



MAINTENANCE MANUAL KAUSHALYA DRONE

KUSHAL INCUBATION AND INNOVATION FOUNDATION

Version 2

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VERSION CONTROL

Date	Version	Amendments	Page Number	Done by	Reviewer
17/06/2023	1	N/A	N/A	Sai Kumar Pallati	Sai Raj Bayela
14/12/2023	2	Life of critical items	5	Sai Kumar Pallati	Sai raj Bayela



Chapter 0: Key features

-This section describes the key features of UAV.

Life of Critical items:

Life of propeller	5000 flight hours
Battery	256 cycles (charging & discharging)
Life of air frame	5000 flight hours
Max permissible landings	5000 landings

List of critical items:

1. Top carbon fiber plate -1
2. Bottom carbon fiber plate -1
3. Landing gear tube -4
4. Arm connectors-4
5. Battery
6. Propeller



1.0 Maintenance schedule:

The following table summarizing the overhaul schedule of all the individual components.

Inspection schedule	
No. of flights	List of items
Scheduled Maintenance	Carbon fiber top plate-1
	Carbon fiber bottom plate-1
	Landing gear-4
	Arm connectors-4
Every flight	Motor bolts
	Propellers
	GPS
	Battery
Every 50 flights	Motor plate
	Battery plate
	Battery Velcro
	Battery knurling bolt
	Motor C clamp
	Foldable arm
Every 100 flights	Landing gear
	Foldable arm connector
	Antenna
	Side railing
	Back railing
	Front railing
	Battery stopper
Every 150 flights	Top plate
	Bottom plate
	Top shell

The following chapters give details on the maintenance activities performed according to the frequency listed in the above table.



2. MAINTENANCE MANUAL

2.1 Inspection of critical components:

-This section describes the procedure to follow during inspection of critical components of Kaushalya UAS.

2.1.1 Top carbon fiber plate:

Top carbon fiber plate helps carbon fiber arms and arm connectors holds together and absorbs the shocks from the landing gear & withstands for the loads from motors. The cracks, deformation & delamination can be observed on the top carbon fiber plate during flying by the end user. The general inspection has to be performed by the end user & periodic inspection is carried out by the manufacturer during maintenance for every 4 months. If any damages found in the top carbon fiber plate of Kaushalya UAS contact Ikushal support team for further assistance.

2.1.2 Bottom carbon fiber plate:

Bottom carbon fiber plate helps carbon fiber arms and arm connectors holds together and absorbs the shocks from the landing gear, withstands for the loads from motors & payload. The cracks, deformation & delamination can be observed on the bottom carbon fiber plate during flying by the end user. The general inspection has to be performed by the end user & periodic inspection is carried out by the manufacturer during maintenance for every 4 months. If any damages found in the bottom carbon fiber plate Kaushalya UAS contact Ikushal support team for further assistance.

2.1.3 Arm connector:

Aluminum inner arm connectors are used to connect the Top carbon fiber plate & bottom carbon fiber plate to Motor arms. There could be deformation in the arm connector for continuous deformation. The manufacturer has to observe the deformation, cracks in the connectors during maintenance for every 4months. If this problem is continuously observed on Kaushalya UAS contact Ikushal support team for assistance.

2.1.4 Landing gear tube:

Landing gear tubes are connected to bottom carbon fiber plate, due to harsh landing and max landing made by the end user, there can be a chance of cracks propagation and deformation. The end user has to check the landing gear during each landing for the cracks and deformation of the landing gear. The manufacturer checks the deformation and cracks propagation on the landing gear during the maintenance of the UAS for every 4 months. If this problem is continuously observed on Kaushalya UAS contact Ikushal support team for assistance.

2.2 Inspect every post flight

This section describes the procedure to follow during inspection of Kausalya drone every post flight.



-Motor bolts

-Propeller Level

-GPS

-Battery

2.2.1 Motor bolts

-This section describes the procedure to be followed during inspection of Motor bolts.

Pilot has to check the motor bolts at each and every flight using Allen Key for any frequent loosening of all the bolts before takeoff. Loosening of these bolts will lead to vibrations and may at times lead to crash.

Rotate the propeller with free hand, and check for noise. The motion has to be free during the rotation. Check the motor bolts shown in the image below.

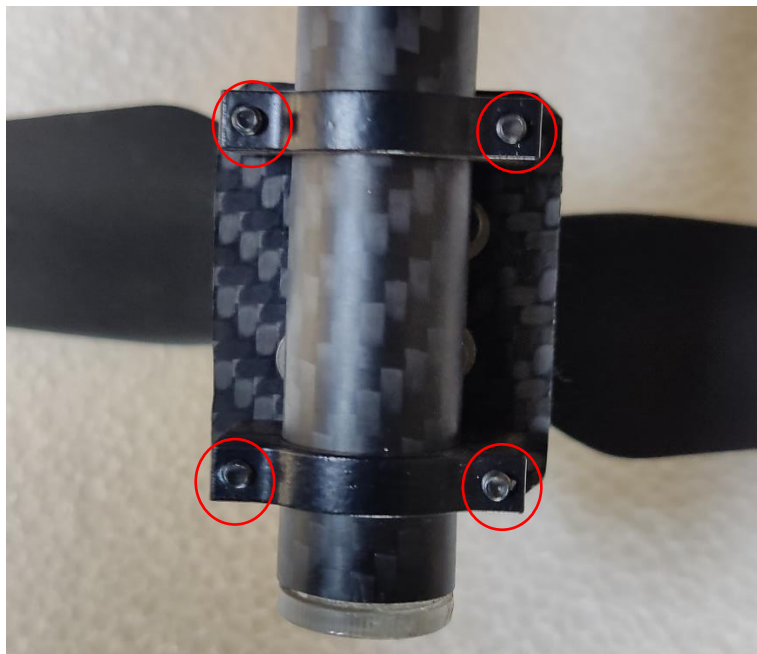


Image1: Motor bolts

2.2.2 Propeller level

-This section describes the procedure to be followed during inspection of propeller level.

The propellers have to be in level with respect to horizon for the drone to be stable,

Observe the leveling of propellers by aligning two adjacent propellers linearly. If pilot found propellers are not level to each other, contact the KUSHAL SUPPORT team.



2.2.3 GPS

-This section describes the procedure to be followed during inspection of GPS.

GPS Towers have to be inspected for any loosening before every flight. GPS tower loosening will lead to malfunction of navigation system on board.

GPS LED lights have specific meaning. Following list covers most use cases

- Yellow flashing indicates GPS is not yet fixed
- Green flashing indicate drone is ready to arm
- Blue, red & yellow colors indicate the drone is rebooting"

If the pilot continuously observes yellow light flashing on GPS even after a few minutes of booting up, please contact the KUSHAL SUPPORT team. after connecting the battery to drone.



Image 3: GPS

2.2.4 Battery

-This section describes the procedure to be followed during inspection of battery



Always check for the battery voltage on the telemetry screen or using a LIPO checker. Battery Voltage should lie within 14.8 Volts to 16.6 Volts.

Check for 'Consumed mAh' on the telemetry screen and 'Charged mAh' on Battery charger for every battery cycle. These both values should match and shouldn't exceed 7,500 mAh with a fully charged battery.

