to conform to standard aviation conventions for propeller controls.

> ⓘ *Note* *This switch has no function while the propeller is operated in MAN (manual) mode.*

Figure 3. *Control Setting Selector (AC200 feathering controller shown).*

2.2.3 Engage Switch (Option)

The engage switch is a momentary lever switch located at the bottom of the controller front panel. It is used in combination with the control setting selector to activate special pitch functions (e.g. feather or beta, if applicable).

To actuate the engage switch, lift it upward. The switch will return to its default position when released.

Figure 4. *Engage Switch (AC200 feathering controller shown).*

2.2.4 Manual Control Switch

The manual control switch is a two-position momentary switch spring-loaded to the central or 'off position'. It is a separate part to the controller and may be mounted elsewhere in the cockpit. It is used to directly control propeller pitch either in manual mode (MAN), or in automatic hold setting mode (AUTO / HOLD).

When held in the FINE or COARSE position, propeller pitch is continuously adjusted in the selected direction selected until a pitch limit stop is reached.

- **FINE:**
  Decreases propeller pitch, thus increasing engine/propeller speed [RPM].

- **COARSE:**
  Increases propeller pitch, this decreasing engine/propeller speed [RPM].

Figure 5. *Manual Control Switch.*

3. PROPELLER FUNCTIONS

3.1 Constant Speed Function

3.1.1 Constant Speed Control

All Airmaster propellers facilitate constant speed control. This is where the controller automatically adjusts ("governs") propeller pitch to maintain a target engine/propeller speed (RPM) within a specified tolerance.

To enable constant speed control:

- Select AUTO.
- Select desired constant speed setting using the control setting selector.

> ⓘ *Note*
> *A built-in 'deadband' tolerance defines the allowable deviation from target RPM before pitch adjustments are made by the propeller. Generally, this tolerance is +/- 60rpm for rotax engines, and +/-30rpm for direct drive engines.*

3.1.2 Constant Speed Selections

The controller offers four primary selections for constant speed operation. These include three fixed preset settings for common flight phases (T.O, CLIMB, CRUISE), and one adjustable setting (HOLD). These settings can be modified by the operator.

- **T.O (Take-Off):**
  Sets the propeller to maintain a preset target RPM suitable for take-off (typically near the engine's maximum permissible RPM, less a safety margin) This allows maximum power to be produced and may be used for go-arounds.

- **CLIMB:**
  Sets the propeller to maintain a preset target RPM optimized for sustained power during climb (typically just below the maximum continuous RPM permissible for the engine). This allows sustained high power to be produced.

- **CRUISE:**
  Sets the propeller to maintain a preset RPM designed to balance air speed and fuel economy during normal cruising operation. Default values are selected based on the specific aircraft, engine and propeller combination.

- **HOLD:**
  Allows the pilot to manually select, store and maintain a new target RPM in-flight (within prescribed maximum and minimum limits). This allows an ideal engine/propeller speed for cruising operation in particular conditions.

  When the hold setting is selected, the manual control switch is used to adjust RPM (e.g. toggle FINE to increase RPM). Once the switch is released, the current RPM is stored by the controller, and the controller will govern propeller pitch to maintain that RPM. This HOLD setting is retained in memory by the controller while power is maintained; and reverts to a default preset at shutdown.

> ⓘ *Note* *For more information on adjusting these settings, refer to procedure* ***ASI-7-2-1***.

3.1.3 Constant Speed Settings

The propeller's constant speed settings are programmed into the controller and recorded in the following locations:

- Propeller logbook.
- "AC_00 Firmware & Parameters Sheet" (provided in the propeller assembly documentation).

Operators should update these values in these locations whenever they are modified. Typical preset settings for common engine types are shown below.

