Operations- and Maintenance Manual

CARRY**AIR** full electric
CARRY**AIR** dual fan

Created by: T. Strieker Checked by: M.Menze

Striekair engineering GmbH

1 Registration data

This flight and operations manual belongs to the aircraft:

Type	VTOL UAV
Model	*Carry*Air
Built year	_____
Build no.	_____

Producer: Striekair engineering GmbH

Owner: _____

_____

_____

This manual must always be kept up-to-date and carried with the aircraft.

document no.:	BHB-002
revision level:	B

2 Change status

You will find the revision status in the footer of every page of this manual. Current pages are to be inserted as soon as available. Invalid pages must be removed. This flight manual must be updated regularly.

Rev.	Reason for change	Date	Name
1.0	first edition	03.2021	T. Strieker
1.1	Takeoff / hover with Tailwind / RC control	04.2021	T. Strieker
1.2	graphs; flight planning Airspeeds	01.06.2021	T.Strieker M.Menze
1.3	Flight in mountainous terrain Checklist Emergency procedures Flight planning Hazard notice	15.11.2021	T.Strieker
1.4	Min. states of charge of battery Chekcklists for mission planning Survey mission in Hover mode	13.06.2022	T.Strieker
1.5	Maintenance Table	20.06.2022	T.Strieker
1.5.1	Flight Altitude	24.10.2022	T. Strieker
1.6	Range Extender Flight time Wiring Range Extender Carbon Front Propeller Screw Torque PA lower	12.12.2022	T.Strieker
1.7	Screw Torque Prop higher	30.05.2023	T.Strieker
1.8	Compass Setup VTOl Approach	10.06.2023	T.Strieker
1.9	Propeller Setup / Payloads	19.05.2026	T.Strieker

2.1 Content

3 Preliminaries

The CarryAir is an UAV belonging to the category of up to 25kg take-off weight up to 3m wingspan and may only be flown by a pilot with appropriate valid permit or an international license.

It may be operated in Germany only with an approved flight mission or in designated areas with a corresponding ascent permit.

When flying abroad, the national provisions and ordinances must be observed and followed.

Before take-off, each pilot must familiarize himself with the specific characteristics of the aircraft and receive instruction from an authorized person.

The flight route is to be selected, especially for take-off and landing, so that a safety landing is possible at any time if necessary.

Unauthorized changes to the controls, firmware, parameter, airframe, supporting structure and aerodynamics are not permitted.

Technical malfunctions or major defects must be reported to the manufacturer.

The operator is responsible for ensuring that the aircraft is always kept up to date in accordance with the technical notices and instructions of the manufacturer.

The operating limits and provisions on the operation and maintenance of the aircraft specified in the flight and operating manual are binding and must be observed.

It is mandatory for the pilot to read the current manuals and operating instructions.

All flights and changes to the aircraft must always be documented in a log.

Appropriate insurance for the aircraft must be applied for.

Hazard Warnings

Please note:

The product is no toy and may only be operated under constant supervision of an adult within visual line of sight and under observation of the applicable safety distances.

Never touch an armed or activated UAV. Remove all Propellers if Aircraft needs to be powered to work directly at it.

The rotors can cause severe cut injuries.

Knowledge of the requirements either from the manufacturer or this flight handbook are pre conditions for usage of this product, e.g. treatment of battery as safety relevant component.

The product is to be operated exclusively in compliance with all relevant laws and regulations of the country or place of use.

4 System description

4.1 Producer

Striekair engineering GmbH
Marienstrasse 18
33332 Gütersloh

4.2 Certification

Unmanned aviation systems with a take-off mass of a maximum of 25 kg and up to a wingspan of 3m.

4.3 Description

The CarryAir is a Blended Wing Body aircraft with 6 hover motors and an additional front drive for forward flight.

The undercarriage is made in glass-carbon fiber composite construction.

The wings are made of a fiber composite honeycomb sandwich shell construction with a composite-spar and have servo-operated elevons.

All motors and the avionics are fed by a central 12S battery. The battery cells must be monitored both during discharging and charging. The balancing takes place exclusively during external re-charging.

The avionics are based on a Pixhawk Cube Controller and a Herelink telemetry and 2.4 GHz RC receiving system which can reach a range of up to 20 km. (More detailed information can be found in the relevant operating instructions for the remote control.)

Two BEC´s are used to supply the flight controller, as well as other BEC´s for the voltage supply of the Herelink RC telemetry, Servos, positionlights…

The hover motors are controlled in a hexcopter mode. The failure of one hover drive train can be compensated for by the remaining drives for flight stabilization. This means that while a landing can still be archieved. No climb in hover mode is possible anymore. Depending on the load, a certain rate of descent can occur at which the aircraft can still be steered in a stabilized manner.

The motor for forward flight consists of an electric drive with a pull propeller optimized for cruise flight.

5 Technical Data

5.1 Type

- Type: VTOL
- Aircraft Design: Blended wing body
- MTOM: 24,95 kg
- Empty weight: approx..12-13 kg
- Motor: P60 KV 170

Payload *CARRY**AIR*** full electric

7kg max @ 2 x 22.000 mAh 40 min (approx. 56km Range)

5 kg max @ 2 x 6S 30.000mAh / 1 hour (approx. 90 km Range)

4 kg max @ 4 x 6S 22.000mAh / 1,5 hour (approx. 125km Range)

Payload *CARRY**AIR*** dual fan

3 kg max @ 4 x 6S 22.000mAh / 0,75 hour (approx 65km Range)

5.2 Main dimensions

- Wingspan 2990 mm
- Wing area 2 m²
- Length over all: 1500 mm
- Max fuselage width: 800 mm

Fig.1: Three view drawing

6 Propulsion Systems

6.1 Motors

The P series (brushless) motors from T-Motor were specially developed for the operation of professional multicopters in the agricultural sector and, according to the manufacturer they are designed for an operating time of 1000 hours.

6.2 Propulsion

Cruise Propeller *CARRY**AIR*** full electric

Diameter: 22“
Pitch: 16“
Material: Carbon

optional

Dual Fan Propulsion *CARRY**AIR*** dual fan

2 x Greenjets IPM5

Hover Propeller Setups for Different Operating Altitudes:

Propeller Size	Maximum Density Altitude
22.2" × 7.2" folding	0 - 1500 ft (approx. 450 m)
22.1" × 8.8"	0 - 5000 ft (approx. 1520 m)
24" × 7.2"	1500 - 7000 ft (approx. 2130 m)
24" × 7.2" CarryAir+ ESC²	1500 - 12000 ft (approx. 3650 m)

6.3 Batteries

General Information

If handled improperly, lithium polymer batteries can explode, burn and release toxic gases as well as cause burns or poisoning. Since we cannot control the proper and correct handling post delivery, we reject any liability for damage and consequential damage of any kind.

1. ALWAYS store and charge any battery in the aircraft outside of an enclosed space or in a fireproof container which, if ignited, will never spread the fire. Use the battery only for the CarryAir. Always store the battery in a dry and dark place in a cool environment. Never expose it to direct sunlight or excessive heat. Keep the battery away from children and unauthorized persons.

2. It is **IMPERATIVE** to observe the information on the number of cells and the discharge and charge currents printed on the respective battery. The number of cells must be placed correctly into the charger. The charging and discharging currents must not be exceeded under any circumstances.

3. **ONLY** use the associated chargers that are suitable for charging lithium polymer batteries. Be sure to use the correct charger. Set the number of cells as well as the charging current and the cut-off voltage on the charger **ABSOLUTELY CORRECT**. To do this, it is **ESSENTIAL** to read and follow the instructions for your charger.

