

课程介绍

Course introduction

该手册将帮助你快速掌握极飞农业无人机作业全流程操作步骤

This Manual will help you quickly master the full-process operating steps for operation with XAG agricultural drone.

那么无人机如何在地里安全飞行？

How can the drone fly safely above a field?

有经验的老飞手如何设置作业参数，以确保作业效果？

How can an experienced pilot set operation parameters to ensure the operation effect?

地里复杂地形下，你必须掌握哪些安全操作的技能？

For fields with complex terrain, what skills must you have to guarantee safe operation?

如何让你的设备比别人更耐用？

How can your device be more durable than others?

章节 1	安全使用须知
Chapter 1	Instructions for Safe Use
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通过操作员实操手册帮助你快速入门了解作业飞行以及对应的操作技巧。通过章节学习，让你每一次的飞行作业更安全、更稳定。

The Operator Manual will help you to quickly understand the flight operation and the corresponding operation skills. After learning all chapters, you can make every flight operation safer and more stable.

祝你学习旅程顺利！

Wish you a smooth learning journey!

在正式开始前，推荐准备以下工具

Before official start of learning, it is recommended to prepare the following tools

1. 极飞 P150 2024 款农业无人机
1. XAG P150 2024 Agricultural Drone

- 2. XRTK6 测绘器
- 2. XRTK6 Ground Module
- 3. SRC4 带屏遥控
- 3. Smart remote controller 4 (SRC4)
- 4. B13970S 电池
- 4. B13970S battery
- 5. GC4000+ 燃油超充站
- 5. GC4000+ supercharge station
- 6. CM13600 充电器
- 6. CM13600 charger



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章节 1 安全使用须知

Chapter 1 Instructions for Safe Use

本章重点：

Key points of this chapter:

学习农业无人飞机飞行前后的安全注意事项及处理措施，减少安全事故的发生，保障飞行任务顺利完成。

Learn the safety precautions and handling measures before and after the agricultural drone flies to reduce the occurrence of safety accidents and ensure smooth fulfillment of each flight mission.

1.1 作业前的安全注意事项

1.1 Safety Precautions Before Operation

1.1.1 设备安全三准则

1.1.1 Three Criteria for Device Safety

1) 实名登记：登录“民用无人飞机驾驶航空器实名制登记信息系统”后进行实名登记。

1) Real-name registration: Log into the “Real-name Registration Information System for Civil Unmanned Aerial Vehicles” to complete real-name registration.

网址：(<https://uom.caac.gov.cn/#/login>)

Website: (<https://uom.caac.gov.cn/#/login>)

注意事项

Precautions

① 根据国务院、中央军委公布的，自 2024 年 1 月 1 日起施行的《无人驾驶航空器飞行管理暂行条例》规定，民用无人驾驶航空器所有者应当依法进行实名登记。“民用无人驾驶航空器未经实名登记实施飞行活动的，由公安机关责令改正，可以处 200 元以下的罚款；情节严重的，处 2000 元以上 2 万元以下的罚款。”

① In accordance with the Interim Regulation on the Administration of the Flight of Unmanned Aerial Vehicles issued by the State Council and the Central Military Commission of the Communist Party of China and implemented from January 1, 2024, owners of unmanned aerial vehicles shall complete real-name registration according to law. “If a civil unmanned aerial vehicle performs flight activities without real-name registration, the owner thereof will be instructed by the competent public security organ to rectify, and may be imposed a fine up to RMB 200, or a fine between RMB 2,000 and RMB 20,000 in serious cases.”

② 对于该无人飞机，系统支持查看及发送实名登记二维码功能，点击发送二维码按钮，系统会将该二维码 pdf 文件发送至注册人的邮箱中，以便无人飞机拥有者将该二维码打印并粘贴到无人飞机机身上。

② For this drone, the system allows you to view and send the QR code for real-name registration. After clicking the “Send QR Code” button, the system will send the PDF file of QR code to the registrant's e-mail so that the drone owner can print the QR code and affix it onto the airframe of the drone.



2) 禁止改装设备

2) It is forbidden to convert the device

① 私自改装无人机或者使用非原厂配件，会改变设备的机身结构，影响飞行稳定性，造成飞行安全事故。

① Unauthorized modification of the drone or use of non-original parts will change the airframe structure of the device, which can affect the flight stability and result in safety accidents during flight.

② 因未按照产品使用说明书要求正确使用、维护而造成产品损坏的，及私自改装、人为损坏、使用非原厂配件等非产品质量问题造成的产品故障或损坏的，不属于三包政策、增值服务或保险服务范围。

② Damage of the product caused by failure to properly use or maintain the product according to the User Manual, and malfunction or damage of the product caused by unauthorized conversion, human error, use of parts not supplied by XAG or other problems not attributable to product quality, are not covered by the "Repair, Replacement and Refund" warranty policy or the scope of value-added service or insurance service.



3) 设备外观及系统检查

3) Device exterior inspection and system checks



- 航前外观检查是良好作业质量的保障，我们需做好前期各项检查工作，确保飞行安全。
- Preflight exterior inspection guarantees good operation quality. We need to carry out checks before flight to ensure flight safety.

① 机身整体结构稳固，否则在作业过程中因震动过大导致炸机。

① Confirm that the overall structure of airframe is secure; otherwise, crash of the drone could be caused due to excessive vibration during operation.

② 确认桨叶没有装反，否则无人飞机无法起飞，且会在地面一直旋转或发生起飞侧倾导致炸机，严重可能会造成人身伤害；检查桨叶没有变形、松脱、裂纹，否则作业过程中会导致载重能力降低、因桨叶高速旋转造成射桨、断桨等情况，引发炸机事故。

② Confirm that the blades are not inversely installed; otherwise, the drone cannot take off and keeps spinning on the ground, or tilts sidewise after takeoff, resulting in fall of the drone; in serious cases, personal injury could be caused. Check that the blades are not loose and have no deformation or cracks; otherwise, reduction of payload capacity will be caused during operation, and flying-off or breakage of the propellers will be caused by high-speed rotation of blades, resulting in fall of the drone.

③ 检查电池插头是否脏污、安装是否牢固，卡扣紧固后再进行开机动作，否则可能会导致无人飞机在作业中发生异常导致炸机事故的发生。

③ Check whether the battery plug is dirty and whether it is installed securely. Make sure the snap fits are tightened before turning on the device; otherwise, the drone could become abnormal during operation, resulting in crash of the drone.

注意事项

Precautions

1. P150、P60 正常作业情况下建议使用电池型号为 B13970S。当装载的电池型号为 B13960S 或 B13970 作业时无人飞机无法进行满载飞行作业。P150 双电池喷洒最大载重不超过 60 公斤，播撒双电池最大载重不超过 60 公斤，P60 无人飞机搭载睿播系统最大载重量不得超过 20 公斤。

1. On P150 and P60, it is suggested to use the B13970S battery for normal operation. If the B13960S or B13970 battery is mounted, the drone cannot operate at full capacity. When P150 is mounted with two batteries, the

maximum payload should not exceed 60kg for both spraying and spreading. When P60 is mounted with the RevoCast system, the maximum payload should not exceed 20kg.

2. 安装电池前，请保持无人机电源接口和电池接口干净、干燥、无金属异物及液体残留。

2. Before battery installation, please keep the power interface and battery interface of the drone dry and clean without foreign metal objects or residual liquid.

3. 启动电池前，请确保电池已经完全插入电池仓内，避免电池因未完全接触无人机电源接口导致作业时发生飞行事故。

3. Before starting the battery, please ensure that the battery has been completely inserted in the battery compartment to avoid flight accidents during operation due to the fact that the battery does not fully contact the power interface of the drone.

4. 确认电机没有异响、卡转，否则会在作业过程中影响作业稳定性，可能会导致电机漆包线发黑，引发电机故障炸机。

4. Confirm that the motors have no abnormal sound and do not get stuck during rotation; otherwise, the operation stability will be affected, which could cause blackening of enameled wires, further resulting in malfunction of the motors and crash of the drone.

5. 无人飞机的 4D 成像雷达、仿地雷达、前视 FPV 摄像头、前视探照灯、下视 FPV 摄像头及下视补光灯等感知系统干净无遮挡，否则会导致相关模块功能受限或影响功能体验，引发安全事故。

5. Confirm that the 4D imaging radar, terrain radar, forward FPV camera, forward searchlight, downward FPV camera, downward fill light and other sensor system components are clean and not covered; otherwise, relevant module functions will be limited or functional experience affected, further resulting in safety accidents.

6. 检查折叠件没有变形及裂纹，检查机臂抱箍稳定无松动，收展机臂时确保完全打开抱箍后再进行操作，长期抱箍与机臂发生碰撞可能会导致功能失效或损坏。

6. Check that the foldable parts have no deformation or crack, and that the arm clamps are secure without looseness. Before folding and unfolding the arms, ensure that the clamps are completely open. Long-time collision between clamps and arms could result in malfunction or damage.

7. 每隔 15 天进行一次整机线路检查，避免因长时间作业的震动对线路外表面产生磨损、线路连接处固定螺栓松脱或被药液腐蚀的情况，影响飞行安全。

7. Check all circuits of the device every 15 days to prevent corrosion by liquid, or abrasion of circuit surface or looseness of setscrews at circuit connections caused by vibration due to long-time operation, which will affect flight safety.



- 除了航前外观检查外，还要在极飞农服 App 进行系统检查，特别注意以下三点
- Apart from preflight exterior inspection, system checks should be carried out in the "XAG One" App. Special attention should be paid to the following three points
- ① 确保固件升级到最新版本，提升设备操作的稳定性。
- ① Ensure that the firmware is upgraded to the latest version to enhance the operation stability of the device.
- ② 检查定位系统，首选连接距离无人机较近的基站，RTK 定位状态正常，卫星数 16 颗以上，定位精度在 1 米以内，航向精度在 2° 以内，否则会导致无人机作业时无法起飞或失控。
- ② Check the positioning system. First connect a base station close to the drone. Confirm that the RTK positioning state is normal; the number of satellites connected is more than 16; the positioning accuracy is within 1m; the heading accuracy is within 2°. Otherwise, takeoff failure or loss of control could be caused during operation of the drone.
- ③ 进行怠速测试，确认电机转向正常、无异响。
- ③ Perform the idle test to confirm that the motors rotate normally without abnormal sound.

