

# Jabiru J230-D Hand Control Modifications

By David Jacka



## **Introduction**

The following report details the hand control equipment and other minor adaptations that have been undertaken to allow a quadriplegic to independently and safely control a Jabiru J230D aircraft in the air and on the ground from the left side only. The new equipment items are non structural components and the existing controls can be overridden as necessary. All existing controls remain on the right hand side.

The main elements of the new hand control equipment include motorised throttle control, hand steering on the rudder/nose wheel, pneumatic brake operating system, electric trim, and other minor modifications such as replacing flap toggle switches to push button and relocated carburettor heat lever.

The wiring used is aircraft grade and all work has been undertaken by a Level 2 Maintenance Authority.

## **Throttle Control**

The functionality of the existing throttle control system has not been modified and can be operated manually as intended. A motorised system has been installed to allow control of the engine via sucking or puffing on a tube.

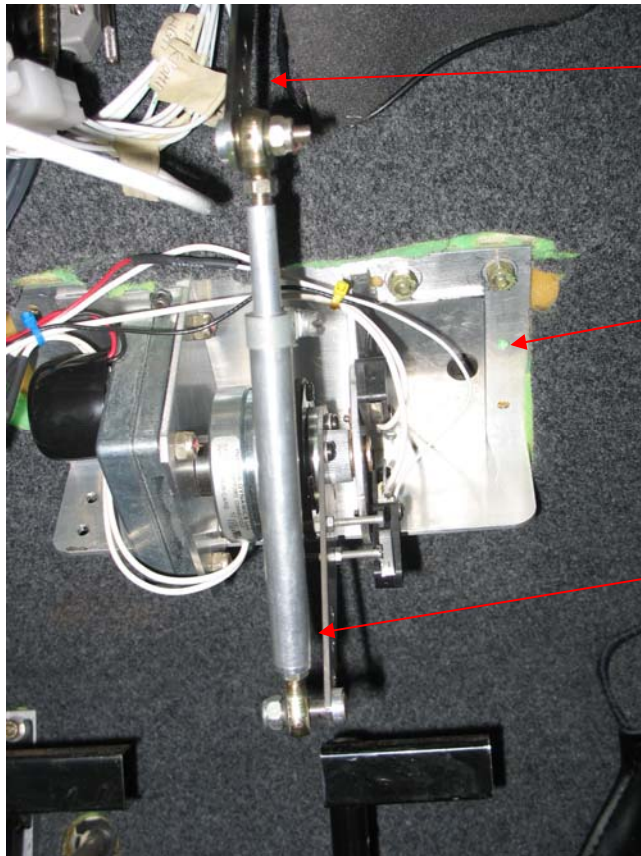
The motorised system comprises of a 12V DC motor (3.4 rpm) coupled with an electromagnetic 12V DC clutch installed under the dash on the fire wall. A lever arm is connected to the clutch, and another clamped to the high mount throttle cross shaft inside the dash panel. These are connected by a connection rod.

Limit switches are located either side of the lever arm on the clutch. When the arm runs to the end of rotation (approx 60 degrees) and contacts the limit switch, power is shut off to the motor and clutch in that direction. The system will allow the motor and clutch to reverse in the opposite direction.

The throttle is then controlled by a Sip & Puff system comprising of two pneumatic switches and relays housed in a box. From the Sip & Puff box a plastic tube is used to either sip or puff air through it, activating either of the pneumatic switches in turn changing the polarity of the power supply to the motor, allowing it to rotate forward or reverse. This inturn drives the high mount throttle cross shaft either throttling up/down the aircraft engine. The system is configured so if you puff on the tube the engine will throttle up, and if you sip on the tube it will throttle down. When you stop the input the system stops immediately allowing incremental adjustments to the throttle. From idle to full throttle the time of travel is approximately 3 seconds.

The sip & puff tube is attached to the mike boom to allow quick and easy access when needed.