Check the XT60 connector shown below for any deformation or loosening for every flight

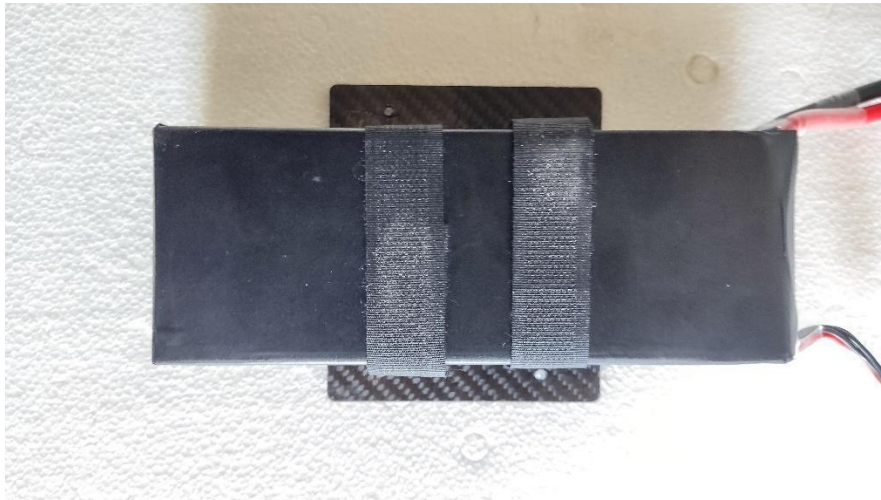


Image 4: battery

Check for any bulging of batteries. If drone batteries are over discharged or over charged, LIPO batteries tend to bulge as shown in the below images. Deformed batteries are not safe to use on any drone. If you find any incidents mentioned above, Kindly contact the KUSHAL SUPPORT team.

2.3 Inspect every 50 flights

This section describes the procedure to follow during inspection of the Kausalya drone every 50 flights.

- Motor plate*
- Battery plate*
- Battery Velcro*
- Battery knurling bolt*
- Motor C clamp*
- Foldable arm*



2.3.1 Motor plate

-This section describes the procedure to be followed during inspection of the Motor plate.

Motor plate helps to mount the motor on the foldable arm. Motor plate tends to deform eventually for certain flights. Inspect cracks, delamination on motor plate for every 50 flights before takeoff. Motor plates tend to delaminate as shown in the image below. If the pilot observes any crack, delamination on the plate, please contact KUSHAL SUPPORT team.



Image 5: Motor plate

2.3.2 Battery plate

-This section describes the procedure to be followed during the inspection of Battery plate

Battery plate helps in holding the battery to RPA. Pilot has to inspect the battery plate for bending, Cracks & delamination of battery plate. Plate tends to delaminate, bend as shown in the image below. If pilot observes any crack, delamination on the plate, please contact the KUSHAL SUPPORT team.

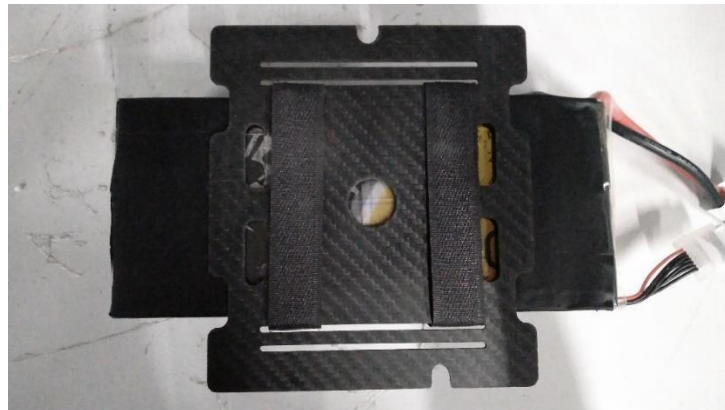


Image 6: batter
plate

2.3.3 Battery Velcro

-This section describes the procedure to be followed during the inspection of battery Velcro

Battery Velcro tape helps in making battery and battery plate close together all the time. Battery Velcro tapes has to be stick to the battery plate as shown in the image below. If pilot observes no Velcro tape on the battery to battery plate. Please, contact KUSHAL SUPPORT team.

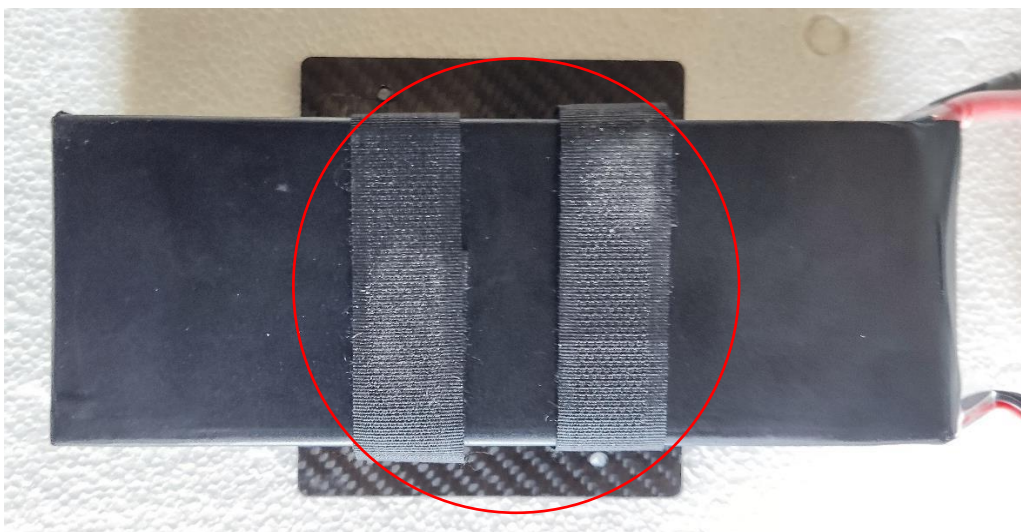


Image 7: Battery Velcro tape



2.3.4 Battery knurling bolt

-This section describes the procedure to be followed during the inspection of battery knurling bolt

Knurling bolt helps to restrict the moment of battery during Flight. Knurling bolt has to be inspected for loosening of the bolt and nut. If pilot observes loosening of battery knurling bolt, please contact KUSHAL SUPPORT team.

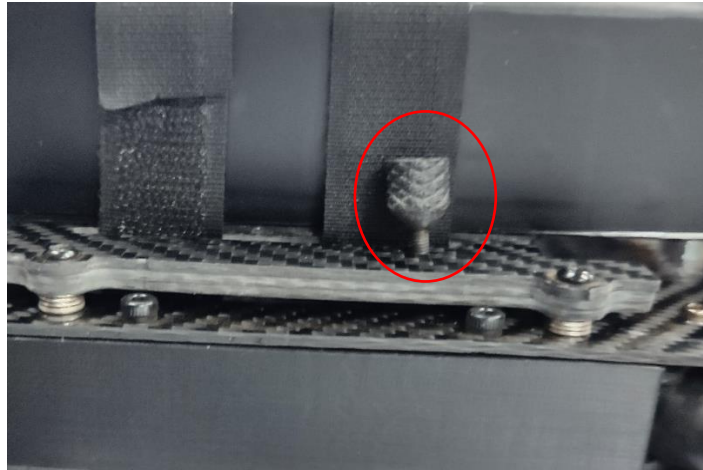


Image 8: Knurling bolt

2.3.5 Motor C clamp & C clamp bolts.

-This section describes the procedure to be followed during inspection of motor C clamps & bolts.

Motor C clamps usually determine the motor and propeller leveling. Motor C clamps and C clamp bolts tends to loosen for certain time, Pilot has to check for clamps & C- clamp bolts on the arm. If pilot observes C clamps bolts are loosening, please contact KUSHAL SUPPORT team.



Image 9: Motor C clamp

2.3.6 Foldable arm

-This section describes the procedure to be followed during the inspection of foldable arm.

Check for cracks, bending & deformation on foldable arm. If pilot observes any of these on foldable arm, please contact KUSHAL SUPPORT team.