注意事项 Precautions

P150 电流不超过 5.5A, P60 电流不超过 3.5A, 怠速测试转速差不超过 100 转, 电调主板温度不得大于 90°C, 电机正常运转。

The current should not exceed 5.5A on P150 and 3.5A on P60. During idle test, the rotational speed variance should not exceed 100rpm; the temperature of ESC mainboard should not be higher than 90°C; the motors should run normally.

- 飞行前检查做的越仔细，产生的问题可能性会大大降低，所以请无人飞机操作员要认真执行。
- Since meticulous preflight checks can greatly reduce the probability of occurrence of problems, the drone operator should carry out checks carefully.

1.1.2 保障人员安全三原则

1.1.2 Three Principles for Guaranteeing Personal Safety

1) 取得“农业无人飞机操作许可证”

1) Obtain the “Agricultural Drone Operator Certificate”

操作极飞农业无人飞机，必须获取“农业无人飞机操作许可证”。若飞行技术不熟练，须有 1 年以上有经验的飞手陪同作业。

The “Agricultural Drone Operator Certificate” must be obtained before operating the XAG Agricultural Drone. Any unskilled operator must be accompanied by a pilot with over 1-year experience during operation.

注意事项

Precautions

根据国务院、中央军委公布的，自 2024 年 1 月 1 日起施行的《无人驾驶航空器飞行管理暂行条例》规定，“未取得操作证书从事常规农用无人驾驶航空器作业飞行活动的，由县级以上地方人民政府农业农村主管部门责令停止作业，并处 1000 元以上 1 万元以下的罚款。”

In accordance with the Interim Regulation on the Administration of the Flight of Unmanned Aerial Vehicles issued by the State Council and the Central Military Commission of the Communist Party of China and implemented from January 1, 2024, “those engaged in regular flight activities with agricultural unmanned aerial vehicles without obtaining the Operator Licence will be instructed by the competent department of agriculture and rural areas of the local people’s government above the county level to stop the operation, and may be imposed a fine between RMB 1,000 and RMB 10,000.”



The image shows a template for the Agricultural Drone Operator Certificate. It features a red header with the XAG logo and the title '农业无人飞机操作许可证' (Agricultural Drone Operator Certificate). Below the header, there is a large white box for a photo. To the right of the photo, there are fields for personal information: Name, Date of Birth, Sex, Issued on, Valid Until, and Issuing Authority. At the bottom left, there is a field for the Licence No. The form is set against a background with faint, stylized lines.

2) 人员状态良好

2) The operator must be in good condition

必须在身体良好的状态下操控无人飞机，以便在紧急情况下能够快速做出有效的安全措施。

The operator must be in good physical condition when operating the drone so that he/she can quickly take effective safety measures in case of any emergency.



3) 个人防护得当

3) Take proper personal protection

作业时正确佩戴口罩、手套等防护设施，避免皮肤长期接触农药化肥，影响身体健康。如进行飞行操作，建议佩戴安全帽，保障安全。

During operation, wear PPE such as mask and gloves to protect your skin from long contact with pesticides and fertilizers which could harm your health. For flight operation, it is suggested to wear a safety helmet to guarantee your safety.



1.1.3 环境检查四要素

1.1.3 Four Elements of Environment Checks

1) “管控区域”限制相关规定

1) Restrictions in “controlled zones”

① 禁止在政府、机关单位、军事基地、监狱、核电站、核设施等国家层面区域以及机场 20 公里范围内的禁飞区域进行飞行，否则将受到法律惩处。

① It is forbidden to fly in national-level areas such as government bodies, public institutions, military bases, prisons, nuclear power stations, and nuclear facilities, and in no-fly zones within 20km of airports. Otherwise, offenders will be punished by law.

② 禁止在人员密集或上空飞行，否则发生坠机事故时，极有可能会造成人伤物损。

② It is forbidden to fly above densely populated areas; otherwise, it is very likely to cause personal injury or property damage when the drone crashes.

③ 当作业区域属于管控区域时，应向当地相关部门备案，获得许可后，将相关证明通过极飞农服 App 上传，申请解禁后才能飞行作业。

③ Any operation in controlled zones shall be filed with the local competent authority. After obtaining the approval, relevant certificate should be uploaded to the "XAG One" App to apply for ban lifting; the flight operation can be started only after the application is approved.

2) 适合作业的天气

2) Suitable weather for operation

选择在天气晴朗、风速小于 3 级的情况下作业，如果长时间在雨天作业，机身的电路系统防水能力不支持长时间淋雨作业，会导致防水能力失效，引发线路短路等风险，而风速过大会降低药物效果及无人飞机飞行稳定性。

Perform operation when it is sunny and the wind speed is below gentle breeze. Long-time operation on rainy days will cause loss of watertightness and result in short circuit and other risks because the waterproofness of the circuit system of airframe does not support long-time operation exposed to the rain. Besides, if the wind speed is too high, both the effect of chemicals and the flight stability of the drone will be reduced.



3) 安全的起降点

3) Safe takeoff/landing point

① 确保起降点开阔平整，否则无人飞机降落时不平稳，容易倾斜倒地造成设备损伤。

① Ensure that the take-off/landing point is open and level; otherwise, the drone is unsteady when landing and can easily tilt and fall to the ground, resulting in damage of the device;

- ② 确定半径 2.5 米范围内平整无杂物，否则起飞过程中强大的风场会把杂物卷到螺旋桨上，导致炸机。
- ② Confirm that there are no sundries in the area within a 2.5m radius; otherwise, the strong wind field during takeoff will take such sundries to the propellers, resulting in crash of the drone.
- ③ 起飞或降落前，所有人员与起降点保持 10 米以上安全距离，否则高速旋转的螺旋桨产生的风场，将沙石卷起撞击到周边人员造成伤害。
- ③ Before takeoff or landing, all people should keep a safe distance of over 10m from the takeoff/landing point; otherwise, the wind field produced by high-speed rotation of the propellers will pick up sand and stones which will hit against people nearby, resulting in injury.
- ④ 确保起降点上方无障碍物（如树枝、电线），否则无人机起飞、降落时，容易撞到障碍物出现撞击事故。
- ④ Ensure that there is no obstacle (e.g., tree branch, cable) above the takeoff/landing point; otherwise, the drone can easily hit obstacles when taking off or landing, resulting in collision accidents.
- ⑤ 起降点远离防风林、信号塔等高大建筑物，避免出现信号遮挡，影响无人机定位精度。
- ⑤ The take-off/landing sites should be located far away from tall structures such as windbreak forests and signal towers to avoid signal obstruction, which may affect the positioning accuracy of drone.



4) 飞行作业区域的安全管理

4) Management of safety in the flight operation area

- ① 作业前复查飞行区域内的障碍物并进行标注，确保航线安全。
- ① Prior to operation, recheck and mark obstacles within the flight area to ensure the route safety.
- 确认操作区域处于下风区，避免喷洒作业时药物往自身方向漂移。
- Confirm that the operation area is down the wind to prevent liquid from drifting toward yourself during spraying.

- 作业前应做好作业区、起降区、操作区、物料区等功能区域划分及安全管理。
- Prior to operation, divide the zone to functional zones such as operation zone, takeoff/landing zone, maneuvering zone and material zone, and carry out safety management.
- ② 作业过程中，对作业区域进行清场，严禁出现无关人员及干扰作业安全的设备。
- ② During operation, the operation zone should be clear of irrelevant people or equipment that can affect the operation safety.
- ③ 在操控无人机时需保持高度专注状态，禁止无关人员干扰操作员作业。
- ③ Keep highly focused when operating the drone; irrelevant people are forbidden to disturb the operator during operation;
- ④ 确保飞行区域内没有超过无人机仿地能力的陡坡。
- ④ Ensure that there is no slope beyond the terrain following capacity of the drone within the flight area.
- ⑤ 针对 P150 2024 款飞机的边界安全距离建议设置 3 米以上。
- ⑤ For P150 2024 Agricultural Drone, it is suggested to set the boundary safety clearance to be above 3m.

1.2 作业后安全处理措施

1.2 Safety Measures After Operation

1. 完成作业后，所有人员必须在螺旋桨完全停止转动后再靠近设备，避免出现误伤。
1. After completion of operation, no one is allowed to approach the device until the propellers completely stop to avoid unexpected injury.
2. 及时清理作业设备，防止农药、肥料腐蚀设备，并妥善处理肥料袋、药罐、残留的农药，避免对环境造成污染。
2. Timely clean the operation device to prevent the device from being corroded by pesticides or fertilizers, and properly dispose of the fertilizer bags, liquid bottles and residual fertilizers to avoid environmental contamination.
3. 转场运输前需对设备进行规范处理：
3. The device should be treated in a standardized manner before transfer and transport:
 - ① 智能电池关机后从无人飞机上取下，禁止将电池插在无人飞机上运输，防止尾插及电池出现损坏。
 - ① After turning off the smart battery, remove it from the drone. It is forbidden to insert the battery to the drone for transport to prevent damage of the plug and battery.
 - ② 并将作业完毕的无人飞机桨叶折叠，并用桨夹固定；使用安全带将无人飞机固定在车上，防止运输过程碰损设备。
 - ② Fold the blades of the drone after completion of operation and fix them with propeller clamps; use a safety strap to fix the drone to the vehicle to prevent damage of the device during transport due to collision.
 - ③ 拧紧燃油超充站油箱盖并关闭汽油阀，使燃油超充站处于关机状态并用绳索固定。严禁边充电边进行转场操作，预防因散热或磕碰引发的安全事故发生。
 - ③ Tighten the tank cap of the supercharge station and close the gasoline valve; ensure that the supercharge station is in power-off state, and fix it with a rope. It is forbidden to perform transfer operation while charging to prevent safety accidents caused by heat dissipation or collision.