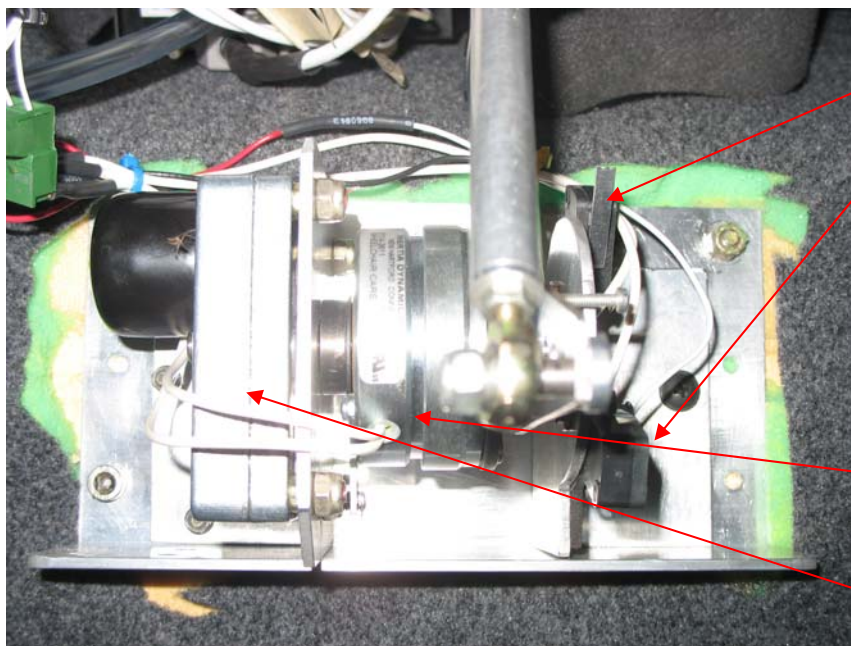
When the motorised system is not activated or power fails, the clutch is not engaged and the throttle input shaft can be used manually without resistance. Both throttle input shafts remain on the dash.



Lever arm connected to high mount throttle cross shaft

Mounting plate to fire wall

Connection Rod and arm on clutch

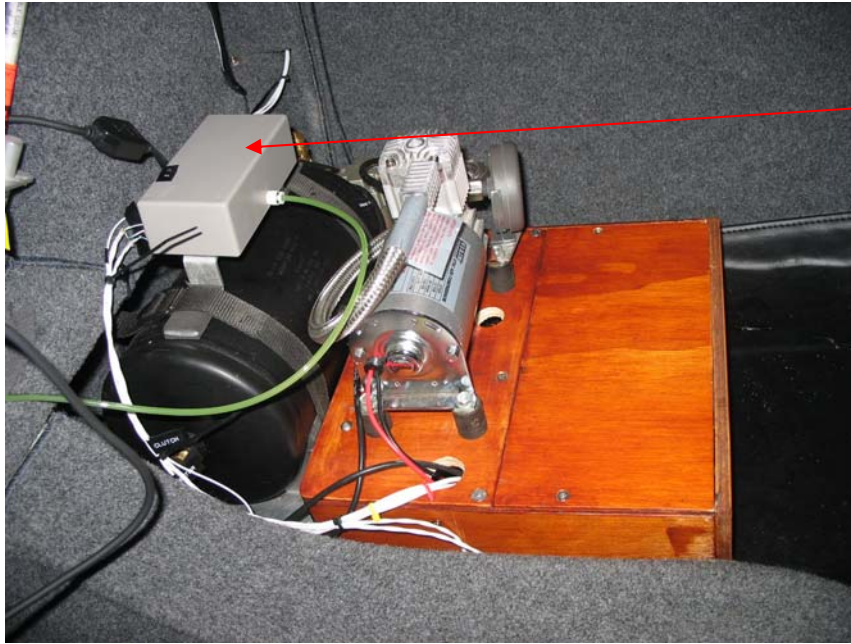


Limit switches

Electromagnetic clutch

12 V DC motor and gearbox

**12V DC Motor & Clutch Arrangement**



Sip & Puff box  
behind the  
right seat

**Sip & Puff Box**



Sip & Puff  
tube attached  
to the  
microphone  
boom

**Sip & Puff Tube on Microphone Boom**

## Pneumatic Brake System

The functionality of the existing brake system has not been modified and can be operated manually as intended. A pneumatic brake actuation system has been installed to allow activation and control of the brake via a toggle switch. The system comprises mainly of a compressor, air receiver, linear actuator and air regulating components.