11.1 V means that the battery has a nominal voltage of 11.1 V. Each lithium polymer cell has a nominal voltage of 3.7 V. This voltage is multiplied by 3 (since there are 3 cells in the battery). This gives us the nominal voltage of 11.1 V. The nominal voltage is approximately 50% of the cell upon delivery. it is approx. 50% fully charged here. Practical operation should already be ended when the nominal voltage is reached, which corresponds to a depth of discharge of approx. 50%. A fully charged lithium polymer cell has a voltage of 4.2 V. When multiplied by 3, this results in a total voltage in the fully charged battery of 12.6 V. This is also the upper cut-off voltage for the charger. 35 C / 60 C Discharge (= discharge) means that the battery has a maximum of 35C (= 35 x 3.7Ah = 129.5 amps) permanently and a maximum of 60C (= 60 x 3.7Ah = 222 amperes) for a short time (1 / 10 seconds). 3C charge means that the battery can be charged with a maximum of 3 C (= 3 x 3.7 Ah results in 11.1 amperes) charging current. (Lower charging currents protect the battery).

4. The individual cells can get slightly different voltages through repeated charging and discharging. So-called balancers are used to prevent this. Always use the supplied balancer for charging. It may have to be set to the number of cells in the battery. It is plugged into the balancer connectors of the battery.

5. When connecting the charger, the balancer and also the controller, **ALWAYS** ensure that the polarity is correct. The two thick high-current cables of the battery are soldered to corresponding high-current plugs and connected to the charger or controller in the model. The red cable is the positive pole, the black cable is the negative pole. The balancer cables are each connected to the plus and minus of the individual cells. The colors of the balancer cables can differ, in which case you MUST measure the correct polarity with a meter and ensure the correct connection of the balancer connector. Each battery has exactly one more balancer cable than it has cells, as there is always tapping between the cells (e.g. a 3S battery has 4 balancer cables). At the balancer connector you MUST also measure the voltages of the individual cells with a simple measuring device for control purposes by connecting a counter cable and connecting the measuring device there (isolated). This is recommended if you are not sure whether your balancer is working properly (**BE CAREFUL NOT TO SHORT CIRCUIT**).

6. Never discharge the battery **to less than 3.2V per cell** under load. In the idle state (measured without load) the voltage per cell should not be less than 3.75V. A deeper discharge will destroy the battery. Do not rely on the safety shutdown of the controller if it only switches off later. Start with only very short flights / journeys and record the cell voltage, gradually approaching the maximum flight / travel time. Make sure you set a stopwatch in the transmitter. Leave approx. 20% remaining capacity in the battery. After use (empty battery), you should be able to charge approx. 80% of the nominal capacity. Your charger shows the recharged capacity at the end of the charging process.

ATTENTION: Due to the high performance of the batteries, the load voltage keeps stable until shortly before it is fully discharged.
A LOW BATTERY CANNOT BE DETECTED BY LOW PERFORMANCE OR THE SPEED OF THE ENGINE. IF THIS DOES HAPPEN, THE BATTERY WILL ALREADY BE DISCHARGED TOO DEEP AND WILL BE DESTROYED (EVEN IF IT IS ONLY ONCE DEEP DICSCHARGED) IN ANY CASE, PLEASE MAKE SURE THAT THE MOTOR IS SWITCHED OFF IN TIME (NEVER LESS THAN 3.75 V PER CELL IN STANDBY, THAT APPROXIMATELY 3.4 V / cell, DEPENDING ON THE LOAD).

If you do not need to use the battery for a longer time, **DO NOT** store it **FULLY CHARGED**, but with approx. 3.7-3.8 V per cell and in a cool environment.

Since we cannot control the proper and correct handling after delivery, we reject any liability for damage and consequential damage of any kind.

Batteries should not be left unused for extended periods of time, either in the aircraft or in storage. If the battery is not used for long period, it must be fully charged at least once every three (3) months to prolong its life and maintain its performance.

Take note the following precautions (Dos):

(a) Routinely check the battery's charge status. Carefully monitor batteries that are approaching the end of their estimated life.
(b) Use the battery within 0° to 40°C temperature range.
(c) Avoid charging the battery outside of the following temperature range 5° to 40° C
(d) Before storage, "storage charge" or discharge the battery to approximately 50% capacity. Remove the battery and store it separately from the aircraft.
(e) Pre-heat battery to 20°C when the temperature is lower than 10°C before charging
(f) If you fly in high temperatures above 40°C, keep an eye on battery temperature. If the battery's temperature gets higher than 65°C, land immediately.

Take note the following precautions (Don'ts):

(a) Do not disassemble, crush, or puncture a battery.
(b) Do not short the external contacts on a battery.
(c) Do not dispose of a battery in fire or water.
(d) Do not expose a battery to temperatures above 60 °C.
(e) Keep the battery away from children and pets.
(f) Avoid exposing the battery to excessive shock or vibration.
(g) Do not use a damaged battery.
(h) Don't charge the battery right after a flight because the battery's temperature may be too high.

Take note of the following when transporting the aircraft:

(a) Store the battery in a specified transportation box/bag before transit to avoid damage. Do not store a battery with metal components or metal container without insulation inside.

(i) Remove batteries from the aircraft when stored for an extended period (more than 10 days).

(b) Discharge the battery to 30% before transit (unless travel to operational site). If the battery needs to be carried onto the plane, discharge it to 5% of its total

power.

Take note of the following when storing aircraft and batteries:

(a) Store the aircraft in a dry, cool and non-magnetic place.

(b) When the aircraft and the battery will be stored for more than 3 months, store in around 25°C and avoid direct sunlight.

(c) Discharge the battery to 40% to 65% prior to storage. Storing a battery with full power or low power for a long time may lead to permanent damage.

7 Minimum operating voltages in flight

- Do not discharge to less than 45V for normal Voltage LiPo and not less then 45.4V for High Voltage LiHv Cells in cruise flight or below 25% of the remaining battery capacity. With additional maneuvers and wind, the displayed voltage may only briefly fall below 43V in Hover flight.

- With a full take-off mass and a 30Ah battery, the remaining battery capacity must not fall below 25%. When using a larger battery, higher discharges can also be tested gradually in accordance to the higher battery capacity. Limitation is a landing at max. wind conditions and a Battery Voltage above 43V in Hover.

- For flights with hover missions over a long period (Hover Survay) or flights with a MTOM higher then 20kg the aircraft always has to be started with a full battery.

8 Undercarriage

The Undercarriage consists of an exchangeable bow swing arm and a replaceable lower fin with a stern swing arm.

Replaceable Titanium struts are used to support the wing tips.