本章小结

Summary of this chapter

这一课从设备安全、人员安全、环境检查这三方面，了解农业无人飞机飞行作业前后的安全注意事项及处理措施，增强作业安全意识，保障飞行任务顺利完成，提高作业效率。

This lecture introduces the safety precautions and handling measures before and after the agricultural drone flies from device safety, personal safety and environment checks, thus to enhance the safety awareness during operation, guarantee smooth fulfillment of flight missions, and improve the operation efficiency.

测试

Test

1. [单选]下面哪一项属于可正常飞行区域()。

1. [Single Choice] Which of the following is a normal flight area? ()

A. 核电站 B. 偏远农村田地 C. 机场周边 D. 军事演习区域

A. Nuclear power station B. Remote rural field C. Area surrounding an airport D. Military exercise area

2. [多选]以下关于极飞农业无人飞机启动作业前注意事项说法正确的是()。

2. [Multiple Choices] As for the precautions before start of operation with XAG Agricultural Drone, which of the following are correct? ()

A. 确保作业区域内没有围观人员 B. 确保 RTK 连接稳定可靠

A. Make sure no other person stay in the operation zone B. Make sure RTK connection is stable and reliable

C. 不需要注意天气状况 D. 酒后操控无人飞机作业

C. It is unnecessary to pay attention to weather conditions D. Operate the drone after drinking

3. [判断]23 款及之前电池与 24 款 P150 机型完全适配，24 款电池也可以在 23 款及之前机型使用，所以 23 款及之前电池可以满载状态下在 24 款 P150 机型上使用。（ ）

3. [True or False] The 2023 and previous batteries can perfectly fit 2024 P150, while the 2024 battery can also be used on 2023 and previous drone models. Therefore, the 2023 and previous batteries can be used on 2024 P150 in full-capacity state. ()

A. 对 B. 错

A. True B. False

章节 2 航前检查

Chapter 2 Preflight Checks

本章重点：

Key points of this chapter:

飞行前检查是无人机每次顺利作业的基础，学习农业无人机航前检查，提高飞行的安全性以及防范设备潜在的问题，减少安全事故的发生，保障飞行任务顺利完成。

Preflight checks are the foundation for ensuring every smooth operation of drones. Learning about preflight checks for agricultural drones can improve flight safety and prevent potential device faults, thus reducing the occurrence of safety accidents and ensuring the smooth fulfillment of flight missions.

本课程将详细讲述飞行前检查的所有步骤和标准，让每一次作业更安心、更顺利。

This course will provide you with a detailed explanation of all the steps and standards for preflight checks, making every operation more reassuring and smoother.

2.1 环境安全检查

2.1 Environmental Safety Checks

作业区域安全检查 Operation zone safety inspection		
模块 Module	标准动作 Standard Action	课程要点讲解 Explanation of Key Points
环境检查 Environmental inspection	1. 需要确认作业环境安全，不属于禁飞区域，可在极飞衣服 App “我的”-“设置”-“禁飞区”查看。 1. Confirm that the operation environment is safe and does not belong to no-fly zones, which can be viewed in the “XAG One” App:	

	"Me" - "Settings" - "No-fly zone". 2. 检查附近有无微波站，无线电信号塔、高压线等高大建筑物，如有，需谨慎飞行作业。 2. Check whether there are microwave stations, radio towers, high-tension cables and other tall structures nearby. If any, please be cautious to perform flight operation. 3. 检查天气晴朗，风速小于 3 级，适合作业。 3. Check that it is sunny and the wind speed is below gentle breeze, which is suitable for operation.	
起降区环境安全 Environmental safety in the takeoff/landing area	1) 起降点需确保开阔平整，如不平整容易导致无人飞机降落不平稳，倾斜倒地造成设备损伤； 1) Ensure that the take-off/landing point is open and level; otherwise, the drone is unsteady when landing and can easily tilt and fall to the ground, resulting in damage of the device; 2) 确保起降点周围无杂物，否则起降过程中风场会将杂物卷入螺旋桨上，导致炸机； 2) Ensure that there are no sundries around the take-off/landing point; otherwise, the wind field during takeoff/landing will take such sundries to the propellers, resulting in crash of the drone; 3) 确保起降点上方无任何障碍物，否则在起降过程中，容易与障碍物相撞，导致撞击事故； 3) Ensure that there are no obstacles above the takeoff/landing point; otherwise, the drone can easily hit obstacles when taking off or landing, resulting in collision accidents; 4) 起飞前需确保人员距离起降点 10 米以外，保障人员作业安全； 4) Before takeoff, ensure that all people are over 10m away from the takeoff/landing point, thus to guarantee their safety during	

	operation; 5) 起降点应远离防风林、信号塔等高大建筑物，避免因信号遮挡而影响无人机的定位精度 5) The takeoff/landing point should be away from windbreaks, signal towers and other tall structures to avoid signal shielding which will affect the positioning accuracy of the drone.	
作业区环境安全 Environmental safety in the operation area	1) 作业前，应合理规划区域，禁止操作人员和车辆停靠在作业区域内； 1) Before operation, make proper zoning and keep the operation zone clear of operation personnel and vehicles. 2) 作业前复查飞行区域内的障碍物是否有标记清楚，确保航线安全； 2) Re-check that obstacles within the flight zone are clearly marked before operation to ensure the safety of the route. 3) 作业前，对作业区域进行清场，严禁出现无关人员及干扰作业安全的设备； 3) Prior to operation, the operation zone should be clear of irrelevant people or equipment that can affect the operation safety; 4) 在操控无人飞机时需保持高度专注状态，禁止无关人员打扰操作员作业； 4) When operating a drone, it is necessary to stay focused and to prevent unrelated personnel from disturbing the operator's operation. 5) 定高飞行时，确保地块内无超过飞行高度的区域；仿地飞行时，确保飞行区域内没有大于仿地高度的陡坡。 5) When flying in Altitude Hold Mode, ensure that there is no area above the flight altitude in the field; during terrain following flight, ensure that the flight zone is free of steep slopes higher than the terrain-following altitude.	

2.2 设备外观检查

2.2 Equipment Exterior Inspection

设备外观检查 Equipment exterior inspection		
模块 Module	标准动作 Standard Action	课程要点讲解 Explanation of Key Points
操作步骤 Instructions	第一步： 完全展开无人飞机，从左至右、从上至下，逐一检查无人飞机的桨叶、电机、电调、机臂、机身结构、雷达、镜头、线路、药箱、脚架，喷头，是否完整无破损，螺丝紧固，表面无异物，无缺失。 Step 1: Completely unfold the drone and conduct a thorough inspection; check the blades, motors, ESC, arms, airframe structure, radars, lenses, circuits, liquid tank, landing gears and nozzles one by one to confirm that they are complete without damage, the screws are tightened, there is no foreign object on the surface, and no part is missing. 以下部件需注意 Pay attention to the following parts 1. 螺旋桨：保持表面清洁、无附着物，检查是否无裂痕、无缺口； 1. Propellers: Keep the surface clean without adhered substances; check that there is no crack or notch; 2. 顶视雷达/摇摆雷达：保持表面清洁、无附着物，否则会干扰飞行避障； 2. Upward radar / 4D imaging radar: Keep the surface clean without adhered substances; otherwise, obstacle avoidance during flight will be disturbed; 3. 仿地雷达/ PSL 飞行员视角/下视 FPV 视角影像：保持镜头表面清洁。如出现脏污，请使用软布按一个方向擦拭干净；	

	3. Terrain radar / PSL / downward FPV camera: Keep the lens surface clean. If there is dirt or stains, please clean them by wiping in one direction with a soft cloth. 4. 电池尾框尾插：金属铜片出现发黑、发绿，可使用棉签蘸取酒精进行清理，否则将影响电池供电； 4. Battery socket: If the copper piece becomes blackish or greenish, you can use cotton swabs dipped in alcohol to clean it; otherwise, battery voltage supply will be affected; 5. 电调：保持表面清洁、无附着物，否则会影响电调散热； 5. ESC: Keep the surface clean without adhered substances; otherwise, heat dissipation of ESC will be affected; 6. 电池：外观清洁无变形，电芯缝隙无杂物填充，安装时确定与电池尾框接口连接牢固； 6. Battery: The appearance should be clean without deformation; there should be no sundries in the cell gaps. During installation, confirm that it is securely connected to the rear frame socket; 7. 机臂折叠件：检查折叠件没有变形及裂纹，检查机臂抱箍稳定无松动； 7. Foldable parts of arms: Check that the foldable parts have no deformation or crack; check that the arm clamps are secure without looseness; 注意：展开 P150 机臂时，需确保抱箍完全打开，如未完全打开，抱箍则容易与机臂发生碰撞，长期碰撞将会导致抱箍损坏。 Note: When unfolding the arms of P150, it is needed to confirm that the clamps are completely open; if not, the clamps can easily collide against the arms, and long-time collision will result in damage of the clamps. 8. 机身结构：整体结构稳固、无变形。 8. Airframe structure: Check the overall structure for stability without deformation. 9. 离心喷头：检查喷头外观无异物，无卡转。 9. Centrifugal nozzle: Check the exterior of	
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	the nozzle for any foreign objects or jamming. 第二步：检查充电设备 Step 2: Check the charging device 1. 电池： 1. Battery: 检查电池尾插有无异物，有无发黑发绿现象，如有需使用酒精棉签擦拭，严重则需更换。 Check whether the battery socket has any foreign object, or becomes blackish or greenish. If any, please use cotton swabs dipped in alcohol to wipe the surface, or replace it in serious cases. 轻按电池按键，检查电池电源指示灯按键是否损坏。 Gently press the battery button to check whether the power indicator button of the battery is damaged. 拿起电池观察电池电芯夹缝是否有异物，如有异物需要即使清理；观察电芯是否变形，如若变形需联系服务站处理。 Pick up the battery, and observe the battery cell gaps to see if there is any foreign object; if any, it should be cleaned promptly. Also observe whether the cells are deformed; if deformation is found, please contact the service station. 2. 燃油超充： 2. Supercharge station: 检查燃油超充汽油盖透气孔是否有异物堵塞。 Check whether the vent hole in the tank cap of the supercharge station is blocked by foreign objects. 检查油箱滤网是否有异物丢失，如有请及时维护； Check whether the fuel tank filter has any foreign object; if any, carry out maintenance promptly; 检查油管/燃油开关是否有漏油、龟裂现象发生，如有请及时更换。	
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	Check the fuel tube / fuel cock to see if fuel leak or crack exists; if any, replace it promptly. 检查火花塞连接线是否松动，如有松动请及时连接紧密。 Check whether the spark plug cable is loose; if loose, please connect it tightly. 检查底部 4 颗减震螺丝是否有松动，如有松动需及时紧固。 Check whether the 4 shock absorbing screws at the bottom are loose; if loose, tighten them promptly. 检查充电接头有无异物。 Check whether the charging socket has any foreign object. 3. 充电管理器 3. Charger 检查充电器充电插头是否有异物，有无发黑发绿。 Check whether the charging socket of the charger has any foreign object or becomes blackish or greenish. 检查充电管理器散热孔是否有异物，如有异物需要即使清理。 Check whether the vent hole of the charger has any foreign object; if any, clean it promptly.	
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2.3 设备系统检查