The compressor system comprises of a 4 litre air receiver, compressor (57 L/min, 150 PSI max working pressure), air regulator, pressure switch, filter, flow control, solenoid valve and pressure relief valve. The system is located behind the right seat on the floor, with the small components and electrical wiring housed in a box. Air hose and wiring is run through the centre console to the front of the aircraft. The compressor cuts in at 110 PSI and cuts out at 150 PSI. The working pressure downstream of the air regulator is approximately 70 PSI.

The pneumatic linear actuator is mounted on the fire wall. An extension rod is connected to the output shaft of the actuator, with the other attached to the brake lever below the handle. When the actuator extends the brake is applied. This is controlled via a toggle switch on the dash similar to the flap switch.

The actuator shaft travels approximately 10 – 15mm per second therefore by flicking the toggle switch quickly on/off the speed and position of the brake application can be controlled easily. If the brake needs to be held on then the toggle switch is held in the on position thereby locking the brakes. Once the switch is disengaged the brake lever returns to its neutral position. The retraction is also assisted by a spring on the actuator.



Flow control,  
solenoid valve,  
regulator

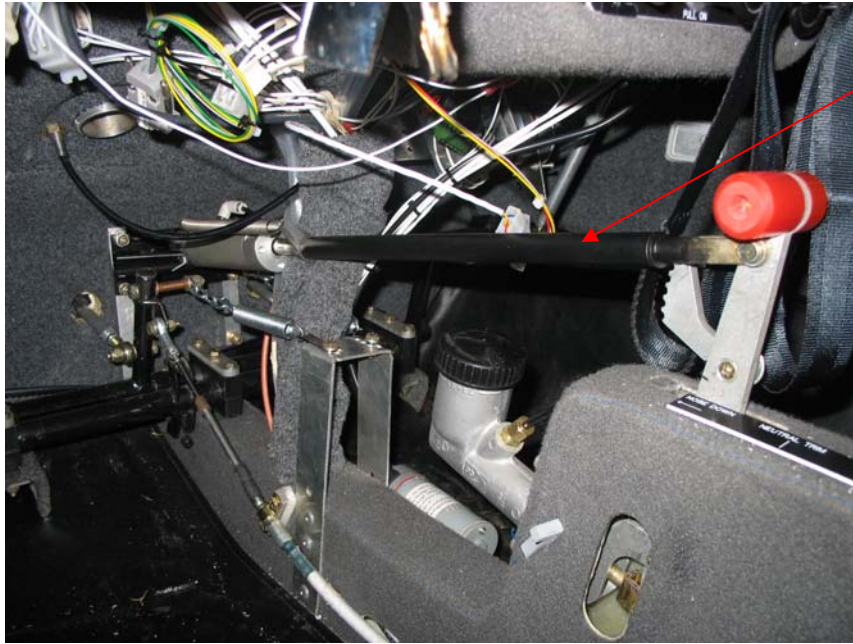
Compressor  
mounted on  
components  
box behind  
right hand seat