9 Elevon linkage

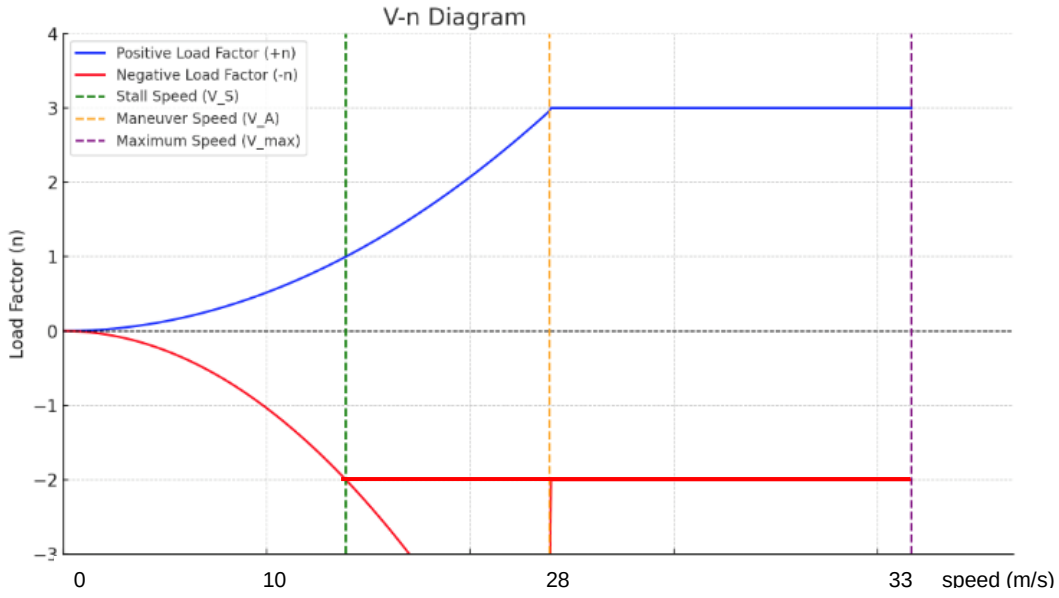
For elevon linkage an industrial servo from Hacker is used. The root rib of the Elevon is linked via an adjustable threaded rod with fork heads secured with a locking wire.

10 Operating limits

10.1 Flight speeds

Tabelle 1 Flight speeds

Design.	Speed	IAS [km/h]
V_{NE}	speed limit	120
V_{Max}	Maximum speed	120
V_{fbwmin}	Min speed in fly by wire	68
V_{fbwmax}	Max speed in fly by wire (Maneuver speed V_A)	100
$V_{Hovergust}$	Maximum gust wind speed in the hover	40
V_{gust}	Maximum gust wind speed in flight	50



10.1 Flight Altitude

Max Flight altitude in fixed wing flight (dynamic flight altitude)

The aircraft has a maximum in flight ceiling of 12,000 feet density altitude. For operations requiring higher altitudes, it is recommended to consult the manufacturer to discuss potential modifications to the front propeller to ensure optimal performance and safety.

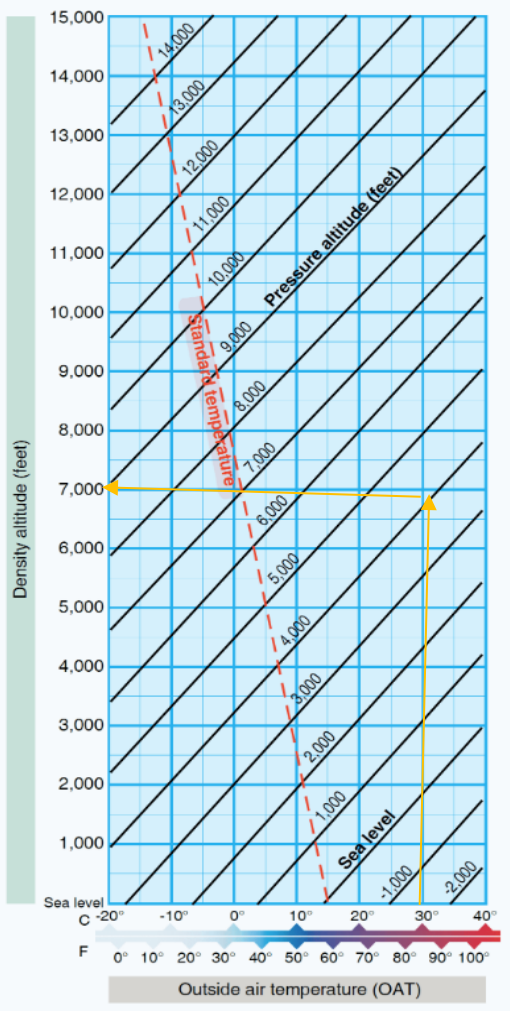
Max Flight altitude in Hover flight (static flight altitude)

The aircraft has a maximum hover flight ceiling of 8,000 feet density altitude. For operations requiring higher altitudes, it is recommended to consult the manufacturer to discuss potential modifications to the hover propellers to ensure optimal performance and safety.

2. Add difference based on the air pressure at sea level to take off altitude to get the pressure altitude

Difference in (ft)	Air pressure at sea level (hPa)
1237	968
1100	973
964	978
827	983
690	988
554	993
417	998
280	1003
144	1008
0	1013
-130	1018
-267	1023
-403	1028
-540	1033
-677	1038
-813	1043
-950	1048
-1087	1053
-1223	1058

1. Determine the intersection of current temperature and pressure altitude (see yellow sample)



10.2 Temperatures

The temperature range for operating the aircraft is -20 to +40 °C.

It must be ensured that the permissible battery temperatures are not exceeded. At low temperatures, preheating of the batteries to a temperature of 20°C must be observed. Likewise, at temperatures below 10°C, care should be taken to prevent the supply of fresh air to the cargo compartment by closing the hole in the front bulkhead.

It is not allowed to foil or lacquer the upper side of the aircraft in a darker color than white.

10.3 Load factors

Maximum tested limit load	+3g / -2g

10.4 Permitted areas of application / restrictions

As long as no SORA has been applied for, flights may only be carried out VLOS.

When flying in mountain areas, following questions have to be taken into consideration:

- Can the aircraft follow the slope of the mountain with the maximum climb rate of 5 m/s? How will downdrafts on the lee side of the mountain affect the climb rate of the aircraft.
- What are the wind conditions at higher altitudes?
- Transitions must not be excectuted towards the mountain (in case the mountain exceeds the permissible hover height of approx. 100m). Rather parallel to the valley of towards the valley depending on the wind direction.
- Gusts, downwinds and vortices may cause the aircraft to prioritize stabilization over climb. This can result in the aircraft not being able to climb further in hover flight until the gusts weaken. If the aircraft cannot climb for a long period, the flight should be aborted.

10.4.1 Forbidden flight conditions

Wind Limits for **full automatic flights:**

- Max wind gust 40 km/h in Hover flight
- Max wind gust 50 km/h in Cruise flight **(**higher Altitude then Hoverflight)

Wind Limits for **Flights with safety operator**

- Max wind gust 45 km/h in Hover flight
- Max wind gust 55 km/h in Cruise flight **(**higher Altitude then Hoverflight)

Precipitation

- The aircraft can be operated in light precipitation of <1mm / hour.

- Flying through clouds is prohibited due to icing conditions.

Attention: Do not cover the gap from fuselage to the wings with tape. The gap is part of the cooling system and the static pressure port.

10.4.2 Stall speed

Care must be taken to ensure that the aircraft is only operated within a safe speed range. If the speed drops below the minimum speed, the aircraft reacts by automatically switching on the hover motors. However, if the speed measurement is incorrect, the aircraft can get into an uncontrollable state. In this case, the Q_Loiter or Q_Hover hover mode must be switched on manually.

Speeds below 70 km/h are to be strictly avoided at full take-off mass!

In Fly By Wire B mode, the flight speed is between 70 and 100 km/h.

The stall speeds can vary with different take-off masses.

The specified speeds apply to straight flight. The stall speed is higher in turns!

11 Flight Operations

11.1 VTOL Approach / Weather Vaning

Since Firmware Version 4.2.2 the CarryAir has its own wind detection at the start in hover modes (Weathervaning) and during flight to detect the wind direction for the landing.

After takeoff in hover mode the aircraft changes the yaw slowly to turn its nose into the wind automatically.

The VTOL approach is as follows:

The aircraft is flown back at an altitude of 100m above the take-off point by setting the RTL command. 200m before reaching the takeoff/landing point, the aircraft goes into a circular flight with a radius of 200m around the landing point and descends to an altitude of 50m. It then turns according to the apparent wind and initiates the automated landing QRTL until the aircraft is landed.