2.3 Equipment System Inspection

设备系统检查 Equipment system inspection		
模块 Module	标准动作 Standard Action	课程要点讲解 Explanation of Key Points
操作步骤	第一步：打开极飞农服 App，点击【我的】，	

Instructions	点击【设备】，选择需要作业的无人飞机，并进入【设备详情】界面，在通用界面确认无人飞机已经绑定遥控器，确保所有固件是最新的版本。 Step 1: Launch the "XAG One" App; tap [Me]; tap [Device]; select the drone for operation; enter the [Device Details] screen. On the General screen, confirm that the drone has been bound with remote controller; ensure that all firmware is of the latest version. 第二步：检查通讯系统，确认信号强度适合作业。如果当前的运营商网络信号不行，可以选择切换成网络信号更好的运营商。 Step 2: Check the communication system to confirm that the signal strength is suitable for operation. If the network signal of the current carrier is poor, you can switch to a carrier with better network signal. 第三步：检查定位系统，确认 RTK 基站已连接，RTK 定位正常，卫星数在 16 颗以上，定位精度在 1 米以内，航向精度在 2° 以内。 Step 3: Check the positioning system. Confirm that the RTK base station has been connected; the RTK positioning is normal; the number of satellites connected is more than 16; the positioning accuracy is within 1m; and the heading accuracy is within 2°. 第四步：检查电池系统，确认电池电量满足飞行需要，电芯电压正常无报错。今天使用的是 P150 需要使用 2 块电池，所以还需要确认压差是否正常。 Step 4: Check the battery system; confirm that the battery level meets the flight requirement, and that the cell voltage is normal without error report. The drone used today is P150 which needs two batteries. Therefore, it is needed to confirm whether the voltage variance is normal. 第五步：检查喷洒系统，需要进行【手动喷洒测试】查看喷盘转动状态和流出液体的雾化情况是否正常。因为喷头会喷出液体，操作员需要移动到合适的位置操作和观察。	
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	Step 5: Check the spraying system. [Manual Spraying Test] should be performed to check whether the rotation state of spray disc and the atomizing condition of liquid flowing out are normal. Since the nozzle will eject water, the operator should move to a proper position for operation and observation. 第六步：检查动力系统，需要进行“怠速测试”，动力测试转速差在 100 转以内，电流 5.5A 以内，空中转速不可超过 200 转，由于螺旋桨会转动起来，所以操作员需移动到合适的位置操作和观察。 Step 6: Check the propulsion system. "Idle test" should be performed; during propulsion test, the speed difference should be within 100rpm, the current within 5.5A, and the speed in air less than 200rpm. Since the propellers will rotate, the operator should move to a proper position for operation and observation. 第七步：感知系统，此时需要将遥控器（SRC4 双手遥控器）控制无人飞机起飞，让无人飞机起飞并悬停在空中，确保避障雷达在 App 中能正常显示感知距离，同时悬停过程中还需观察设备有无晃动，飘高/掉高现象发生，完成检查后将无人飞机降落至原地。 Step 7: Check the sensor system. At this moment, the remote controller (SRC4) should be used to control the drone to take off and hover in the air; ensure that the obstacle avoidance radar can normally display the sensed distance on the App screen. During hovering, it is also necessary to observe whether the device shakes or has an uncontrolled ascent/descent. After check, make the drone land in situ.	
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本章小结

Summary of this chapter

本节课通过三大项飞行前的检查内容：环境的选择到机身结构外观检查，再到 App 的六大系统参数是否正常，是否及时进行固件更新等，以此保障每次的飞行作业安全。

This chapter introduces three major preflight checks, ranging from the environment selection to the airframe structure exterior inspection, and then to the check for parameter normality of 6 major systems and timeliness of firmware update on the App, which ensures the safety of each flight operation.

测试 Test

1. 飞行作业前，我们需要对起降点和作业区域做哪些安全检查，来保障飞行区域安全？
1. Before flight operation, what safety checks are required for the takeoff/landing point and the operation zone to guarantee the safety in the flight area?
2. 怠速测试时有哪些注意事项？
2. What precautions should be observed for idle test?

章节 3 XRTK6 测绘器完成地块测绘 Chapter 3 Field Mapping by XRTK6 Ground Module

本章重点：

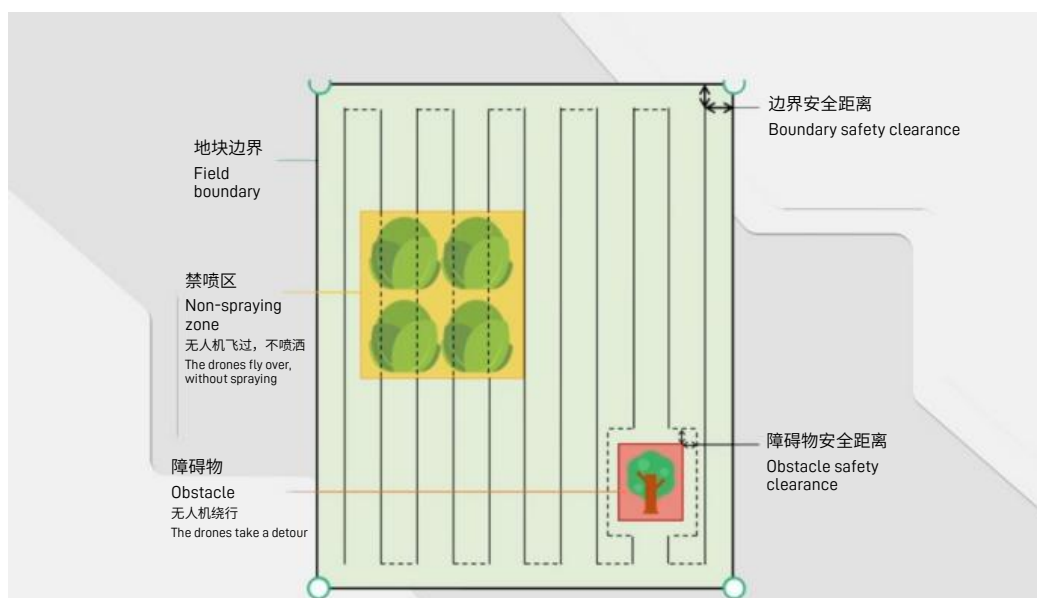
Key points of this chapter:

本文将对测绘器 XRTK6 手持测绘器打点进行讲解，学习如何使用 XRTK6 手持测绘器实现对地块的创建和测绘工作。

This chapter will introduce marking by XRTK6 ground module; you can learn how to realize field creation and mapping by use of XRTK6 ground module.

3.1 测绘地块注意事项

3.1 Precautions for Field Mapping



3.1.1 地块信息标记规范

3.1.1 Specification for marking of field information

- ① 地块边界有一颗枝繁叶茂的大树。
- ① There is a big tree with lush branches and leaves at the field boundary.
- ② 作业地块中有电线杆
- ② There are utility poles in the operation field.
- ③ 为避免类似飞行事故的发生，必须重视关键的 4 个地块信息标记。
- ③ To avoid similar flight accidents, attention must be paid to the marking of 4 key field information.

1) 地块边界

1) Field boundary

- ① 注意事项
- ① Note:

边界线不能出现交叉

The boundary lines must not intersect

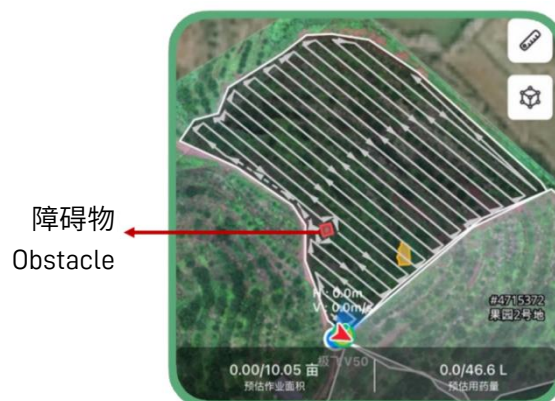
同一打点类型的两点距离不能太近，大于 0.2 米。

The two points marked as the same type must not be too close and should maintain a distance greater than 0.2m.