Image 10: Foldable arm

2.4 Inspection every 100 flights

This section describes the procedure to follow during inspection of Kausalya drone every 100 flight.

- Landing gear*
- Foldable arm connector*
- Antennas*
- Side railings*
- Back railings*
- Front railings*



2.4.1 Landing gear

This section describes the procedure to be followed during the inspection of Landing gear.

Inspect for cracks, dents and deformation on landing gear, if pilot observes any cracks or deformation on landing gear as shown in the image below. Please, contact KUSHAL SUPPORT team.



Image 10: Landing gear

2.4.2 Foldable arm connector

This section describes the procedure to be followed during the inspection of Foldable arm connector.

Foldable arm connector helps in the connection of the top and bottom plate. Inspect loosening of foldable arm connector, Contact KUSHAL SUPPORT team.



2.4.3 Antennas

This section describes the procedure to be followed during the inspection of Antennas.

Antennas are the primary source to transfer the information from transmitter to receiver. Antennas should be tightly fixed to the back railing. Antennas shouldn't be in loose condition. Inspect antennas are getting loosen over time, as shown in the image below. Please contact KUSHAL SUPPORT team.



Image 10: Antenna's

2.4.4 Side railings

This section describes the procedure to be followed during the inspection of Side railings

Side railings are basically cosmetic parts helps in RPS no exposure of the electronics outside environment. Inspect for cracks and deformation on the side railings as shown in the image below, please contact KUSHAL SUPPORT team.

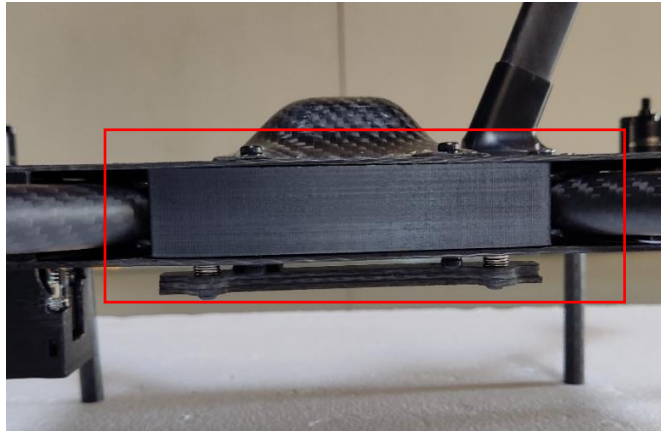


Image 11: side railings

2.4.5 Back railings

This section describes the procedure to be followed during the inspection of Back railings.

Back railings are basically cosmetic parts helps in RPS no exposure of the electronics outside environment. Inspect for cracks and deformation on the back railings as shown in the image below, please contact KUSHAL SUPPORT team.

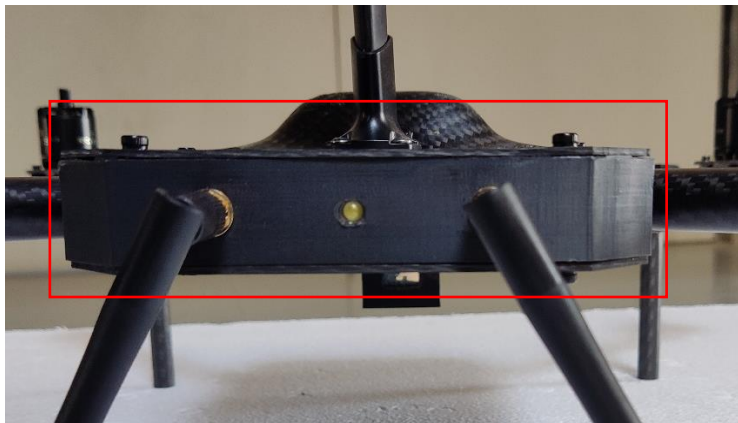


Image 12: back railings

2.4.6 Front railings

Front railings are basically cosmetic parts helps in RPS no exposure of the electronics outside environment. Inspect for cracks and deformation on the front railings as shown in the image below, please contact KUSHAL SUPPORT team.



Image13: Front railing

2.5 Inspection every 150 flights

This section describes the procedure to follow during inspection of Kausalya drone every 150 flight.

-Top plate

-Bottom plate

-Top shell

2.5.1Top plate

This section describes the procedure to be followed during the inspection of top plate.

Inspect bolts on the top plate of side railings, Back railing, Front railing, foldable arms, C clamps & Landing gear bolts, nuts. they will get loosen over time as shown in the image below. Pleas, contact KUSHAL SUPPORT team.

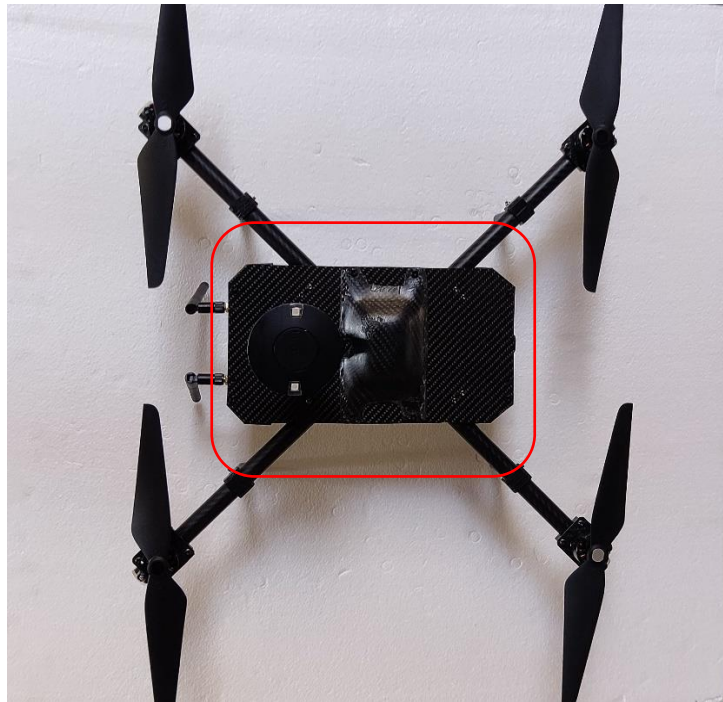
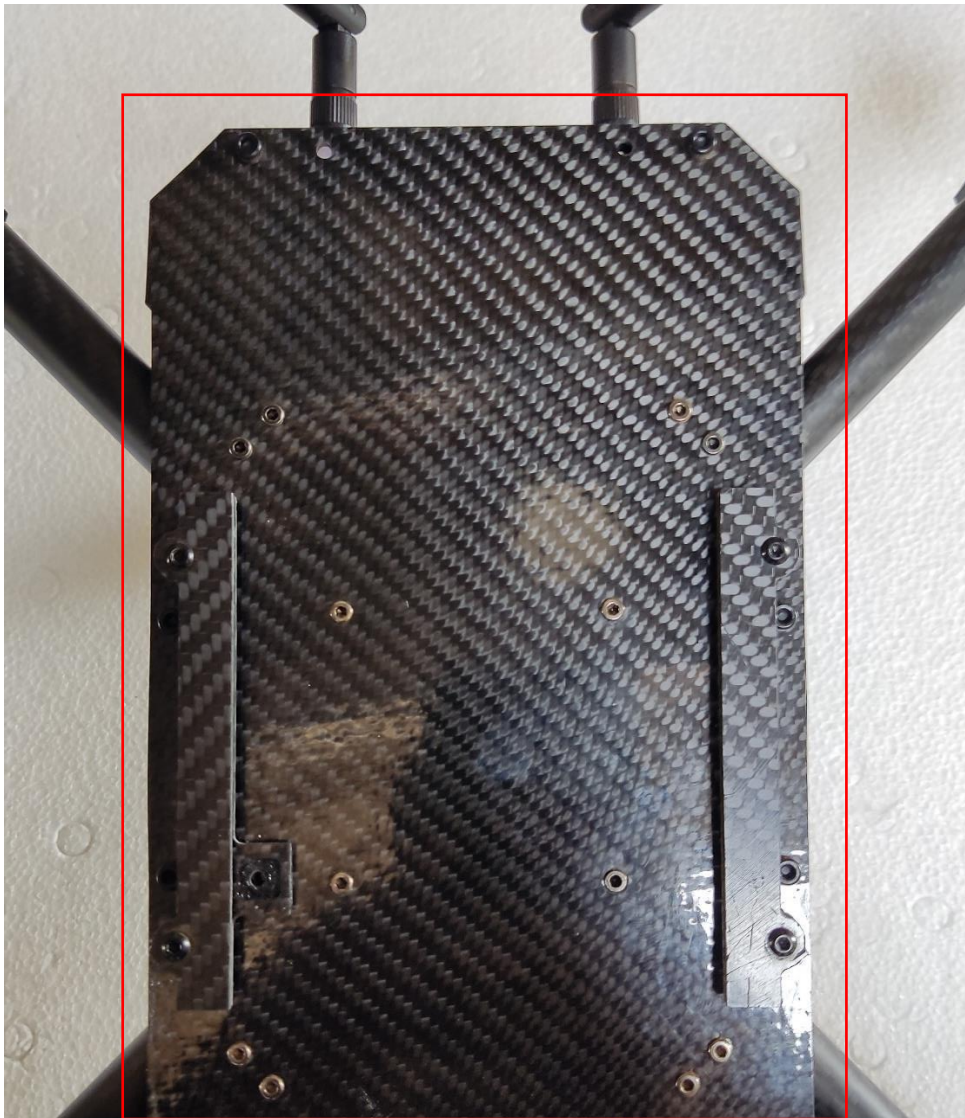