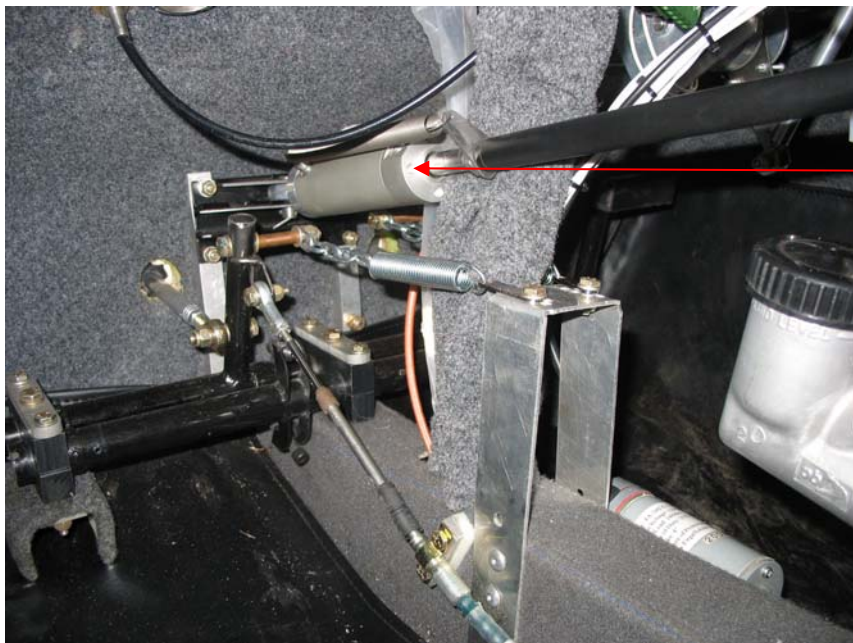
Air receiver



**Compressor System**



Extension rod  
connected to  
brake lever



Pneumatic  
Linear  
Actuator  
mounted to fire  
wall

### **Pneumatic Linear Actuator System**





Brake toggle  
switch

**Brake Toggle Switch**

## Rudder & Nose Wheel Steering

The functionality of the existing rudder & front wheel steering has not been modified. The pedals on the right side remain and are fully functional.

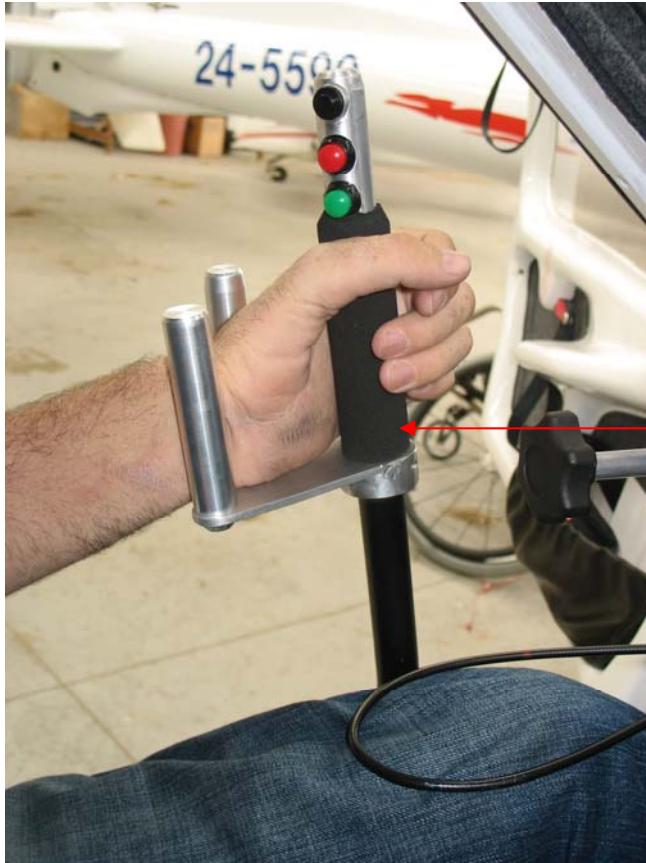
The left side rudder pedals have been removed, and the rear rudder pedal assembly shaft has been extended closer to the left side wall of the aircraft with a connection lever to allow for feet positioning. From the connection lever a rod connects to a hand lever mounted to the side wall of the aircraft. By pushing the lever the aircraft will turn right and by pulling the lever the aircraft will turn left.

Due to having no finger function to hold the steering lever, hand supports are required which consist of three upright posts. The wrist is supported between the two end posts with the hand and fingers wrapping around the centre post. The wrist is then held in an extended position, which securely locks the hand in place to allow movements in all directions. The hand can be removed easily and quickly by sliding it out in an upward direction as necessary.