- 对作业区域的“每一个拐角”进行地块边界标记，并确保“地块边缘上的障碍物”已被完整圈出地块边界外。
- Mark the field boundary for “each corner” in the operation area and ensure that “obstacles on the field edges” have been fully marked outside the field boundary.
- 可以避免无人机在作业时把农药或者肥料送出地块外，造成不必要的浪费，还能避免误喷地块外的作物，防止药害发生。
- It can prevent drones from spreading pesticides or fertilizers out of the field during operation, causing unnecessary waste, and can also avoid accidental spraying onto crops outside the field, preventing pesticide damage.

2) 障碍物

2) Obstacle



- 障碍物标记又分为圆形障碍物打点和多边形障碍物打点，根据不同需求进行合理选择，默认为多边形障碍物打点。
- For obstacle marking, circular obstacle marking and polygonal obstacle marking can be reasonably selected according to different needs, where the default is polygonal obstacle marking.
- 把无人机作业过程中“需要绕开的所有物体”做障碍物标记，标记的范围需完全包括障碍物（尤其需要注意空中部分）。
- Mark "all objects that need to be avoided" by the drone during operation as obstacles, and the marked range should fully envelop the obstacles (especially the parts in the air).
- 障碍物标记至少由“4 个标记点”组成，生产的作业航线会自主绕开障碍物，提高作业效率。
- The obstacle marking should consist of at least "4 marked points", and the operation routes generated will autonomously avoid obstacles to improve the operation efficiency.

3) 禁喷区

3) Non-spraying zone



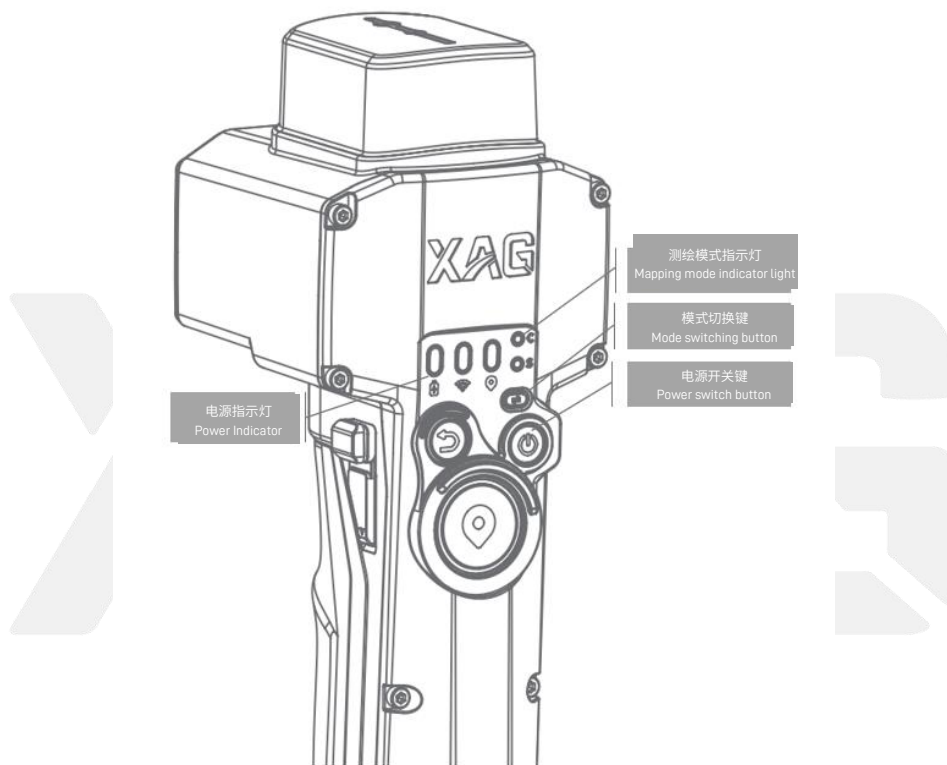
- 把无人机作业过程中“不需要喷洒或播撒的区域”做禁喷区域标记。
- Mark the "areas that do not require spraying or spreading" during the drone operation as non-spraying zones.
- 禁喷区标记至少由“4 个标记点”组成，无人机会在禁喷区域飞行通过，但不会进行喷洒或播散，可减少作业中农药或肥料的浪费。
- The non-spraying zone marking should consist of at least "4 marked points"; the drones fly over the non-spraying zones, without spraying or spreading, which can reduce the waste of pesticides or fertilizers during operation.

3.2 XRTK6 手持测绘器操作步骤

3.2 Operation Steps for XRTK6 Ground Module

3.2.1 添加 XRTK6 手持测绘器

3.2.1 Add XRTK6 ground module



① 在测绘器关机状态下，长按电源开关键 2 秒，听到蜂鸣器“嘀”声后，松开电源开关按键，此时所有指示灯同时闪烁，表示成功开机。

① When the XRTK6 is in power-off state, long press the Power button for 2s; when the buzzer produces a “Di” sound, release the Power button. At this moment, all indicator lights will flash simultaneously, indicating successful startup.

② 等待指示灯闪烁结束后，电量指示灯变为常亮，表示测绘器初始化完成，可以正常使用。

② When all indicator lights stop blinking, the battery level indicator will remain on, indicating the XRTK6 has finished initialization and can be used normally.

注意：

Note:

● 当测绘器电量低于 5% 时，蜂鸣器会发出“滴滴滴”响，并在一分钟自动关机，请务必及时为测绘器充电。

● When the battery level of the XRTK6 is less than 5%, the buzzer will produce a “Di Di Di” sound, and the XRTK6 will turn off automatically in one minute. Please charge the rover promptly.

● 测绘器充电过程中，若使用快充适配器充电，电源灯将快闪且蜂鸣器“滴滴”响。当电源灯绿色常亮时，代表测绘器电量充满。

● If a fast charge adapter is used to charge the XRTK6, the power indicator light will flash fast, and the buzzer will produce a "Di Di" sound. When the power indicator changes to solid green light, it indicates the XRTK6 has been fully charged.

③ 打开“极飞农服”App，点击右上角“+”图标，选择“添加设备”。

③ Launch the "XAG One" App; tap the "+" icon at the upper right corner, and select "Add a device".

④ 进入“添加设备”界面后，请确认测绘器已开机、手机已开启蓝牙功能并授权蓝牙权限给到 App，XRTK6 测绘器支持两种添加方法：

④ After entering the "Add a device" screen, confirm that the XRTK6 has been turned on, that the Bluetooth function has been enabled on your mobile phone and that Bluetooth permissions have been granted to the App. XRTK6 ground module supports two adding methods:

方法一：测绘器在开机状态下，通过扫描测绘器上的二维码，或输入测绘器上的序列号，点击“确定”按钮。

Method 1: When the XRTK6 is in power-on state, scan the QR code on the rover or input the serial number shown on the rover, and tap the "OK" button.

方法二：测绘器在开机状态下，点击“扫描设备二维码”界面右上角的“...”按钮，选择“通过蓝牙添加设备”，会自动查找附近开机的测绘器，点击“添加”按钮。

Method 2: When the XRTK6 is in power-on state, tap the "..." button at the upper right corner of the "Scan device QR code" screen; select "Add a device via Bluetooth"; the system will automatically search the nearby XRTK6 in power-on state; tap the "Add" button.

⑤ 在设置设备信息页面会显示添加的设备，设置设备名称或保持默认点击“下一步”，提示【添加成功】，表示测绘器添加完成。

⑤ The "Set device info" screen will show the device added; set the device name or keep the default name, and tap "Next"; the prompt reading [Added successfully] will be given, indicating the XRTK6 is added.

3.2.2 测绘模式

3.2.2 Mapping mode

① 确认“测绘模式指示灯”（C 灯）是否绿灯常亮。

① Confirm whether the "Mapping mode indicator" (C light) is solid green light.

注意：如果指示灯在移动基站模式（S 灯），可在开机状态下短按“”键，切换为测绘模式（C 灯）。

Note: If the indicator is in Portable Station mode (S light), you can short press the "" button in power-on state to switch to Mapping mode (C light).

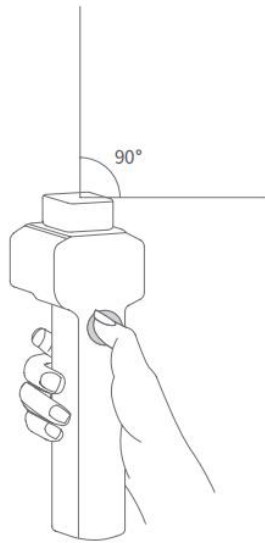


- ② 确认定位指示灯为绿色常亮。
- ② Confirm that the positioning indicator is solid green light.

注意：

Note:

- 使用测绘器打点时，为了确保设备打点的精确度，请尽量确保测绘器竖直握持，同时避免测绘器被遮挡导致通信信号阻断。
- For marking by XRTK6, to guarantee the marking accuracy of the device, please make sure the XRTK6 is held vertically, and also avoid covering the XRTK6 which could cause communication signal blocking.
- 在测绘模式中，当测绘器倾斜角度大于 50°，测绘模式指示灯会变成绿色快闪，请注意及时调整测绘器的握持姿态，避免影响测绘器正常使用。
- In Mapping mode, when the inclination angle of the XRTK6 is greater than 50°, the Mapping mode indicator will flash green light (fast). Please note that the XRTK6 holding gesture should be adjusted timely to avoid affecting normal use of the XRTK6.



- ③ 点击“固件更新”确定所有固件已是最新版本。
- ③ Tap “Firmware update” to confirm that all firmware is of the latest version.
- ④ 点击设备--测绘器--定位服务，可以查看 “RTK 定位状态”和“连接卫星数”。
- ④ Tap “Device” -- Rover -- Positioning service; you can view “RTK positioning state” and “Number of satellites connected”.