ENGINE SPECIFICATION		PRESET SPEED SETTING [RPM]			ENGINE LIMITATIONS	
ENIGNE MAKE	**ENGINE MODEL**	**T.O**	**CLIMB**	**CRUISE**	**Max Speed [RPM]** (5min Max)	**Max Cont. Speed [RPM]**
ROTAX	**91*x***	5700	5400	5000	5800	5500
EDGE PERFORMANCE	**EP91*x***	5700	5400	5000	5800	5500
UL	**260i(*x*)**	3000	2800	2700	3300	2800
	350i(*x*)	3000	2800	2700		
	390i(*x*)	3000	2800	2600		
	520i(*x*)	3000	2800	2600		
	520T	2700	2550	2400		
JABIRU	**2100**	3300	3000	2800	3300	3150
	3300	3300	3000	2800		
	5100	3300	3000	2800		
LYCOMING	**O-235**	2700	2550	2400	2800	2600
	(I)O-320	2700	2500	2400	2700	2700

WARNING *Some RPM ranges may have known resonance. Always verify with Airmaster.*

Note
The tachometer supplied with some engines can be inaccurate. If governed speeds appear different to that indicated in the propeller logbook, an independent check on the tachometer accuracy should be conducted before further investigation. An optical tachometer may be useful for this purpose.

3.2 Feather Pitch Function (Option)

3.2.1 Feather Facility

The feather facility is an option for Airmaster propellers, it enables the propeller to attain a feather pitch angle (typically around 81°), which exceeds the standard coarse pitch limit. This is designed to minimize drag and maximize gliding distance in the event of an engine failure.

- Feather operation can be performed either automatically or manually.
- The propeller can automatically return to normal pitch after the feather operation.
- A 2-stage activation is required to prevent inadvertent activation of automatic feather operation.

> *Note*
> *Feather facility is represented by controller parameter: Control Word (000) = 0 (Control Type: Feather).*

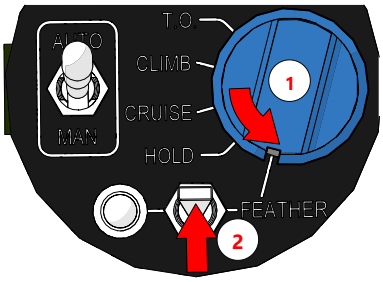
3.2.2 Automatic Feather Operation

During automatic feather operation, the propeller automatically adjusts pitch beyond the coarse pitch limit and stops at the feather pitch limit.

PROCEDURE

Step 1 **Automatic Feather Operation**

- Select AUTO / FEATHER.
- Actuate the engage switch.



> *Note*
> *For more information on the correct response during automatic feather operation, refer to* ***ASI-5-1-1****.*

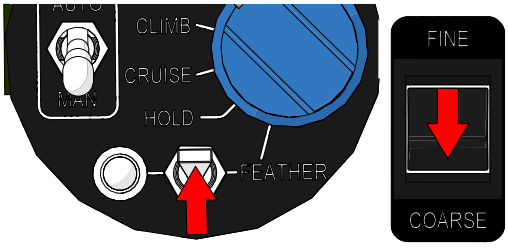
3.2.3 Manual Feather Operation

During manual feather operation, the propeller is manually adjusted into the feather pitch region (beyond the coarse pitch limit) using the manual control switch and will stop at the feather pitch limit.

PROCEDURE

Step 1 **Manual Feather Operation**

- Select MAN.
- To adjust propeller into feather pitch region:
  - Lift and hold up the engage switch,
  - Toggle COARSE on manual control switch.



> *Note*
> *For more information on the correct response during manual feather operation, refer to* ***ASI-5-1-1****.*

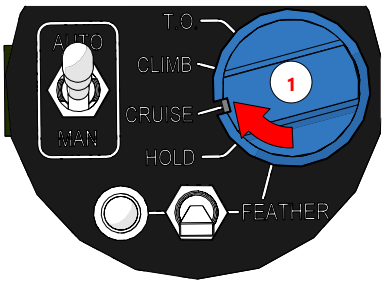
3.2.4 Automatic Return Operation

During automatic pitch return operation, the propeller automatically drives out of the feather pitch zone and returns to the normal pitch zone (halts at coarse pitch stop).