Image 15: Top plate

2.5.2 Bottom plate

This section describes the procedure to be followed during the inspection of bottom plate.

Pilot has to inspect the bottom plate and bolts for every 15 flights before and after takeoff. He / She has to check the cracks, dents & damages on the bottom plate. Check all the bolts are tightened enough on the bottom plate.



2.5.3 Top shell

This section describes the procedure to be followed during the inspection of Top shell.

Top shell is the center part of the RPA .Pilot has to inspect all the bolts on the top shell for every 15 flights before and after takeoff.

he / She has to check the bolts are completely tightened on the top shell. Check the top shell image as referred to image below.

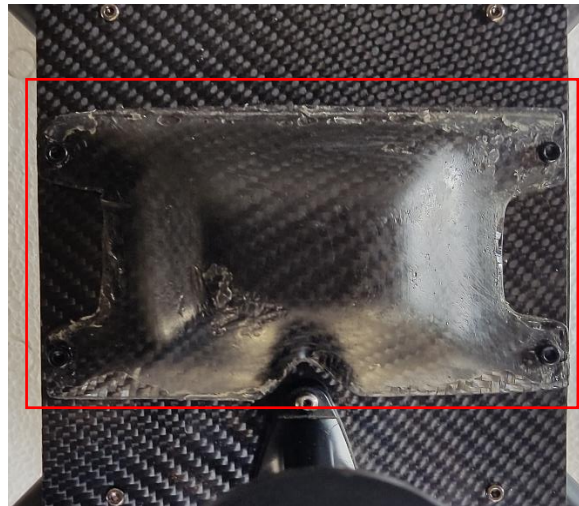


Image 16: Top shell.

2.5.4 Motor

This section describes the procedure to be followed during the inspection of Motor.

Motor is the primary and the moving part in the RPS. Pilot has to inspect the motor condition for every 15 flights before and after takeoff. When he/ She rotates the propeller with free hand there shouldn't be any noisy, the moment has to be very free.



Image 17: Motor.



3. Continuous components monitoring LOG:

3.1 Components monitoring process:

3.1.1 Objective

A component performance monitoring system, identifying root causes of component failures, and deficiencies and implementing corrective measures is considered essential to improve product safety and reliability in Aviation. A component performance monitoring system is designed to meet the objective mentioned above.

3.1.2 Procedure

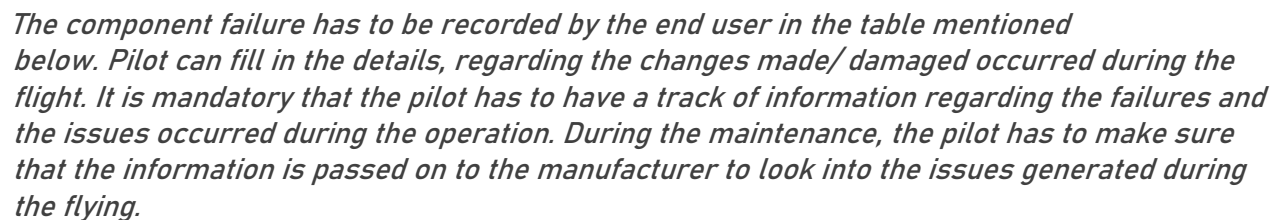
- Proper collection of data, accurate analysis and interpretation of data are key elements in this procedure.
- Every failure, replacement of, prematurely withdrawal of component, and damage is a data point, hence it is to be recorded meticulously.
- Associated information regarding drone life, component life, name, specs, etc. of affected components, date/hours since installed are recorded.
- Repeated failure within 10 sorties is considered repetitive failure & the component/part is considered critical from a failure point of view.
- Root causes analysis of the cause of failure/ premature withdrawal will be addressed by the manufacturer if not sorted out by the user.
- Based on root cause the causes of failures are bucketed into different categories.
- The same measures are adopted for the next highest cause factors. Once these measures are adopted, continually, over some time the product, safety and reliability would be considerably improved.
- In case of no defect observed during the components lifetime the same component can be used
- Once the life of the component expires the old component will be replaced with a new one.