3.2.3 测绘器打点

3.2.3 Mark by XRTK6

1) 打点须知

1) Marking Instructions

- 在使用测绘器时需要竖直朝上握持，RTK 卫星数较低时，可以尝试举过头顶查看定位状态。
- When using the XRTK6, hold it vertically and upward. If the number of RTK satellites is small, try lifting it overhead to view the positioning state.
- 在使用测绘器时，测绘器上的 RTK 不能有遮挡，且打点时手持测绘器移动至标记点位置上方再进行打点操作。
- During use of the XRTK6, RTK on the XRTK6 should not be covered; before marking operation, hold and move the XRTK6 to be above the marked point position.
- 在地块测绘打点时需记录边界每一个拐角，弧形边界需多打点，边界线不能出现交叉，按顺时针或逆时针顺序打点。
- During marking for field mapping, it is necessary to record every corner of the boundary, and mark more points for cambered boundary; no cross should appear on the boundary line; mark points clockwise or counter-clockwise.

2) 操作方法

2) Operation Method

① 打开“极飞农服”App，在首页界面（主界面）点击右下方“测地按钮”，进入测绘界面。

① Launch the "XAG One" App; on the Home screen, tap the "Mapping" button at the lower right corner to enter the Mapping screen.

② 在测绘界面点击右下角  的图标，选择已绑定的测绘器。

② Tap the  icon at the lower right corner of the Mapping screen to select the bound XRTK6.

注意：在使用测绘器打点时，建议点击右侧  图标禁用“触屏打点”，避免误触。

Note: For marking by XRTK6, it is suggested to tap the  icon on the right side to disable "Tap to Mark", thus to avoid touching by mistake.

③ 手持测绘器步行移动至需要标记的地块边界点上方，短按  键即可记录地块的边界点，记录完所有边界点后，点击 App 上的“自动闭合”或长按  键，系统将自动生成地块。

③ Walk to move the XRTK6 to be above the field boundary point requiring marking; short press the  button to record the boundary point. After recording all boundary points, tap "Auto close" on the App screen, or long press the  button; the system will automatically generate a field.

注意：短按测绘器上  键可记录标记点，短按  键可撤销点。

Note: Short press the  button on the XRTK6 to record the marked point; short press the  button to cancel the point.

④ 依次在 App 内选择打点类别（地块边界、障碍物、禁喷区等），到地块中进行打点测绘。

④ On the App screen, select the marking type (e.g., Field boundary, Obstacles, Non-spraying zone) in sequence to mark points in the field.

3) 打点类型

3) Marking types

① 地块边界

① Field boundary

1) 手持测绘器移动至需要标记的地块边界，单击测绘器“打点”按键即可记录地块的边界点，单击“撤销”按键可撤销上一个边界点。

1) Move the XRTK6 to the field boundary requiring marking; click the "Mark" button on the XRTK6 to record the field boundary point; click the "Undo" button to cancel the previous boundary point.

2) 最后一个点测绘完成后，在“极飞农服”App 上点击第一个点，系统将会自动生成地块。

2) When mapping of the last point is completed, tap the first point in the "XAG One" App; the system will automatically generate a field.

② 障碍物

② Obstacle

选择“障碍物”，在障碍物编辑界面中，手持测绘器，在障碍物边缘外 2 米处进行标记打点。障碍物标记分为多边形障碍物标记和圆形障碍物标记。

Select "Obstacles"; on the obstacle editing screen, hold the XRTK6 to mark points at the position 2m away from

the obstacle edge (outside). Obstacle marking includes polygonal obstacle marking and circular obstacle marking.

③ 禁喷区

③ Non-spraying zone

选择“禁喷区”，在禁喷区编辑界面中，使用测绘器在禁喷区边缘进行标记打点。

Select “Non-spraying zone”; on the non-spraying zone editing screen, use the XRTK6 to mark points at the edge of non-spraying zone.

3.2.4 保存地块

3.2.4 Save field

① 作业区域绘制完成后，点击右下方的“保存”按钮。

① When mapping of operation field is completed, tap the “Save” button at the lower right corner.

② 完善地块信息，点击右上角的“确定”保存地块。

② Complete the field information, and tap “OK” at the upper right corner to save the field.

注意：在完善地块信息页面--保存地块后，可以根据需求在保存地块之后选择是否跳转到继续测地、执行作业或着返回首页的功能界面。

Note: After saving the field on the field information completion screen, you can select whether to continue mapping, perform operation or return to the Home screen as per need.

3.3 常见障碍物打点技巧

3.3 Techniques for Marking Common Obstacles

3.3.1 电线杆斜拉线的正确打点法

3.3.1 Correct marking method for stay wires on utility poles

标记电线杆斜拉线，在电线杆及每根线的接地点往外 2 米的安全距离打标记点，避免无人机与斜拉线刮蹭。

When marking the stay wires on utility poles, mark at the points with 2m safety clearance away from the grounding points of the utility poles and each stay wire to avoid collision between the drone and stay wires.

(1) 树木的正确打点法

(1) Correct marking method for trees

标记树木，要站在距离树冠边缘 2 米以上打标记点，避免无人机在高速飞行时，撞到树枝上。

When marking trees, mark at the points with over 2m distance away from the edges of the tree canopy to prevent the drone from colliding with branches during high-speed flight.

(2) 树木的正确打点法

(1) Correct marking method for trees



本章小结

Summary of this chapter

以上就是本课程的全部内容，地块测绘是无人机最关键部分，如地块规划没做好，会造成无人机撞击障碍物事故。

Above is all the content of this course. Field mapping is the most critical part of drone operation; if the field planning is not well done, accidents such as drones colliding with obstacles will be caused.

测试

Test

1. 在作业地块内有一颗枝繁叶茂的树木，针对该树木，我们该如何对障碍物进行打点，确保作业航线的安全性。
1. When there is a leafy tree in the operation field, how can we mark points for this tree as an obstacle to ensure the safety of operation route?

章节 4 自主作业

Chapter 4 Autonomous Operation

本章重点：

Key points of this chapter:

本课程将详细的讲解使用 P150 2024 款农业无人飞机进行喷洒作业的操作，让学员掌握全流程中每个操作环节的重要和要点，从而学会如何进行一次安全的流程的喷洒作业。

This lecture will introduce in detail how to perform spraying operation by use of P150 2024 Agricultural Drone so that trainees can understand the importance and key points of each operation process and learn how to perform spraying operation safely.

喷洒作业和播撒作业流程都是一样，唯一区别是喷洒作业设置的喷洒量，播撒作业设置的是播撒量，我们以喷洒作业为例。

Process of spraying operation is the same as that of spreading operation, with the only difference being that the parameter set for spraying operation is Spray Volume, while the parameters set for spreading operation is Spread Amount. Let's take spraying operation as an example.

4.1 作业前准备

4.1 Preparation Before Operation

4.1.1 睿喷系统的安装方法

4.1.1 How to Install RevoSpray System

第一步：将 P150 飞行平台下方的两条输药管从固定位拆出，将飞行平台的四个限位孔与“睿喷”系统的凸台对位件对接，将挂载线和两条输药管伸出机体下方，锁紧机体两侧的固定卡扣。

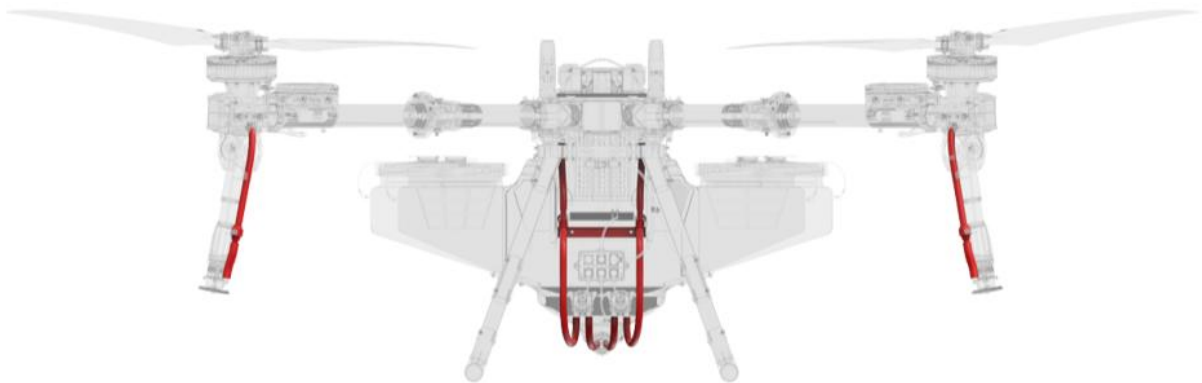
Step 1: Remove the two liquid tubes at the lower part of P150 drone from the fixing positions; connect the boss counterpoints of the RevoSpray system to the four holes of the drone; extend the mounting cable and two liquid tubes to be below the airframe; lock the hasps on the both sides of the airframe.

注意：轻提机身晃动几下，确认连接稳固。

Note: Gently lift the fuselage and shake several times to confirm that the connection is secure.

第二步：将“睿喷”挂载线与飞行平台的 18pin 挂载线进行连接后，固定在线路固定架上；连接输药管，并用扎带扎紧管口。

Step 2: After connecting the "RevoSpray" mounting cable with the 18pin mounting cable of the drone, fix the cables to the cable holder; connect the liquid tubes, and use cable tie to tighten the tube openings.



第三步：拆开桨叶的捆绑扎带，完全打开折叠部位的抱箍，按照从外到内的顺序，拉开机臂卡件，展开机臂，将抱箍的下半部分扣紧，再压牢红色搭扣，会听到“嗒”的一声。确保机臂没有松动后展开桨叶。

Step 3: Remove the cable ties for binding the blades, and completely open the clamps at the folding positions; pull open the arm fasteners to unfold the arms; tighten the lower half of clamps; then secure the red hasps by compression; you will hear a "Da" sound. Unfold the blades after confirming that the arms are not loose.