Important, the following should be noted:

Since the aircraft is flown back at an altitude above the starting point of 100m, no mountain or object may exceed the height of 80m above the GPS lock.
Furthermore, the terrain around the take-off point with a 280m radius must not exceed the height of 30m.

11.2 Selection of the airfield

The selection of the airfield is the basis for a safe operation of the VTOL. The view of the aircraft must not be obstructed in the wind direction dependent directions during the transition as during the return transition by trees, mountains or the like. If the take-off site is in a sheltered area, the wind direction at flight altitude must be obtained using a weather app or from the weather service. The maximum gust wind speed is the limiting speed for flight operations. The starting area must be level, firm, free of holes and free from sticks lying around. In the event that the launch site is prepared with a tarpaulin or something similar, it must be ensured that this is adequately fastened at the edges. The tarpaulin must also be heavy enough and lie so close to the ground that it cannot come into contact with the propeller blades.

11.3 Remote control

The control is executed via a Long range HD video transmission and controller system.

The displayed key configuration has been preconfigured and allows a clear selection of the different flight modes.
The assignment of the keys should be worked through before each flight to get enough routine for the following flight.

QHover (emergeny operation):	QLoiter (GPS Position Hold):	RTL (Return to Launch)	Auto (Automatic flight Mode)	Loiter	FBWB (Fly By Wire B)
Flight axes must be controlled sensitively across all axes. The maximum actual and rate of climb is 3 m/s). Caution: Never move backwards into the wind. Nose into the wind and nose in the direction off light!	Changes to the control stick change the GPS coordinates. Max. rate of climb and incline 3 m/s Max. Airspeed over ground 5 m/s	Automated return of the aircraft until the landing is completed. Check VTOL approach height of 50m on a circle radius of 200m .	Automated flight operations in which a mission created in advance and uploaded to the cube is flown.	Auto flight Circles around the activated point within a radius of 200m	Figth operation in which the control sticks set a rate of descent and climb of max. 5 m/s as well as an incline +/-45° at full deflection and a speed oft eh aircraft between 70 and 90 km/h.

11.4 Pre-flight check

Before commencing **each** flight, the pilot-in-command must carry out a pre-flight check. The pre-flight check is for safety purposes and should be carefully processed point by point. It is the only way to identify damages, defects and wear and tear at an early stage and to rectify them in good time.

11.4.1 External control of the UAV

11.4.1.1 Drives:

- Check the front engine propeller for damage and the tight fit of the spinner. - Pay attention to possible grinding marks on the motors (these indicate defective engine mountings or improper Close fastening).
- Check the engine mountings and hover propeller Blades for play and cracks by hand.

11.4.1.2 Landing skids

- Check that all parts are firmly seated
- Check for deformation or cracking

11.4.1.3 Left and right wing:

- Pitot tube (s) tight and free of dirt and water?
- Check the condition of the wing, elevons by hand for play and cracking.
- Fastening and connections for elevons, rudder connections and linkages secured?

11.4.1.4 Fuselage

- Condition of the surface (cracks, holes or similar)
- Check payload cover hinges and locking mechanism

11.4.1.5 Left and Right Wing

- Check the condition of the wing, elevons (Holes, cracks or the like)
- Check Hinges and lever arm for elevons connections and linkages.

Carry out a pre-flight inspection

Checklist before take off

PRE-FLIGHT CHECK					
TRANSMITTER	ON AND QGC IS STARTED				
WING BOLTS SECURED	COMPLETED				
AIRCRAFT CENTER OF GRAVITY	AIR BUBBLE INSIDE SPIRIT LEVEL				
ELEVON CONTROL SURFACES	STIFF AND WITHOUT PLAY				
PROPELLER	FOLD OPEN				
MOTOR MOUNTINGS	CHECK FOR TIGHT SIT				
HOVER BATTERIES	CHARGED				
TRANSMITTER	CHARGED				
PLANE POSITIONING	NOSE TOWARDS WIND				
BATTERIES	PLUGGED IN MAIN BATTERIES				
TRANSMITTER AND NOTEBOOK	COMPASS ALIGNMENT CHECKED				
TRANSMITTER AND NOTEBOOK	ROLL / TILT MOVEMENTS ARE CHECKED				
COVERS / DOORS	CLOSED AND LOCKED				
PILOT TUBE	AIRSPEED TESTED (BLOW IN TUBE)				
RESCUE DEVICE	ACTIVE				

Manual flight

- Align aircraft nose against the wind
- Control neutral
- Switch the aircraft to QLoiter, QHover
- When airspace and approach are free, activate the aircraft (arms by throttle to idle and rudder steering fully to the right for approx. 3 sec. until hover motors turn to idle and an acoustic feedback from the RC control follows.
- All motors have to run in idle.
- Slowly push the throttle control lever all the way forward so that the maximum rate of climb is achieved.
- At a rate of climb of 3 m / s approx. climb for 20-30 seconds. Climb to a height of 50m and pull the throttle back to the middle position.
  If Aircraft doesn´t climb for more then 10 seconds, land aircraft and Check the following:
    - Check all Propellers working properly
    - Check CG and Max take-off weight
    - Battery Charged ?
    - Wind direction and wind speed also at higher altitude?
    - Battery Temperature min. 18°C?

- Switch from Q Loiter Mode to Fly By Wire (FBWB)
- In FBFB mode, the throttle lever is now used to set the airspeed. The middle throttle position corresponds approximately to a flight speed of 80 km/h. The hover motors are now automatically used to maintain the height.
- From the middle throttle position corresponds to an airspeed of approx. 80 km/h. Attention, **no elevon movements can be carried out** on the RC system during the transition before airspeed V_{fbwmin} has been reached.
- It is recommended to leave the throttle stick in the center position on the whole flight.
- Fly the aircraft at approx. 80 km/h IAS and continue to climb. The hover motors automatically shut down within 2 sec after V_{fbwmin} is reached.

- The flight can be continued as usual as a fixed wing aircraft. However, it must be ensured that in Fly by Wire Mode B the position of the control sticks does not indicate the position of the rudder surfaces. The throttle position specifies the airspeed and not the engine speed. Accordingly, a stall condition cannot be recognized on the basis of the position of the control stick. Flying by the speed indicated through the pitot tube tube is essential.

11.5 Cruise Flight

When transitioning to cruise an economical speed of about 80 – 85 km/h IAS should be aimed for. The required engine power depends on the weight of the aircraft.

The maximum permissible speed of VNe = 117 km / h IAS must not be exceeded under any circumstances. In gusty weather, a maximum speed of VB = 90 km / h IAS must be observed.

11.6 Turning Flight Maneuvers

Curves with a bank angle of more than 45° are automatically limited by the flight controller. If, for any reason, this bank angle is deviated, a safe hovering flight is automatically initiated by the aircraft switching on its hover motors. Switching back to FBWB mode and setting the throttle position, the aircraft can be brought back to its safe starting speed by transition, as it was during take-off.

11.7 Manual Landing Maneuvers

- Before the landing approach, the RC pilot has to inspect the landing site and call out: ATTENTION LANDING. Other people must go to a secured area.
- The landing should, if possible, be carried out over a large area in order to gain time for establishing the necessary landing configuration.
- An altitude of approx. 50m should be approached above the landing point. **The approach must be against the wind.**
- About 100m before reaching the landing point, FBWM must be switched over to Q_Loiter.