Rudder steering lever with hand supports

New connection rod and rudder steering lever connection joint



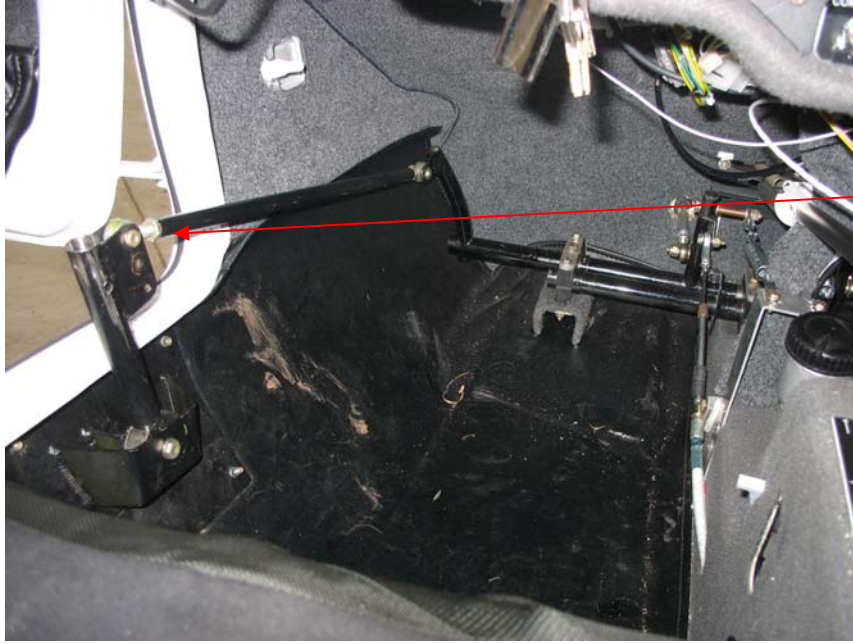
Rudder steering lever with hand supports

### Steering Lever with Hand Supports



Rudder steering shaft with foot pedals removed

New connection lever and shaft extension. 4130 steel tube



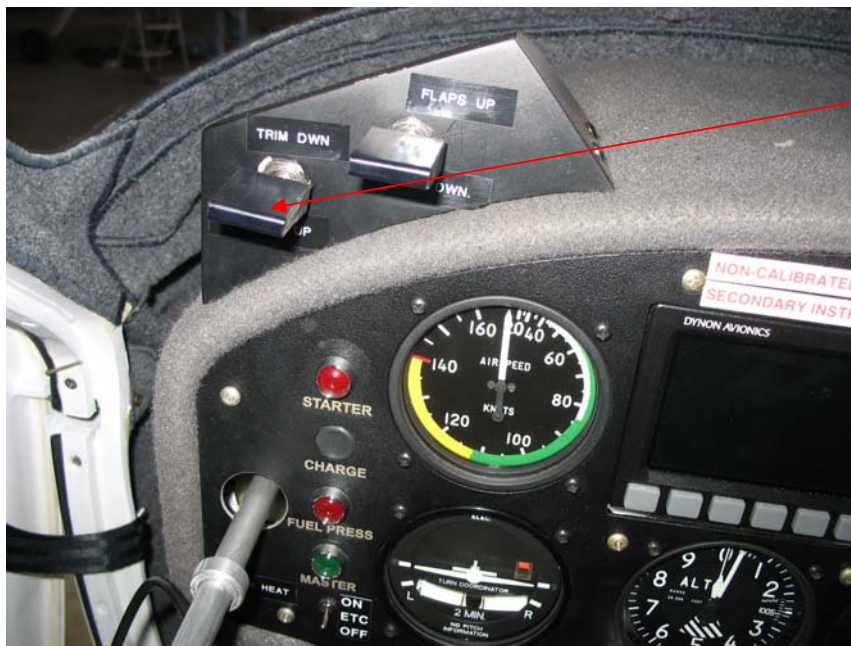
New  
connection rod  
and rudder  
steering lever  
connection  
joint