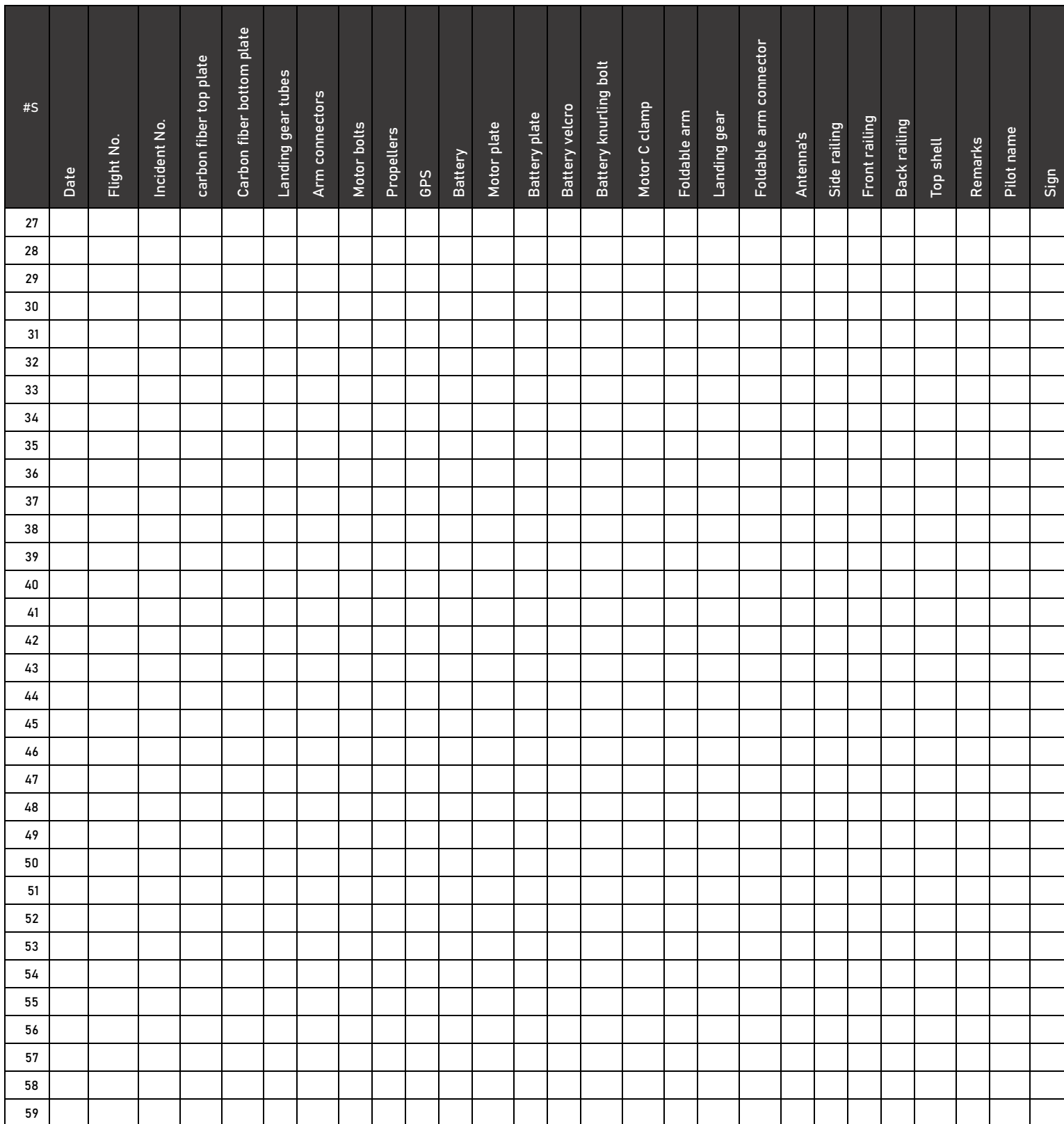
3.1.3 Drone Identification Details:

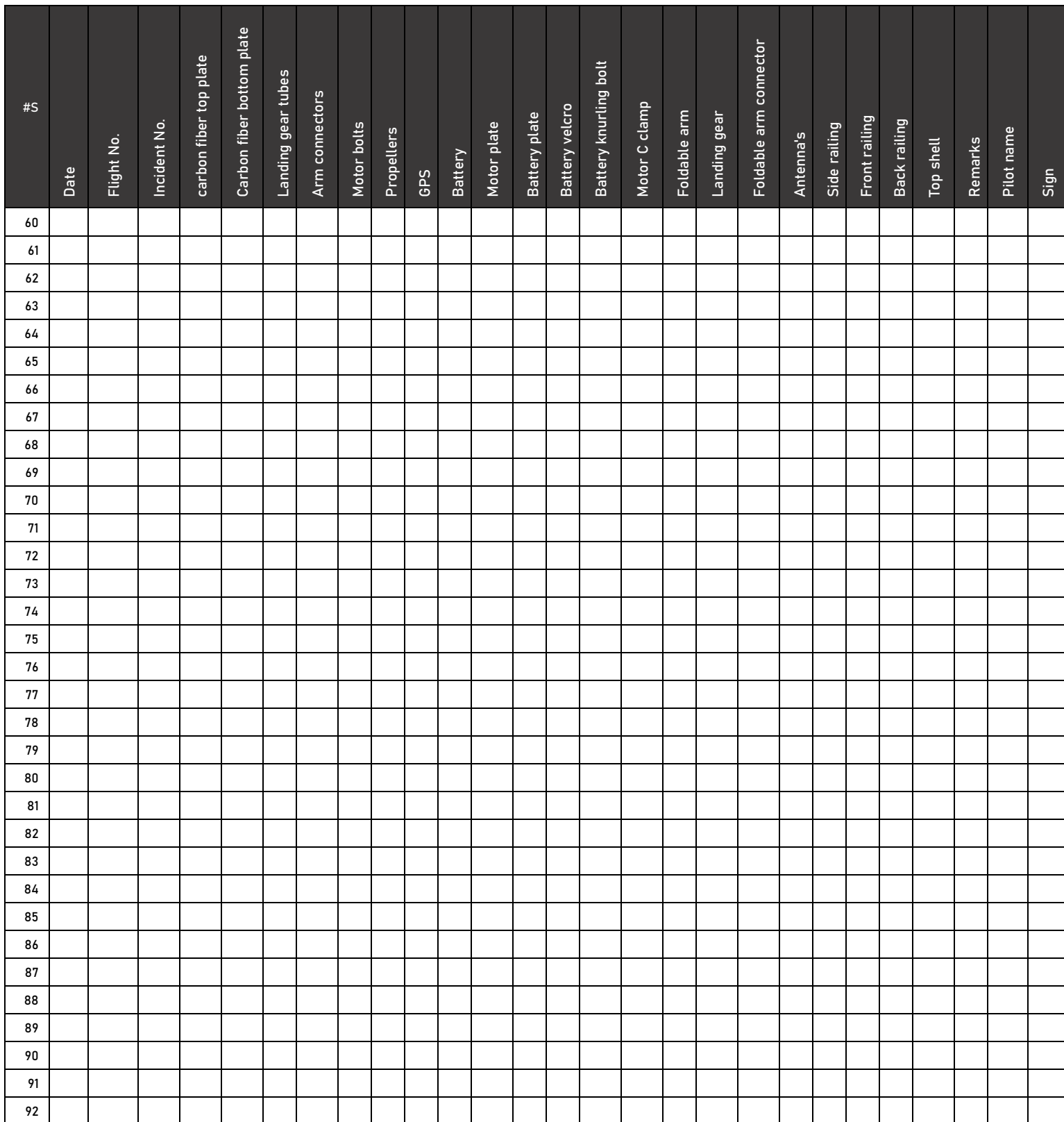
Product ID	
Customer Name	
Date of Purchase	