- The aircraft now turns on the hover motors gradually until a speed of 0 km / h is reached.
- The remaining approach is carried out in the selected hover mode.
- In Q_Loiter mode, the aircraft is automatically held at position and altitude. The flight control should only correct the GPS position and the rate of descent.
- The Q_Hover mode should be selected in the case a clean QLoiter flight is not possible due to the wind strength or insufficient GPS or compass data.
- Shortly before touchdown, the rate of descent must be reduced as much as possible.

After touchdown and motors idling, the aircraft must be **disarmed by turning the throttle down and full rudder deflection to the left**.

11.8 Fail Safe Modes

If the RC signal is lost, the flight controller reacts differently depending on the flight mode the aircraft is currently in.

- RC loss in **auto flight mode**, the Aircraft **continues** the uploaded **flight mission**

- RC loss in **Fly by wire b mode** (Flight mode), the Aircraft goes into the **RTL** mode and comes back the GPS lock position.

- RC Loss at **hover flight mode** above GPS Lock Position, the Aircraft goes into **Land Mode**.

11.9 Post Landing

Post Landing check-list

POST LANDING	
FLIGHT MODE QHOVER RESP. QLOITER	DEACTIVATE BY YAW TO THE LEFT
PILOT TUBE	COVER ON
FLIGHT DEVICE	OFF
TRANSMITTER	OFF
NOTEBOOK	OFF
RESCUE SYSTM	SECURED
HOVER BATTERIES	CHECK CHARGE LEVEL DELTA CELL VOLTAGE <0.1V

11.10 EMERGENCY PROCEDURES

The emergency procedures must be planned and trained in advance for each flight phase. A corresponding emergency procedure should be gone over in advance for each flight phase and initiated if needed.

In Qhover mode, the aircraft must not be flown backwards or backwards into the wind. The nose must be turned in the direction of flight before the forward flight is initiated in the hover.

No warranty is given for damage to the aircraft due to poor GPS, compass or barometer readings, in which case the aircraft must be put into hover mode and landed by hand manually.

EMERGENY PROCEDURES	
DISTURBANCE DURING HOVER TO STARTING ALTITUDE	HOVER BACK TO STARTING POSITION
FLIGHT DEVICE RISES OUT OF CONTROL IN THE QLOITER	SWITCH TO QHOVER AND LAND
PROBLEMS IN TRANSITION	EITHER IN QHOVER OR QLOITER MODE BACK TO START POSITION
THE YAW STABILIZATION deviates by more than 15 °	EITHER IN QHOVER OR QLOITER MODE BACK TO START POSITIONWIND CHECK WINDDIRECTION
STALL	HOVER MODE AND BACK TO FBWM
HOVERMODE CANNOT BE EXECUTED IN FLIGHT	ACTIVATE RESCUE DEVICE
FLIGHT DEVICE NO LONGER CONTROLLABLE	ACTIVATE RESCUE DEVICE
FLIGHT DEVICE NO LONGER VISIBLE	ACTIVATE RTL MODE
FLYING DEVICE OVERLAPS STARTING OR LANDING	QUICKLY DEACTIVATE BY YAW TO THE LEFT
FRONT DRIVE FAILS	WHEN POSSIBLE GLIDE TO STARTING POINT AND HOVER TO GROUND
CANCEL RTL MODE IN FLIGHT	SWITCH TO FBWB
CANCEL RTL MODE IN HOVER	SWITCH TO QHOVER MODE
HOVER PROPELLER FAILURE IN THE HOVER FLIGHT OR IN TRANSITION	CAREFULLY LAND ON A LEVEL SURFACE IN QHOVER MODE
FLIGHT DEVICE CAN NOT BE SWITCHED OFF	PULL KILL SWITCH TO DISCONNECT POWER SUPPLY

12 Handling

12.1 Handling

The aircraft can easily be maneuvered by hand or lifted by two people. The areas which are marked with LIFT HERE were dimensioned with sufficient strength in order to be handled carefully.

12.2 Parking

In extreme weather conditions or strong winds, the aircraft must anchored to the ground, or dismantled and housed in a vehicle.
When anchoring on the ground, the aircraft must be secured to the ground with appropriate weights or screw anchors.

- if possible, let the nose of the flight device point into the wind
- ropes of straps (no chains, wire- oder steelbands) attach to the undercarriage.

13 Weighing and loading plan

The aircraft must be checked for the correct center of gravity before the flight or after changing the mass distribution.

Screw eyes are screwed into the two M5 bores which are located outside the CENTER OF GRAVITY markings in the payload bay root ribs.

The aircraft is lifted (optionally with a luggage scale) and the flight attitude must be determined with the spirit level in the fuselage. If the air bubble is not within the marked area, the center of gravity must be corrected by moving the batteries.

Appropriate measures must be taken to secure the batteries in place.

14 Typeplate and labelling

A metal plate with the LBA registration number must be attached to the aircraft.

Another typeplate was installed by the manufacturer in the front of the payload bay.

15 Assembly / Disassembly / Case Storage

The wings can be removed for transport.

In a first step the provided support must be attached to the rear of the fuselage.

Then the locking cap must be turned 180 ° forward over the wing bolts.

The wing bolt can now be pulled out on the key ring with a slight twisting motion. Attention, if the wing supports have already been removed, the wing must be protected of dropping.

The wing can now be carefully removed from the plug connections and the spar brackets.

1. Disasemble the right wing, put it with the trailing edge first into the case and remove the wing landing strut. Fold Propellers into wing spar direction.

2. Disasemble the left wing, put it with the trailing edge first into the case and remove the wing landing strut. Fold Propellers into wing spar direction.

3. Under the Fuselage the aft propellers have to be folded forward and the Front Propellers have to be folded inward.

4. Set the Fuselage into the case on top of the wings. The lower fin is lowered in advance.

Attention: The rear folded propellers must rotate freely in the case to prevent damage to the propeller blades during transport.

16 Care

Care:

All metal parts are corrosion-proof and do not require any special care.

We recommend using plenty of clear water with a little dish-washing detergent to soften and rinse off dirt.

Under no circumstances should solvents or cleaning agents containing acetic acid be used.

16.1 Rudder deflection of Elevons

Deflections of the elevons are measured from the rear tip of the elevon root down to the trailing edge of the wing.

Deflection of Ailerons:

Upward	28 mm
Downward	18 mm

Deflection of Elevators:

Upward	26 mm
Downward	19 mm

17 Mission planning for automatic flights

Based on the following aircraft parameters, the energy requirements can be determined. We recommend to plan a remaining battery capacity of at least 25%. For cross-country flights, the wind conditions must be taken into account in particular the headwind at flight altitude. Higher battery capacities may allow for lower residual capacities. However, these should be carefully tested. For cross country flights the distances to be covered as well as the prevailing wind conditions have to be taken into account.

When planning autoflights with QGroundcontrol, the following has to be taken into account:

- Choose aircraft type as VTOL
- Cruise flight for example 120m
- Select VTOL Start and set a transition height of 50m (the hight should be set to at least 20-30 m above highest obstacle)
- Set flight speed to 85km/h
- Allow for first waypoint to travel at least 400m distance
- Further waypoints within visual line of sight (1 km)
- Choose last waypoint as RTL
- Check all waypoints in the bar-graph of qgroundcontrol
  Upload mission!