第四步：松开喷杆的固定旋钮，向后拉动喷杆，展开到位后拧紧旋钮，轻摇喷杆确认是否展开到位。

Step 4: Loosen the spray rod fixing knob; pull the spray rod backwards; tighten the knob after unfolding; gently shake the spray rod to confirm whether it is unfolded properly.

第五步：加入需要喷洒的农药，P150 标配的药箱容量为 60 升，一次最多可以挂载 60 公斤的药液。

Step 5: Add pesticides to be sprayed; the capacity of liquid tank included in the standard configuration of P150 is 60L; up to 60kg of liquid can be loaded each time.

注意：严禁超载作业。

Note: Overload operation is strictly forbidden.



第六步：插入电池，电池安装到位时会听到“咔”的一声。然后轻提电池检查是否安装稳定。

Step 6: Insert the battery; when the battery is installed properly, you will hear a "click" sound. Then gently lift the battery to check whether it is installed securely.

注意：B13970S 电池采用长按 2 秒的方式开/关机：在关机状态下，接上充电器或用电设备，长按电源按键 2 秒，电量指示灯亮起，表示开机成功；在开机状态下，长按电源按键 2 秒直到所有电量指示灯熄灭，表示关机成功。

Note: The B13970S battery can be turned on/off by long pressing the Power button for 2s: In power-off state, connect the charger or electric device, and long press the Power button for 2s; when the battery indicator lights up, it indicates the battery is turned on successfully. In power-on state, long press the Power button for 2s until all battery indicator lights go out, which indicates the battery is turned off successfully.

4.1.2 喷洒校准

4.1.2 Spray calibration

① 为保证喷洒量的准确，在下面几种情况都需要进行喷洒校准，分别是：

① To ensure the accuracy of spray volume, spray calibration is required in the following circumstances:

- a. 更换叶轮或叶轮泵以后；
- a. After replacement of the impeller or impeller pump;
- b. 首次使用睿喷系统或喷洒作业一段时间后；
- b. When the RevoSpray system is used for the first time or after a period of spraying operation;
- c. 双喷头转换 4 喷头或 4 喷头转换双喷头后。
- c. Dual nozzles are changed to 4 nozzles, or 4 nozzles are changed to dual nozzles.
- d. 长时间未使用睿喷系统。
- d. The RevoSpray system has been left unused for a long period of time.

② 校准睿喷的方法如下：

② RevoSpray calibration method is shown below:

第一步：将空量杯置于所需校准叶轮泵对应的喷头下方。

Step 1: Place the empty counting cup under the nozzle corresponding to the impeller pump to be calibrated.

第二步：打开“极飞服务” App ，点击“我的”-“设备”选择需要校准的设备，点击进入“设备详情”界面。

Step 2: Launch the "XAG One" App, tap "Me" - "Device", select and tap the device to be calibrated to enter "Device Details" screen.

扩展：P150 药箱有两种规格，分别是 60L 和 70L，在校准喷洒前需要先确认挂载药箱是否和“药箱容量”的选择相匹配，若不匹配可点击“喷洒系统”-“药箱容量”，选择当前设备挂载药箱的容量后点击“关闭”按钮返回。

Extension: P150 liquid tank is available with two specifications: 60L and 70L. Before spray calibration, first confirm whether the liquid tank mounted matches the "Liquid tank capacity" selected; if not, tap "Spraying system" - "Liquid tank capacity" to select the capacity of the liquid tank currently mounted on the device; then tap the "Close" button to return.



第三步：点击“校准”按钮，根据 App 界面提示往药箱中加入适量清水，点击“下一步”，按照 P1-P2 的顺序进行校准即可。

Step 3: Tap "Calibrate" button, then add appropriate volume of water to the liquid tank according to the prompts on the screen, and then tap "Next" to carry out calibration according to P1-P2 order.

注意：

Note:

a. 建议首次使用时，使用清水进行喷洒校准。后续作业时，建议使用需要喷洒的药液进行喷洒校准。

a. It is recommended to perform spray calibration with clean water for the first time of use. For subsequent operations, it is recommended to use the liquid to be sprayed for spray calibration.

b. 在 4 喷头改双喷头后，要将未安装喷头的两条管道用堵头堵住，否则会影响校准的准确性。

b. After changing to dual-nozzle mode from 4-nozzle mode, the two tubes without nozzles should be blocked with plugs, otherwise calibration accuracy will be adversely affected.



4.1.3 航前检查

4.1.3 Preflight checks

注意事项

Precautions

① 当装配的电池型号为 B13960S 或 B13970 时，P150 无人飞机无法进行满载飞行作业，P150 双电池喷洒最大载重不超过 60KG，超载作业可能会引发电池故障、飞行事故或其他安全事故。

① If the B13960S or B13970 battery is mounted, the P150 drone cannot operate at full capacity. When P150 is mounted with two batteries, the maximum payload should not exceed 60kg for spraying; overload operation could cause battery fault, flight accidents or other safety accidents.

② 喷洒作业前，务必对无人机进行航前检查。航前检查分为环境检查、设备外观和系统检查三项。

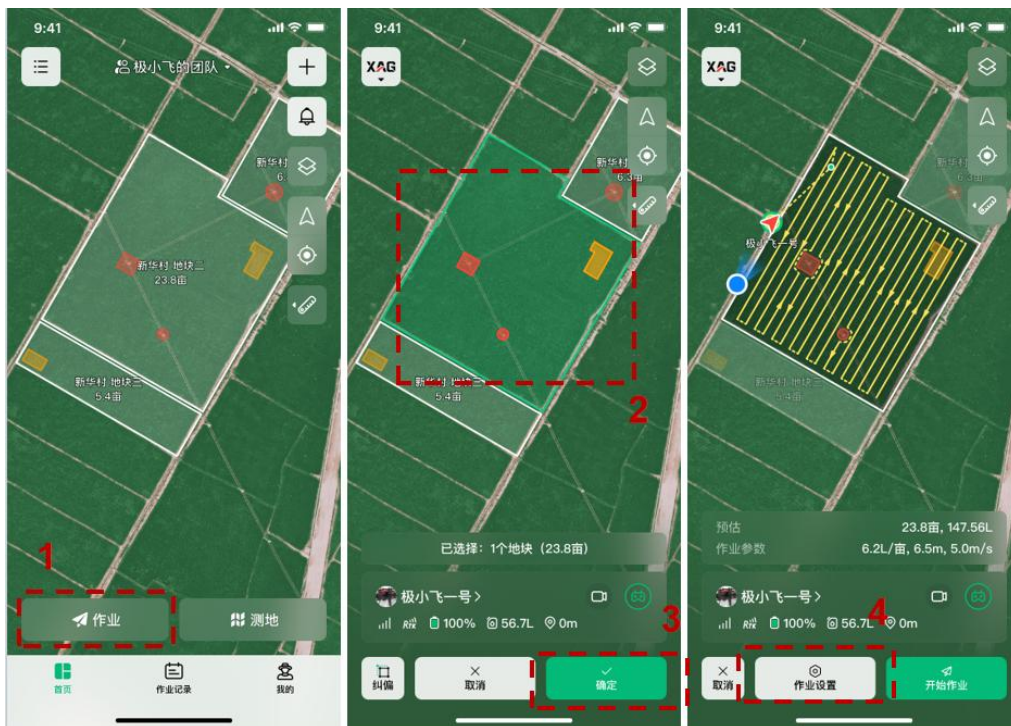
② Before spraying operation, the drone must be subjected to preflight checks. Preflight checks include environment checks, device exterior inspection and system checks.

4.2 喷洒作业参数设置-基础参数

4.2 Parameter Setting for Spraying Operation - Basic Parameters

在对无人机设置参数前，需要先进入作业界面：① 打开“极飞农服”App，点击首页的“作业”；② 在地图上选择作业“地块”；③ 点击“确定”；④ 即可看到所选择的作业地块已自动生成航线并可以点击“作业设置”进行作业参数的修改。

Before setting parameters of the drone, first enter the Operation screen: ① Launch the “XAG One” App, and tap the “Operation” button on the Home screen; ② select the “Field” for operation on the map; ③ Tap “OK”; ④ now you can see that a route has been automatically generated for the operation field selected, and you can tap “Operation settings” to change the operation parameters.



在“作业设置-基础”界面，可以按顺序设置以下参数：

Tap “Operation settings - Basic” to enter the corresponding screen, and set the following parameters in sequence:

4.2.1 喷洒设置

4.2.1 Spraying settings

① 喷洒量：指每亩农田喷洒药液的亩用量。

① Spray volume: The volume of liquid used for spraying per mu (≈ 0.0667 ha) of field.

② 雾化颗粒：指药液的颗粒大小,可根据药液和作物来调节,颗粒越小越容易被作物吸收,但也容易挥发。

② Atomized droplet: The droplet size of liquid sprayed, which can be adjusted according to the liquid sprayed and crops; Smaller droplets can be absorbed by crops more easily, but are more volatile.



4.2.2 换航段喷洒

4.2.2 Spray during lane change

指在无人机作业完一条航线后,要转弯到另一条航线时,在转弯处选择喷洒的工作方式,如果转弯处有作物,建议开启。

When the drone completes the operation of one route and turns to another route, you can select whether or not to enable the spray function for the turning position. If there are crops at the turning position, it is suggested to enable this function.

4.2.3 作业航线

4.2.3 Operating route

作业航线指的是无人机在作业区域内的飞行线路,需要依次设置“高度和速度”、“航线方向和间距”、“安全距离”等参数设置。

Operating Route refers to the flight route of the drone in the operation zone, which involves the setting of parameters including "Altitude & Speed", "Route Direction & Spacing" and "Safety Clearance" in turn.