PROCEDURE

Step 1 **Pitch Return Operation**

- Select AUTO / CRUISE.



> *Note*
> *For more information on the correct response during pitch return operation, refer to* ***ASI-5-1-1****.*

3.3 Beta (Reverse) Pitch Function (Option)

3.3.1 Beta Facility

The beta (reverse) facility is an option for Airmaster propellers, it enables the propeller to attain beta pitch angles (typically -20°) which are below the normal fine pitch limit. This provides reverse thrust, which may be useful for amphibious aircraft.

To prevent inadvertent activation of beta operation, multiple safeguards are in place:

- A two-stage activation is required: beta engage, then beta drive. The propeller must also be intentionally driven into the beta pitch region by use of the manual control switch.
- The controller prohibits either stage from occurring if engine speed exceeds a defined limit (see par 400 and 404) which would not normally be encountered in flight.
- A mechanical hard stop (centrifugal throw-out arm) prevents adjustment in the beta pitch direction if engine speed exceeds a limit which would not normally be encountered in flight.

Note
The beta facility is represented by controller parameter: Control Word (000) = 8 (Control Type: Beta).

WARNING
The beta facility is not designed for air braking. This is not possible due to RPM lockout restrictions.

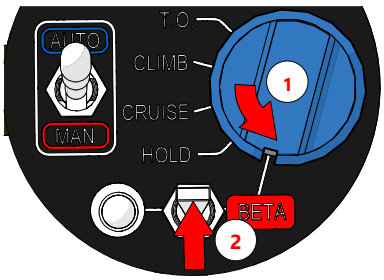
3.3.2 Beta Operation

The propeller is manually adjusted into the beta pitch region using the manual control switch.

PROCEDURE

Step 1 **Beta Engage Operation**

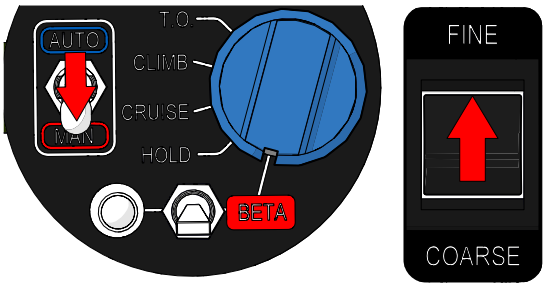
- Ensure that engine speed is below the maximum beta_engage rpm (see par 400).
- Select AUTO / BETA.
- Actuate the engage switch.



Note
*For more information on the correct response during beta engage operation, refer to **ASI-5-1-1**.*

Step 2 **Beta Drive Operation**

- Ensure that engine speed is below the maximum beta_run rpm (see par 404).
- Select MAN.
- Toggle FINE on the manual control switch to adjust propeller into beta pitch region.



> *Note*
> *For more information on the correct response during beta drive operation, refer to **ASI-5-1-1**.*

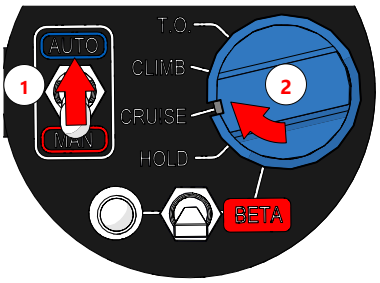
3.3.3 Automatic Return Operation

During automatic pitch return operation, the propeller automatically drives out of the beta pitch zone and returns to the normal pitch zone (halts at coarse pitch stop).

PROCEDURE

Step 1 **Pitch Return Operation**

- Select AUTO / CRUISE.