17.1 Checklist Mission planning

Flight Planning QGC						
Aircraft	Unplug Battery					
Controller	Switch on and start QGroundcontrol					
Go to flight planning	Select menu file					
Create Plan	Choose Blanc					
Under Mission Start	Select VTOL Aircraft (Flight Level relative to GPS Lock) Firmware Ardupilot					
Flight Speed	82 km/h					
Hover Speed	15 km/h					
Menu option Takeoff	VTOL Takeoff on 50m Height, heading default					
Menu option Waypoint	Set first Waypoint approx. 400m in distance into the wind at approx. 70m altitude					
Menu Option Waypoint	Other Waypoints up to max 120 m above Ground Level or a Survay with a typical spacing of 120m					
Menu Option Waypoint	Last Waypoint select RTL (klick on Triangle beside Waypoint and klick on RTL)					
Altitudes above ground	Check Bar graph for flight altitude above ground level					
Mission	Upload					

17.2 Hover Survey in combination with long range flight

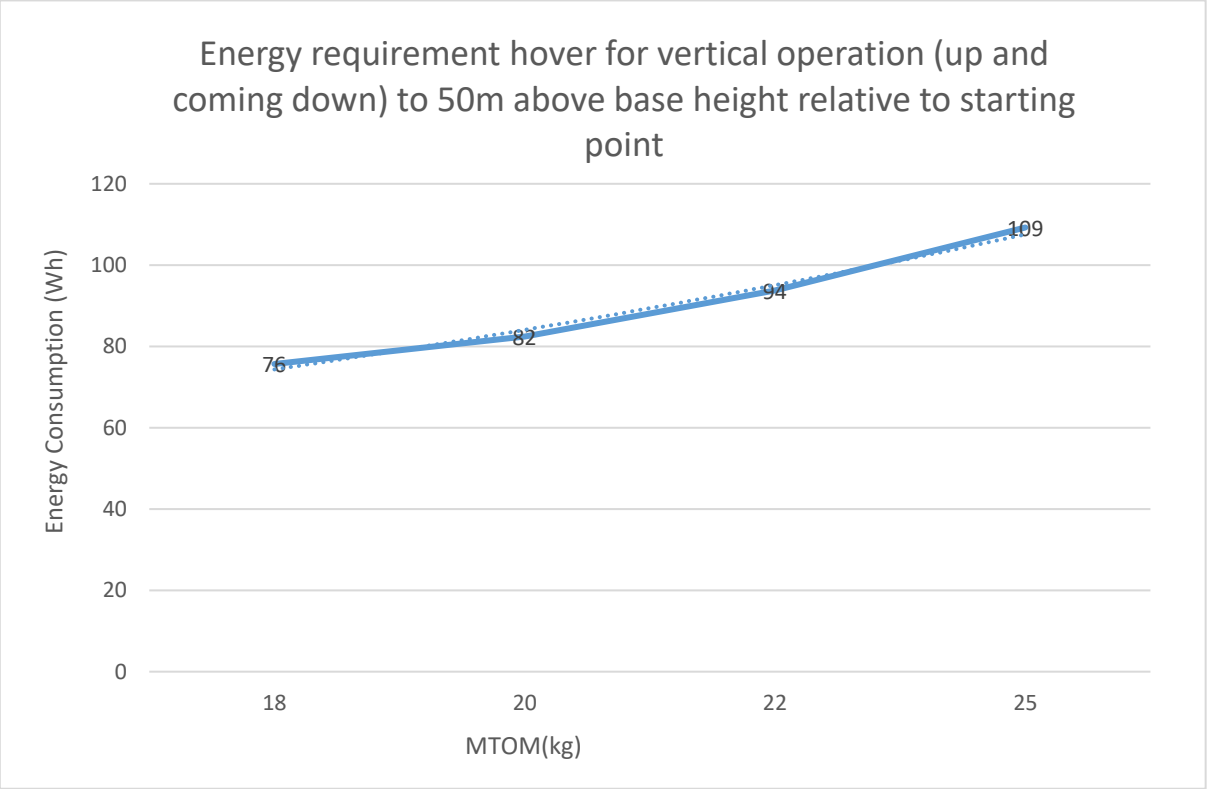
It is possible to integrate a surveillance flight as part of a flight mission.

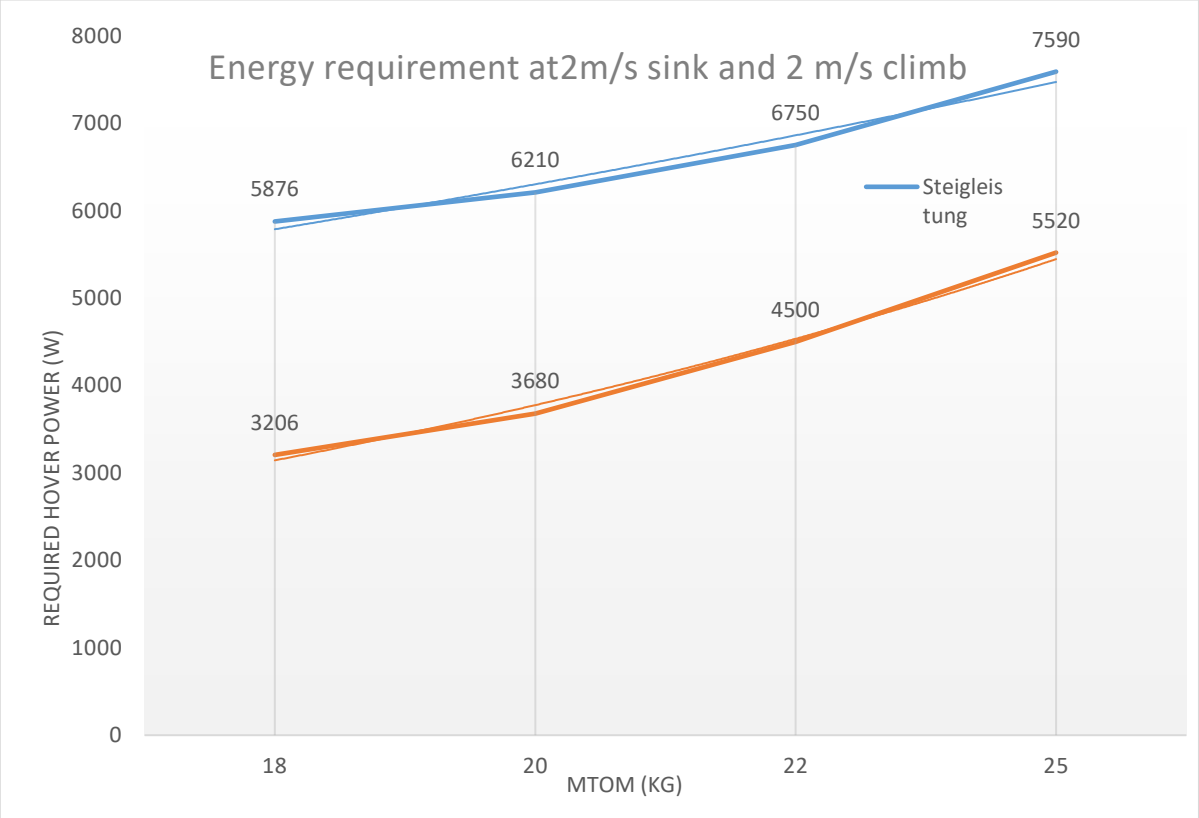
Generally it should be noted that a transition into fixed wing mode and a reverse transition from fixed wing to hover flight mode must be carried out as fixed wing under the menu item Waypoint VTOL Transition. Only after the reverse transition has been completed may the menu option Waypoint VTOL Transition Multirotor Mode be selected. A reverse transition is selected directly the multirotor mode can lead to significant rotation of the vertical axis (yaw).