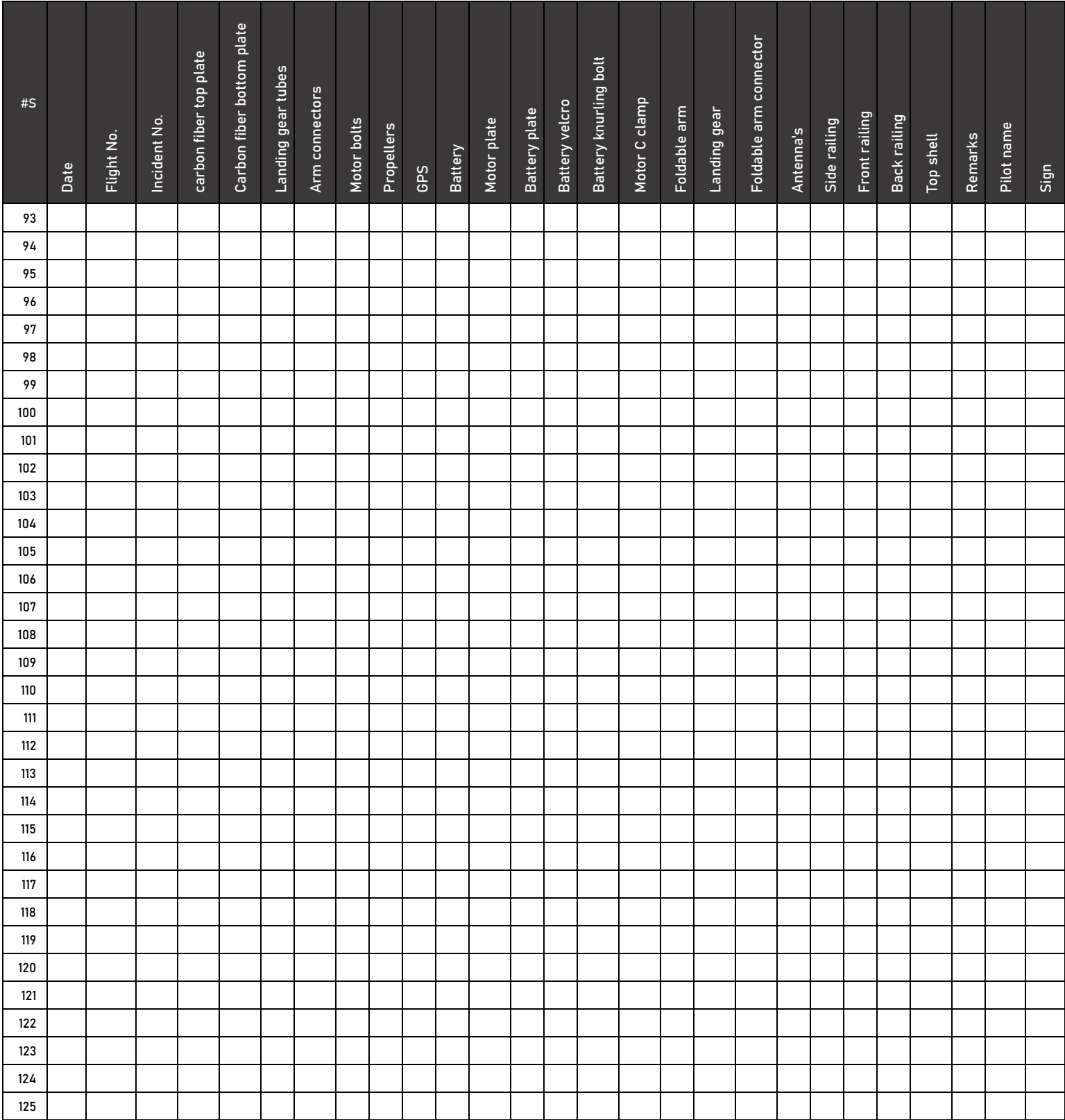
3.2 Component failure & continuous monitoring process:

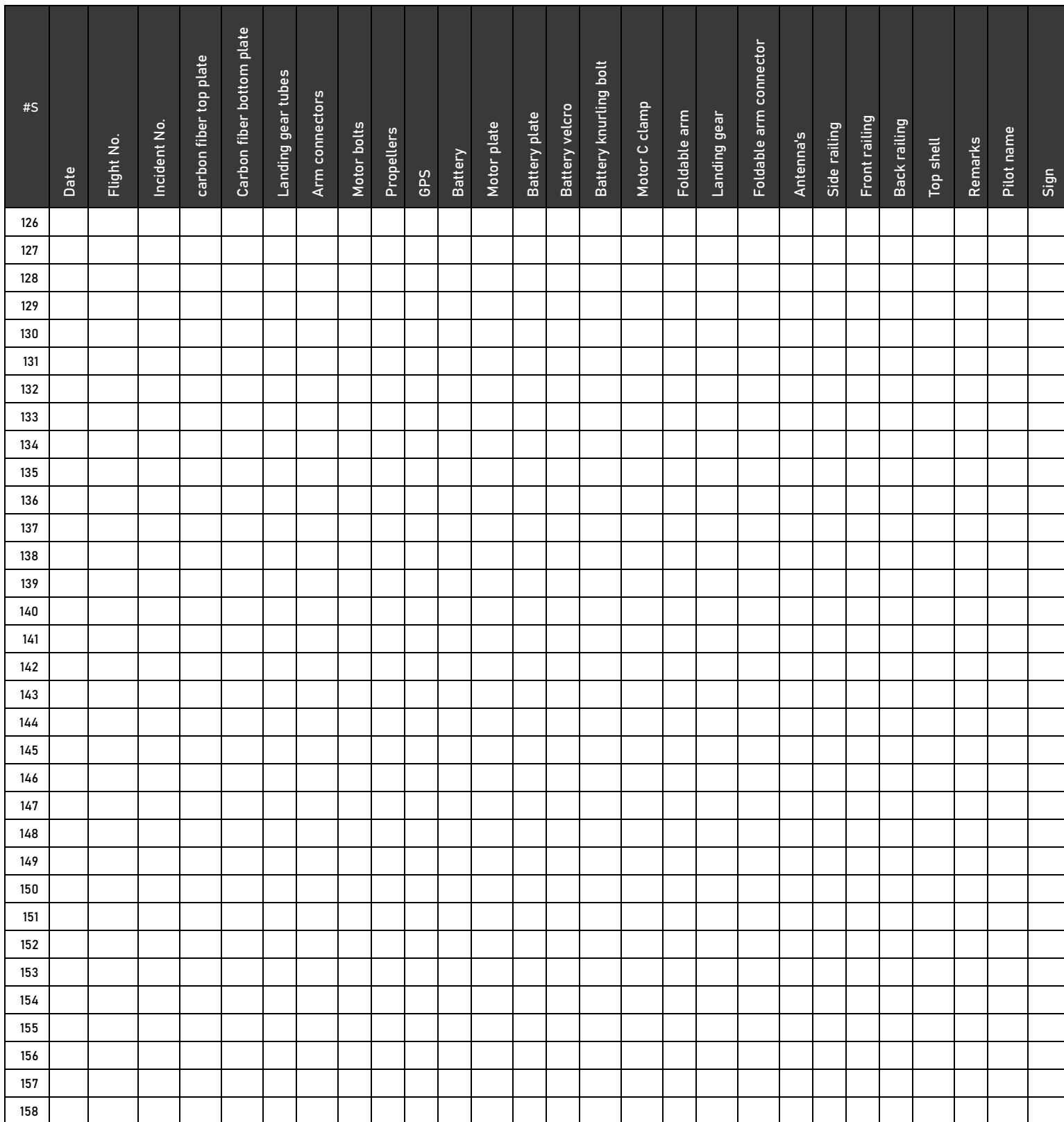
This section describes the component failure of UAV during the operation.