> *Note*
> *For more information on the correct response during automatic beta-exit operation, refer to **ASI-5-1-1**.*

3.4 Pre-Rotate Pitch Function (Option)

3.4.1 Pre-Rotate Facility

The pre-rotate facility is an option for Airmaster propellers, it enables the propeller to attain (near) neutral pitch angles which are below the normal fine pitch limit (approximately 0°). This provides minimal drag for the purposes of achieving maximum pre-rotation speed during run up for autogyro aircraft.

To prevent inadvertent activation of pre-rotate operation, multiple safeguards are in place:

- A two-stage activation is required: pre-rotate engage, then pre-rotate drive. The propeller must also be intentionally driven into the beta pitch region by use of the manual control switch.
- The controller prohibits either stage from occurring if engine speed exceeds a defined limit (see par 400 and 404) which would not normally be encountered in flight.
- A mechanical hard stop (centrifugal throw-out arm) prevents adjustment in the beta pitch direction if engine speed exceeds a limit which would not normally be encountered in flight.

> *Note*
> *The pre-rotate facility is represented by parameter: Control Word (000) = 48 (Control Type: AutoGyro).*

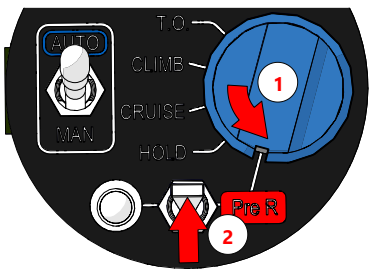
3.4.2 Pre-Rotate Operation

The propeller is manually adjusted into the (near) neutral pitch region using the manual control switch.

PROCEDURE

Step 1 Pre-Rotate Engage Operation

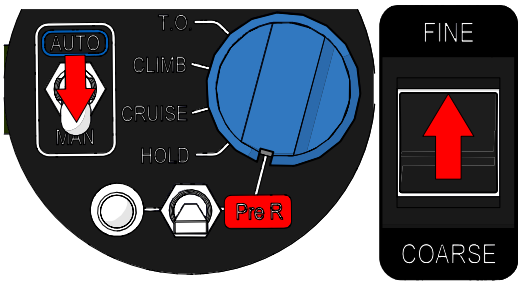
- Ensure that engine speed is below the maximum beta_engage rpm (see par 400).
- Select AUTO / PRE-ROTATE.
- Actuate the engage switch.



> *Note*
> *For more information on the correct response during pre-rotate engage operation, refer to **ASI-5-1-1** (same response as beta operation).*

Step 2 Pre-Rotate Drive Operation

- Ensure that engine speed is below the maximum beta_run rpm (see par 404).
- Select MAN.
- Toggle FINE on the manual control switch to adjust propeller into neutral pitch region.



> *Note*
> *For more information on the correct response*

*during pre-rotate drive operation, refer to **ASI-5-1-1** (same response as beta operation).*

3.5 Remote Control Function (Option)

3.5.1 Remote Facility

The remote facility is optional for Airmaster propellers, it enables remote command of the propeller controller by an external computer via a serial RS232 link at 19,200 baud. This facility requires a specific setting of controller parameters and the use of a separate remote-control program.

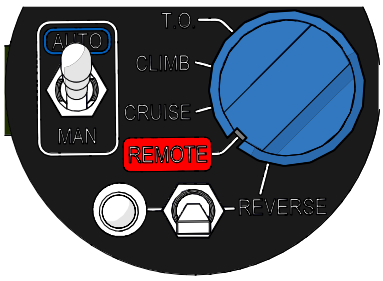
3.5.2 Enable Remote Operation

Remote control operation can be enabled for applicable controllers as follows:

PROCEDURE

Step 1 **Enable Remote Control**

- Select AUTO / REMOTE.



Note
This may be AUTO / HOLD depending on the panel sticker.

Note
Remote Control (300) parameter must be set to 3. Other parameters are available to configure the time and frequency at which packets of status data are sent from the controller.

Note
*For more information on the remote command set and further use of this facility, refer to **APL-TD-10**.*