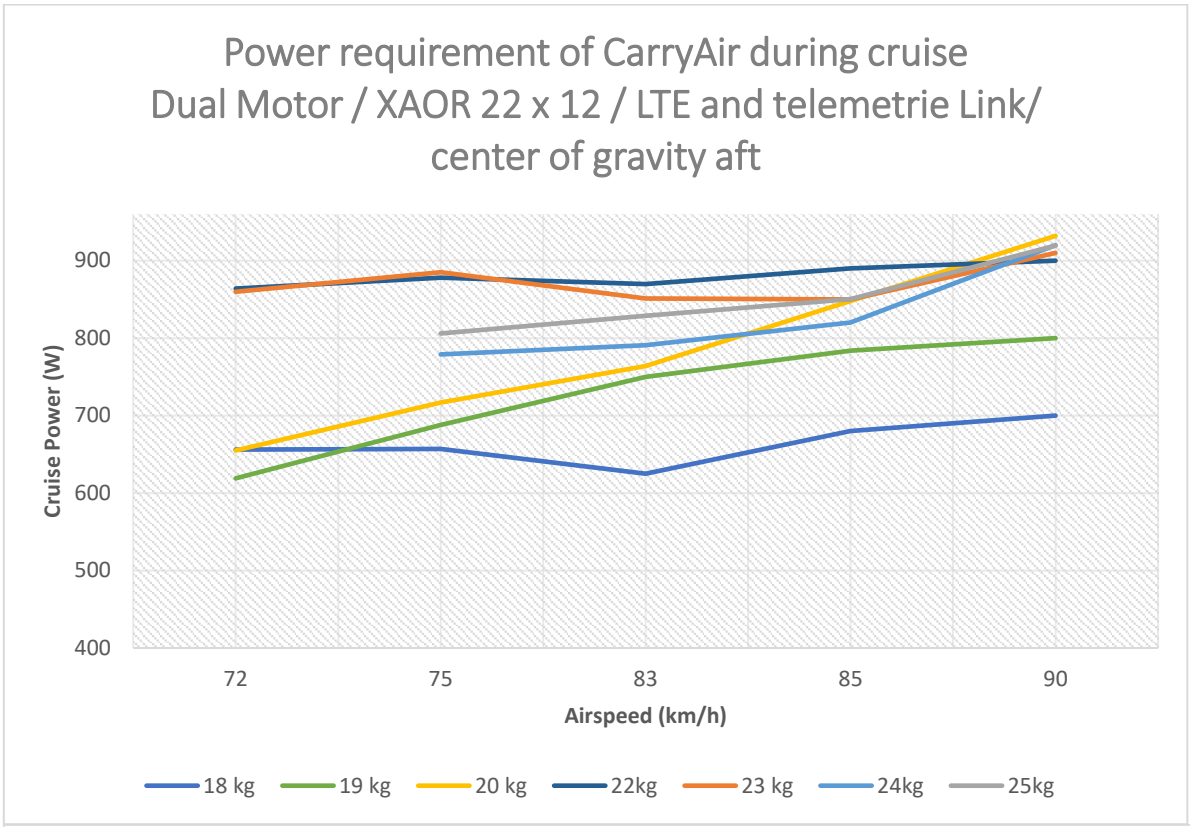
For save operation following modes of operation are to taken into consideration to do a Hover Survey with a long hover sequence:

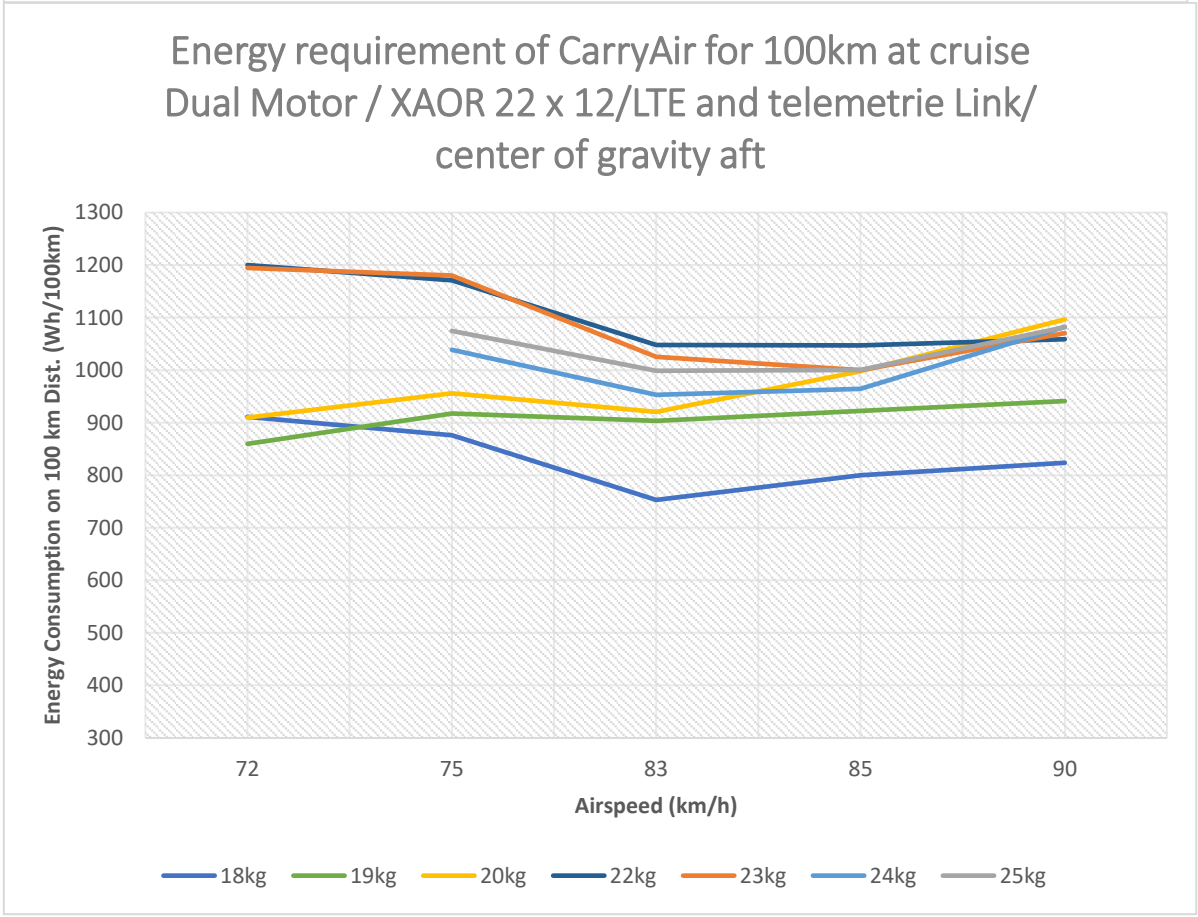
- MTOW 22kg (For higher Payloads contact Striekair for larger carbon Hover Propelllers)
- Max wind gusts of 30 km/h
- State of charge of a 30.000 mAh 12S battery has to be at least 75% at the start of a hover mission
- Max time span for hover flight within a surveillance mission must not exceed approx. 8 minutes (Depending on the MTOM)
- Max outside temperature to be limited to 30°C
- Center of gravity neutral

18 Performance and Energy Requirements









The following calculations are based on the SLS LiPo batteries and a gasoline Range Extender and describe possible battery configurations with calculated results in regard to airtime and maximum range with a safety margin of 20% battery capacity remaining after landing. **It must be taken into account that higher wind speeds, closely successive flight maneuvers and a payload that is adding aerodynamic drag result in shorter ranges and flight times.**

As soon as the critical voltage message is displayed, the aircraft must be switched to RTL mode. An automatic initiation of the RTL Mode can be activated in consultation with the manufacturer, but appropriate geofencing and terrain specifications must be taken into account.