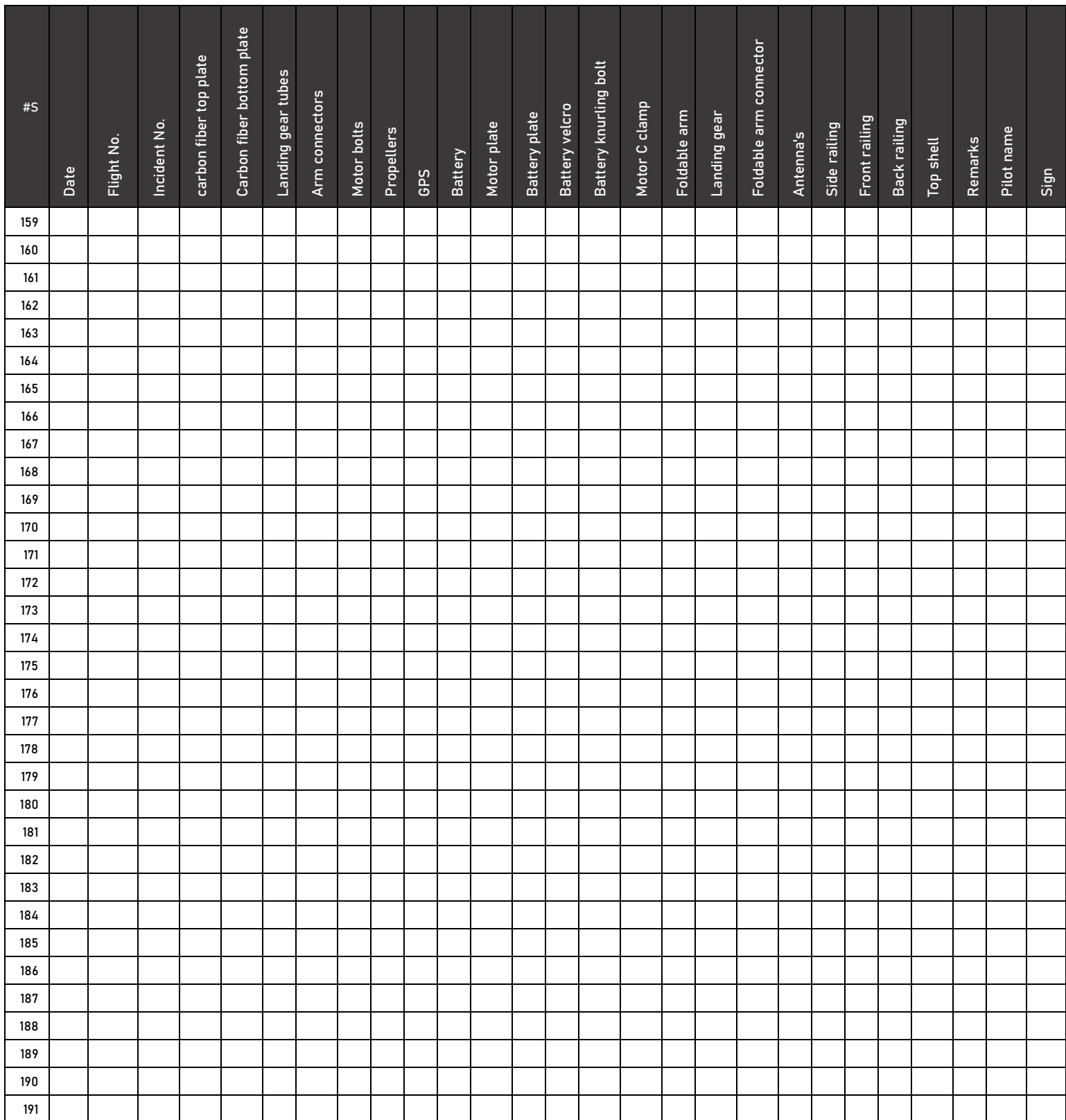
[illegible]