**Rudder Steering**

## Trim Control

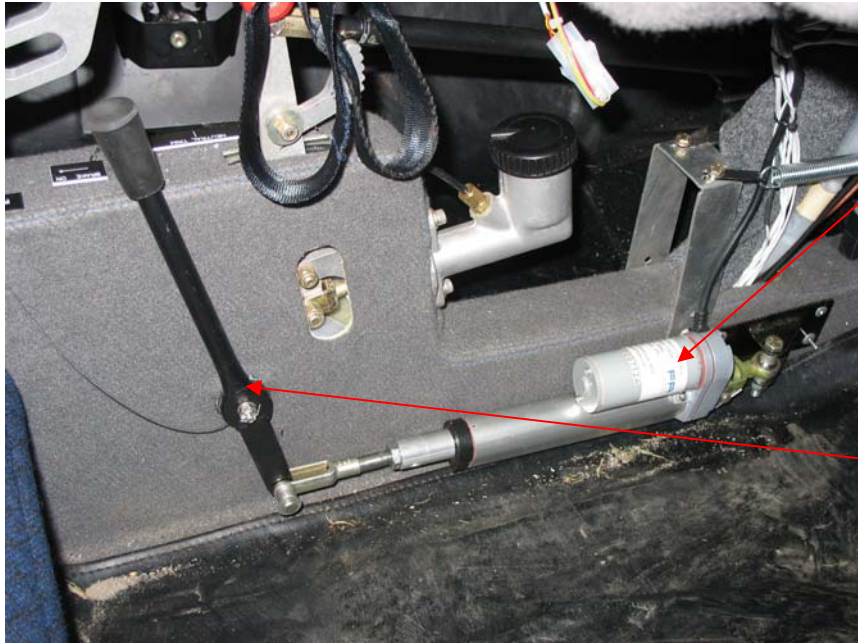
The trim system has been modified to be operated by a toggle switch driving a 12V DC electric linear actuator (100mm stroke @ 9mm/sec) forward and backwards.

The existing levers were replaced to incorporate the electric actuator. If the actuator fails to operate, it can be disengaged by pulling a pin which releases the actuator and drops to the floor. The trim lever can then be operated manually as necessary. Only one trim lever has been installed as I can only operate the right side manually if necessary, the left side is too difficult.



New trim  
toggle switch

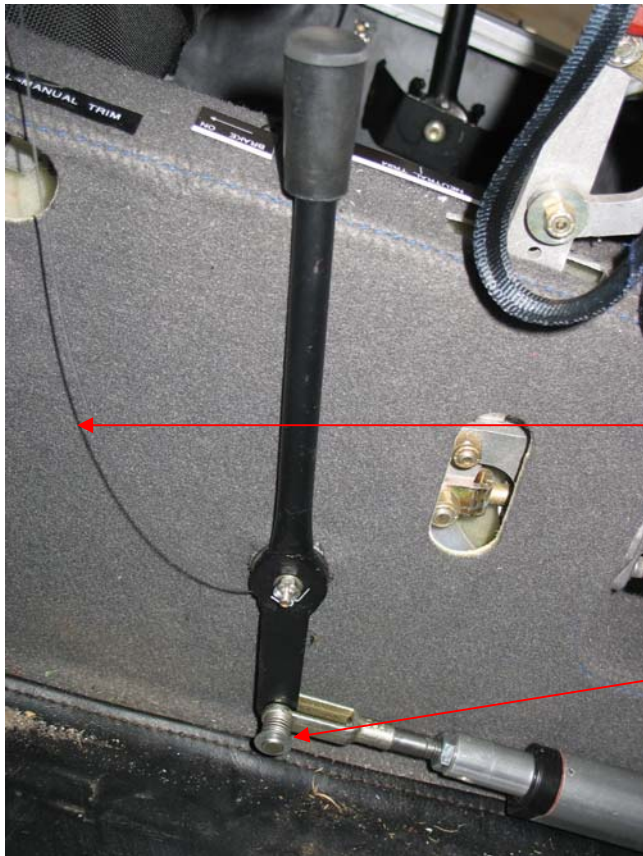
Trim Toggle Switch



New electric trim linear actuator

New trim lever

**Actuator & Connection Rod (Right side)**



Release pin cable

Release pin

**Release Pin**

## Miscellaneous Items

### Carburettor Heat

The Carb Heat lever was relocated to the left side of the dash to provide better accessibility. It could not be operated from the original position.



### Rudder Springs

The rudder springs were replaced with lighter ones (approximately 60%), which reduces the force required to operate the rudder/ground steering.



## Flap Switch

The flap control switches have been incorporated into the rudder lever, with additional buttons on the co-pilots side.



New flap toggle switch position (push red – flaps down, push green – flaps up. The black button changes the stored radio frequencies in memory)

## PTT Switch

The PTT switch for the left side was relocated for better access and a larger button installed for easier use.



PTT Switch



## Control Column

Due to having no finger function to hold the control column, hand supports are required which consist of three upright posts. The wrist is supported between the two end posts with the hand and fingers wrapping around the centre post. The wrist is then held in an extended position, which securely locks the hand in place to allow movements in all directions. The hand can be removed easily and quickly by sliding it out in an upward direction as necessary.