Flying in the front center of gravity position can result in a higher energy requirement of about 20%.

19 Maintenance

The proportion of mechanically complex components was deliberately kept at a minimum during the developement of CarryAir.

The individual components and electrical installation of the aircraft have to be checked according to the following table and according to the specified maintenance intervals.

19.1 General Maintenance Instructions

- All maintenance must be carried out by competent personal according to the maintenance table.

- All repairs and changes must be reported and tested

- Repairs: The owner may only carry out repairs as they relate to exchange of defective components.

- For purposes of replacement only original parts can be used. Components may not in any shape or form be repaired.

- Technical failures:

  All technical failures or defects must be reported to:

  Striekair engineering GmbH
  Marienstrasse 18
  33332 Gütersloh

19.1 Compass Setup

An improperly calibrated compass can disable the aircraft from arming. One reason for this may be that the aircraft has to be flown in the southern hemisphere and it has been calibrated in the northern hemisphere.

Please follow the steps below to calibrate the compass.

First Step: Large Aircraft Basic setting with Mission Planner

1. Open the latest version of the Mission Planner firmware on your PC.
2. Set up the aircraft outdoors, as far away from metallic objects and buildings as possible, and align it with a compass (Handy Compass app if necessary).
3. Connect the drone to the computer with a USB cable. Plug the USB cable into the USB micro connector on the cable in the rear electronics area of the flight controller.
4. Click on "connect" in the upper right corner of Mission Planner and select Auto or the appropriate Mavlink Cube orange COM if the connection fails.
5. Go into the menue Setup of the mission planner and choose the compass setting on the left side.
6. Choose “Large Aircraft” in the bottom area.
7. The aircraft must have enough Satellites to get the GPS Lock.
8. Fill in the right Heading that is shown on your compass into to text field of the Mission Planner.
9. Check the Heading of the Compass on the flight controller and compare it with the other compass.

Second Step: Manual input of compass values from the flight log

The most precise calibration is achieved by determining the compass values from the last flight log which the aircraft should have flown for a few minutes.

1. Send the Log file to the Manufacturer
2. Get the calibrated compass values from the manufacturer

19.2 General information about bolt joints

All bolt joints except 3mm Bolts must be secured with Locktite or with new lock nuts.

The control rods on the elevon servos are to be secured by safety wire so that the spring clips for attaching the fork heads are looped with the wire.

- For thread sizes M4 or larger, medium-strength threadlocker of the type Locktite 243 has to be used.

- For thread sizes M3, low-strength threadlocker of the type Locktite 222 has to be used.

Torques of the different screw connections:

Bolt diameter	Torque
M3 plus Locktite 222	1 Nm
M3 Propeller Grade 12.9 no Locktite	2 Nm
M4 In 3D printed Polyamide engine mounts plus Locktite 243	0,8Nm
M4 in all metall parts like Motors plus Locktite 243	2.5 Nm
M5 plus Locktite 243	4Nm
Screw terminals main power distributor red / blue	2,5Nm
Front propeller screws M8 NO Locktite Retighten after the first 10 flight hours or 2 month after first test flight Degrease propeller shaft and clamping cone inside 6mm properly with brake cleaner	15 Nm

Checklist of all mechanical components

The TBO for this aircraft is 300 hours of flight. The aircraft has to be send back to the manufacturer for detailed inspection.

The 50 hours check requires a maintenance training by the manufacturer.

The prescribed maintenance intervals of the manufacturer of the additionally installed components must be observed.

- Payload
- Control system
- Range Extender
- Batteries

Before all inspections clean aircraft with a mild dishwashing detergent

Intervall hours	preflight	50	Operation
	x		Check the fuselage and wing for damage
6 pcs. Hover motors		x	Check bearing play and bearing noise Inspect the motor for any deformities by checking the gap between the motor and its base is even and its spins freely. If not sure, refer to the workshop for further inspection.
2pcs. Front motor		x	- Check for bearing play and bearing noise. - Check the bolting points on the CFRP motor mounts. - Tighten the propeller with a torque of 15 Nm. Attention, a second wrench must be placed from the inside behind the rear motor so that the torque is also applied to the rear clamp connection.
Front and aft undercarriage	x		Check for cracks and play in the bolting points
Wing supports outside		x	Check adjusting rings for tight fit and plastic clamping. It should be possible to turn the feet with slight friction.
Hover Propellers	x		- Check blade root tightening points. The blades must be able to move backwards with light fingertip force, but must not have any play. - Gently slide propeller between two fingers and feel if there are any chirps, crack or damage on the propellers. Replace if the damage is visible and may compromise a safe flight.
Frontpropeller and Spinner	x		Check for cracks If the aircraft shows louder vibrations in flight than usual, rebalance the spinner and propeller. Contact the manufacturer for this.
Wing connection bolts		x	Check for play Check for cracks Check for wear
Rudder Linkages	x		Check hinges for hairline cracks Check rudder horns for cracks and tight fit. Check clevises with locknuts and wire retainers for cracks and tight fit.
Payload Bay	x		Check hinges (play, cracks) Check Payload attachment Remove Dust or loose parts Check door closer Check Rescue system
Servos			Check servos for servo play and servo noise. If you notice a significantly larger rudder play as well as a trembling of the servos, they must be replaced.

19.3 Checklist of electrical components

Intervall hours	10	50	Operation
Automatic Motor connectors in the wing rootrib	x		Contact sockets centered in plug center, not bent? Plug housings may have slight play, but should be held firmly in position
Cables		x	Check for abrasion, insulation and tight fit
Battery Plugs	x		Check for abrasion, insulation - Check for tight fit - Check for discoloration and high temperatures due to melted insulation.
Screw terminals main power distributor red / blue		x	Retighten screws with the specified tightening torques
Flightcontroller / Kompass / DC-DC Board /Airspeed sensor / Motorcontroller etc.		x	- Check for tight fit - Check for discoloration and high temperatures due to melted insulation.
Positionlights		x	- Clean contact surfaces of the automatic connectors - Check the function of the lights - Check screw connections of the lights for tightness.
Payload		x	Use Checklist of the manufacturer of the payload itself
Electrical main terminal Plus an Minus Block		x	Tighten the Screws to clamp the cables of the main connector for the first time after 10 Flight hours and later in a 50 Flight hour interval.

Acceptance Test

	Special reworking / replaced Components	Signature / Date
After 50 h		
After 100 h		
After 150 h		
After 200 h		
After 250 h		
TBO 300 h (At manufacturer)		
After 350 h		
After 400 h		
After 450 h		
After 500 h		

Basic drone maintenance/repair toolkit

Hand Tools

- Screwdrivers Slot and Phillips medium and small
- Hex wrenches (2,5mm, 3 mm)
- Torx Screwdriver T10, T20
- Pliers and Wire cutters/strippers
- Torque Screwdriver 0,8Nm, 1 Nm, 2Nm, 3Nm, 4Nm, (VANPO Digitale 1/4'', 0.3-6Nm)
- Torque wrench with 14mm Nut @ 15 Nm (Wera 05075604001 Click-Torque A 5)
- Long 2.5 mm adapter for Nm torque wrench (For Propeller hub 2 Nm)
- Wrench Set 5,5mm – 14mm

Electrical Tools

- Crimping clamp
- Crimping connectors
- Hot air gun
- Heat shrink tubes
- Electrical tape
- Cable ties

Cleaning Equipment

- Lint-free cloths
- Compressed air can
- Isopropyl alcohol
- “Presto” (acetone free) brake cleaner

Calibration Tools

- Multimeter
- Spirit level
- Measurement tape

19.4 Electrical System Diagram