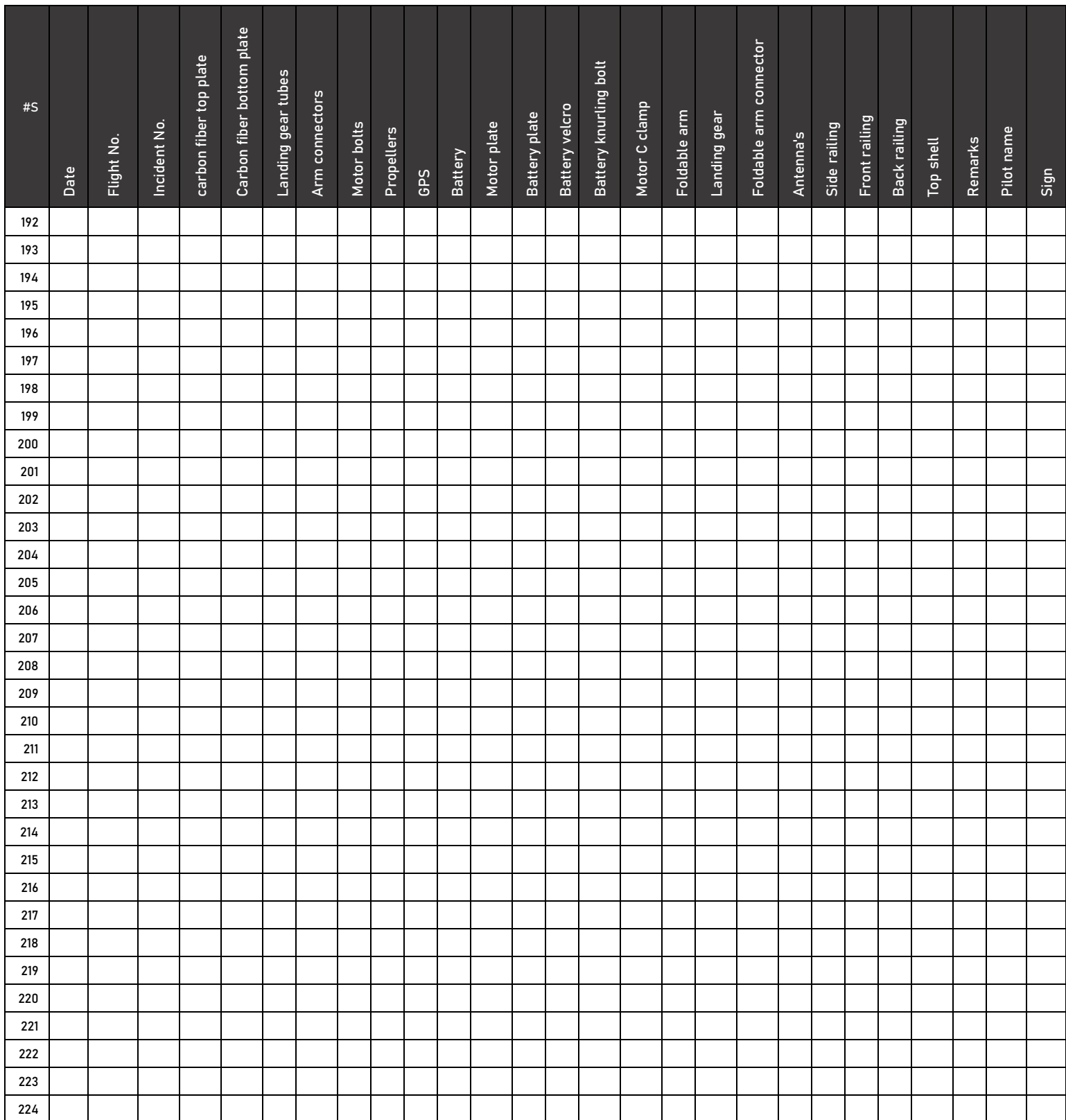


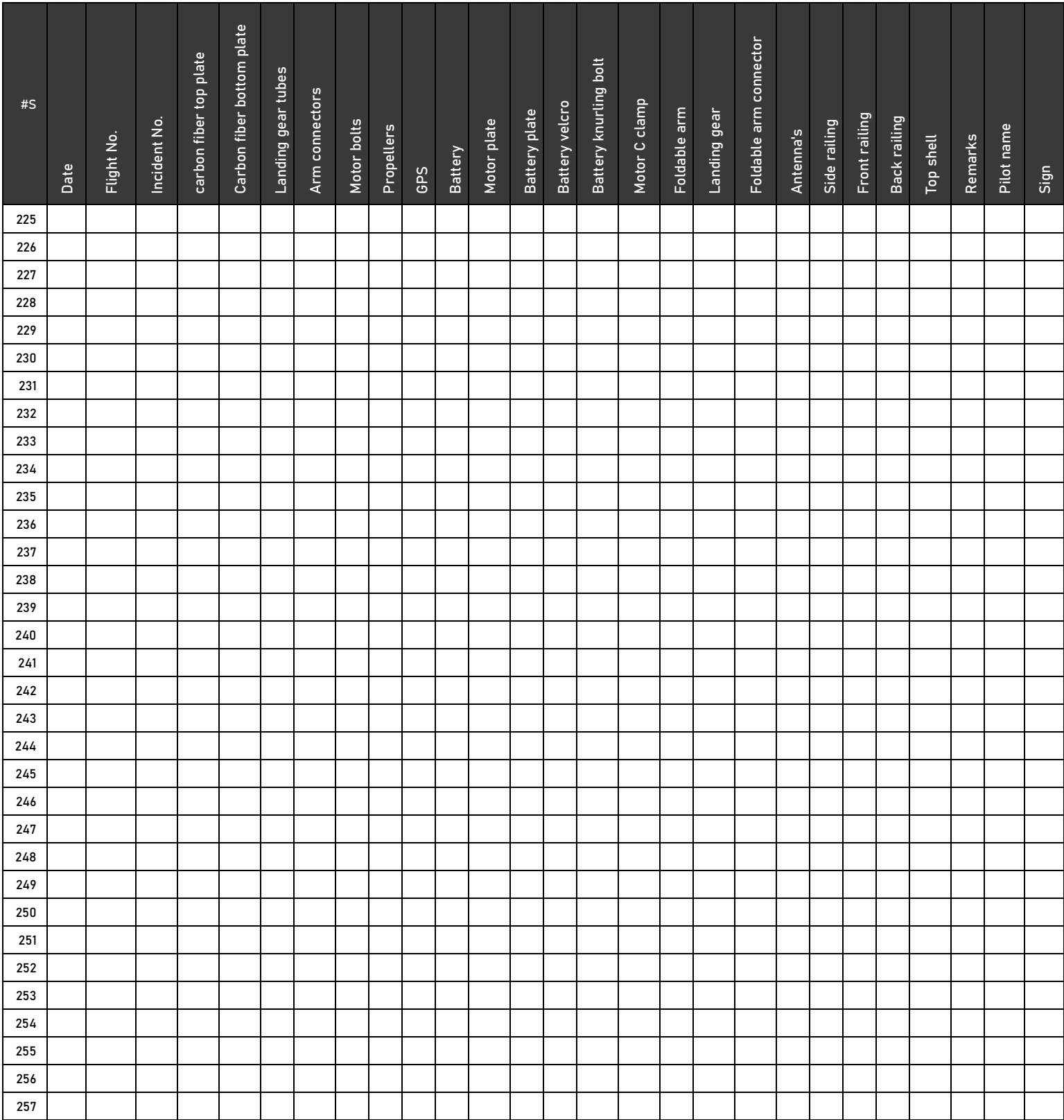


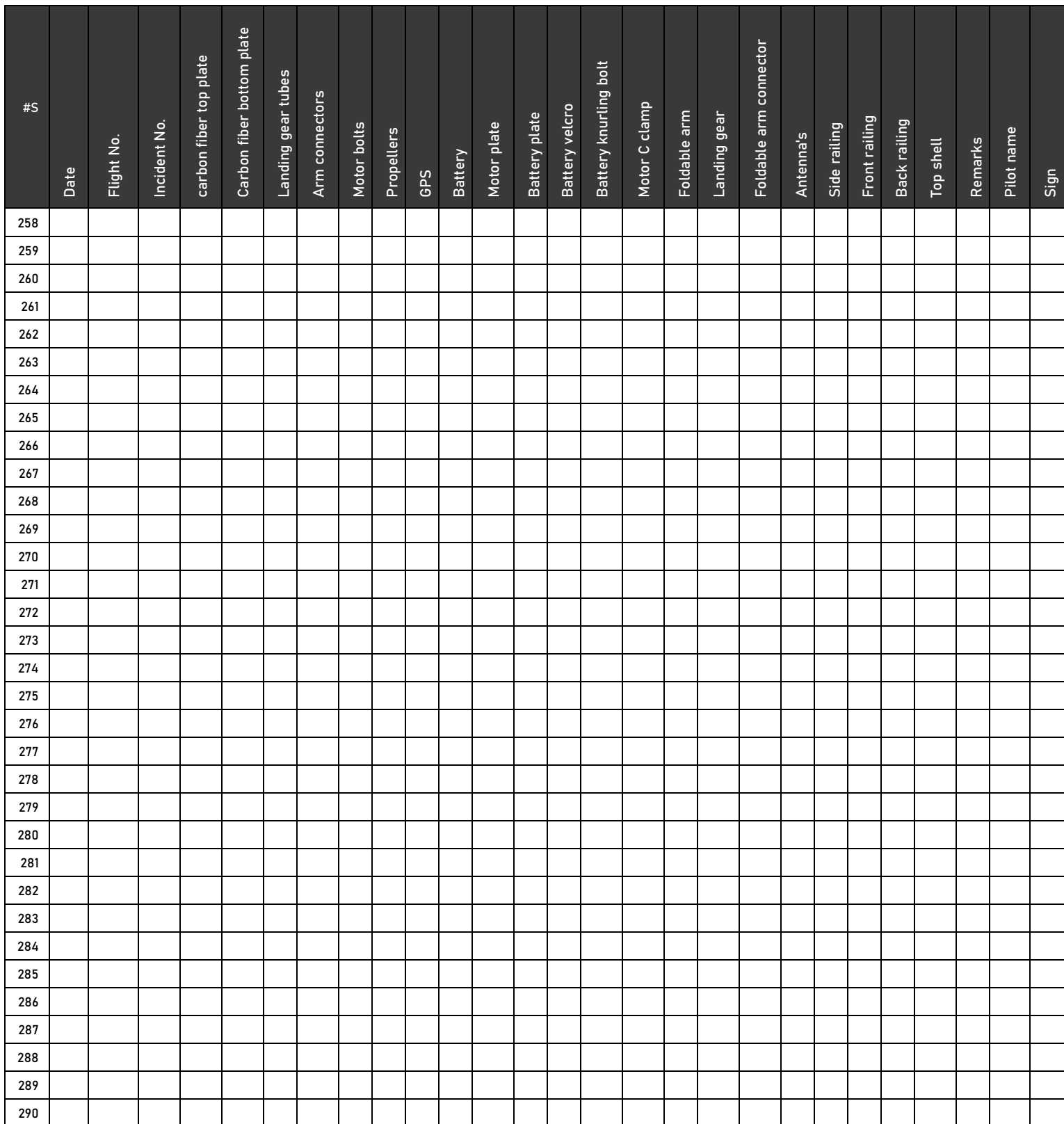














#S	Date	Flight No.	Incident No.	carbon fiber top plate	Carbon fiber bottom plate	Landing gear tubes	Arm connectors	Motor bolts	Propellers	GPS	Battery	Motor plate	Battery plate	Battery velcro	Battery knurling bolt	Motor C clamp	Foldable arm	Landing gear	Foldable arm connector	Antenna's	Side railing	Front railing	Back railing	Top shell	Remarks	Pilot name	Sign
291																											
292																											
293																											
294																											
295																											
296																											
297																											
298																											
299																											
300																											

Note:

1. The Pilot can monitor the list of items are attached above to ensure the smooth takeoff & Land.
2. If any incident happened during the flight. Pilot has to fill in the details on the damage of the items &
3. These columns can be a reference to the manufacturer during the maintenance.
4. This can easily help the customer on the resolving issue easily.

Instructions to fill the table:

1. If a pilot finds any kind of cracks / issues during flight, they can enter the issue in the above table.
2. Informing the manufacturing for seeking help to clear the issue.
3. Pilot has to make sure that the maintenance record has to be shared with the manufacturer during the maintenance.
4. The manufacture will have the track of information about the issues faced by the customer/ end user.
5. Basic maintenance can be done by the pilot remotely; those are mentioned in 1.0 above.

4.Root Cause Analysis Procedure