作业航线的高度、速度，会影响农作物生长、农药喷幅效果、无人机飞行安全，需根据作业实际情况设置参数。

The altitude and speed set for the operating route affect crop growth, pesticide spraying effectiveness, and drone flight safety; parameters need to be set according to the actual situation of operation.

在“喷洒设置后”向下滑动可看到作业航线设置，按顺序设置以下参数：

After "Spraying Settings", swipe down to see the operating route settings, and then set the following parameters in order:

① 高度和速度

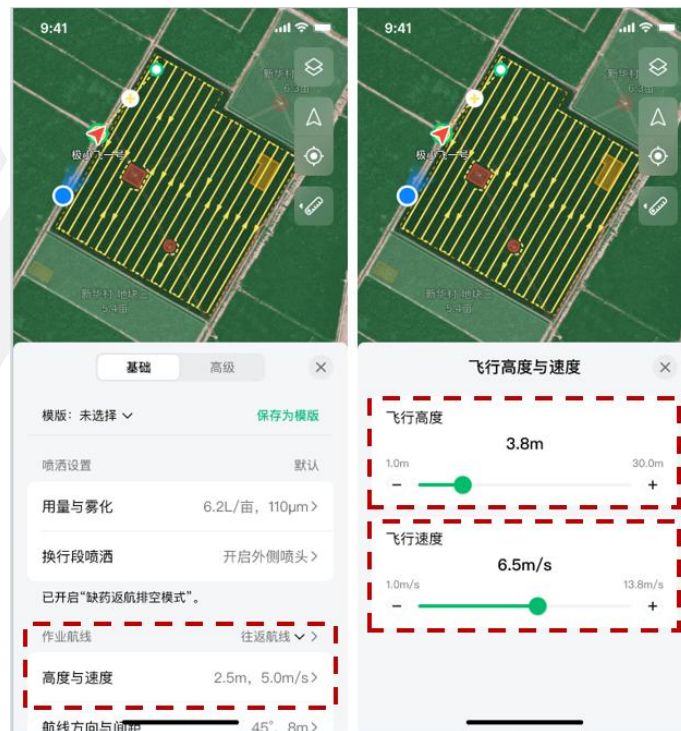
① Altitude & speed

a. 飞行高度：指无人机作业中的飞行高度。

a. Flight altitude: The altitude at which the drone flies during operations.

b. 飞行速度：指无人机作业区域中的速度。

b. Flight speed: The speed at which the drone flies within the operation area.



② 航线方向和间距

② Route direction & spacing

a. 航向方向：拖动航线方向调节栏调整航向方向，选择合适的航线方向可以减少飞行转弯次数，提高飞行效率（也可以点击对应地块边界选择合适的作业航线）。

a. Route direction: Drag the route direction adjustment bar to adjust the heading; choosing the appropriate route direction can reduce the number of turns during flight and improve flight efficiency (you can also tap the corresponding field boundary to select the appropriate operating routes).

b. 航线间距：指两条航线之间的距离，也称喷洒宽幅。

b. Route spacing: The distance between two routes, also known as spray width.

③ 安全距离

③ Safety clearance

a. 统一边界安全距离：当地块边界有障碍物延展至地块内，如树冠，需设置边界安全距离，避免撞击障碍物或作业漂移到地块外。

a. Uniform boundary safety clearance: When any obstacles (e.g., tree canopy) on the field boundary extend into the field, it is necessary to set the safety clearance to avoid collision against the obstacles or operation drift outside the field.

b. 特殊边界安全距离：指根据作业需求可以独立调整单侧地块边界不同的安全边界距离。

b. Special boundary safety clearance: The safety clearance from the single-side field boundary can be separately adjusted according to operation needs.

c. 与障碍物安全距离：通过调节参数可以改变航线和碍物之间的安全距离，避免碰撞障碍物。

c. Obstacle safety clearance: The safety clearance between route and obstacles can be changed by adjusting the parameter, thus to avoid collision against the obstacles.

4.2.4 进出航线

4.2.4 Access route

指的是无人飞机进入和退出作业地块的飞行路线，需要依次设置“飞行高度”、“飞行速度”、“安全点”等参数。

It means the flight path of the drone for getting in and out of the operation field, which requires setting the parameters such as "Flight Altitude", "Flight Speed", and "Safety Point" in sequence.

在“作业航线”设置后，向下滑动可看到“进出航线”设置，按顺序设置以下参数：

After setting the "Operating Route", you can swipe down to view the "Access Route" settings; please set the following parameters in sequence:

① 高度和速度

① Altitude & speed

a. 飞行高度：指设置无人飞机在起降点进入或者飞出作业区域时的飞行高度。

a. Flight altitude: The altitude at which the drone flies into the operation area from the takeoff/landing point or flies out of the operation area.

b. 飞行速度：指设置无人飞机在起降点进入或者飞出作业区域时的飞行速度。

b. Flight speed: The speed at which the drone flies into the operation area from the takeoff/landing point or flies out of the operation area.



② 进出航线的模式，分为安全点模式和安全区模式

② Access route modes include safety point mode and safety zone mode.

a. 安全点模式：无人飞机进出地块，都必须先经过安全点，进而保障飞行安全。适用于作业的进出航线范围有较多障碍物，需要特定航线进出的情况，具体操作方法如下：

a. Safety point mode: The drone must first pass by the safety point when accessing the field, thus to guarantee the flight safety. This mode is suitable for the circumstances where there are many obstacles on the access route and specific routes are required for access the operation area. The operation method is detailed as follows:

拖动安全点的位置，若仍然无法避开进出航线上的障碍物，可点击航线上的"+"号，添加辅助点来调整路线。该功能为默认功能，往返时无人飞机会先飞至安全点再执行往返航线。

Drag the position of safety point. If it is still impossible to avoid the obstacles on the access route, you can tap "+" on the route to add a guide point, thus to adjust the route. This is a default function that enables a drone to fly to the safety point before following the standard mode on a round trip.

辅助点：安全点到返航点之间，可以根据障碍物的情况，增加辅助点来绕开障碍物，以保障飞行安全。

Guide point: A guide point can be added between the safety point and the RTH point according to the condition of obstacles, thus to bypass obstacles and guarantee flight safety.

注意：安全点无法移动出地块安全边界外和障碍物区域。

Note: The safety point cannot be moved beyond the field safety boundary and obstacle area.

b. 安全区模式：指无人飞机采用直线路线进出地块（地块中有障碍物会绕开）。适用于返航点到地块白色区域范围内没有障碍物，或者障碍物都已经测绘出来的情况。

b. Safety zone mode: In this mode, the drone flies in and out of the field along a straight route (obstacles in the field, if any, will be bypassed). This mode is suitable for the circumstances where there are no obstacles in the white area ranging from RTH point to the field, or all obstacles in this area have been pre-mapped.

注意：需确认已预先测绘出白色扇形安全区域内全部障碍物或该区域内没有影响作业安全的障碍物存在。

Note: It is needed to confirm all the obstacles in the white sectorial safety area have been pre-mapped, or confirm that there is no obstacle affecting operation safety in this area.

③ 雷达仿地：为了保证飞行安全及喷洒效果，可打开“仿地功能”，使无人飞机的飞行高度与作物顶部保持固定高度。

③ Radar terrain following: To ensure flight safety and spraying effectiveness, you can enable "Terrain Following" to keep a fixed distance between the drone and the top of crops.

注意：

Note:

a. “雷达仿地”功能默认为上次的选择方式，如果在上个地块设置中关掉了该功能，再次选择作业地块时不会自动开启，作业前需确认是否已打开或关闭该设置项。

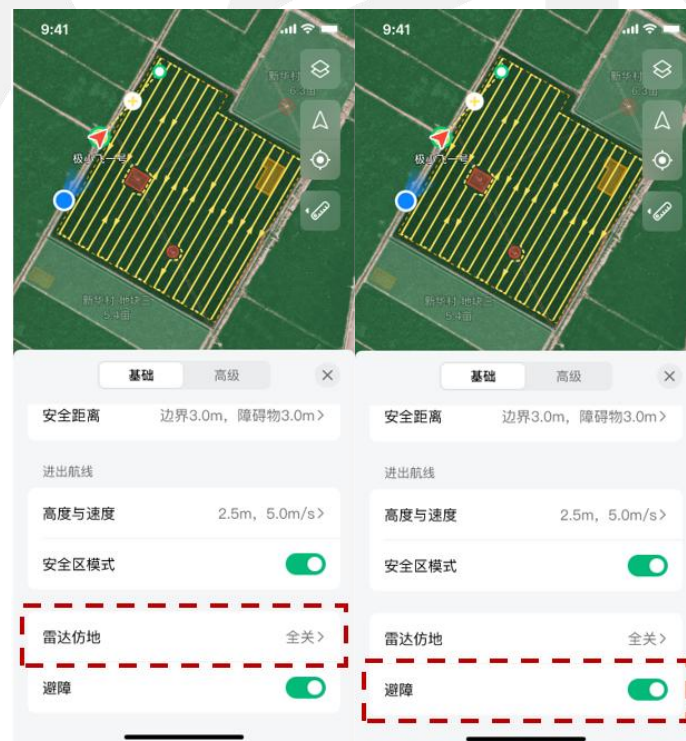
a. The default status of "Radar Terrain Following" is that selected last time. If this function is disabled in the last operation, it will not be automatically enabled for the next operation. Prior to operation, it is needed to confirm whether this function is enabled or disabled.

b. 在水面作业场景中，不能使用“雷达防地”功能。

b. In water surface operation scenarios, the "Radar Terrain Following" function cannot be used.

④ 避障功能：初次作业的地块，建议打开避障功能，提高飞机安全效果。

④ Obstacle avoidance: If the field is operated for the first time, it is suggested to enable the "Obstacle Avoidance" function, thus to enhance the flight safety.



4.2.5 作业中可调参数

4.2.5 Parameters adjustable during operation

为提高作业效率，满足作业需求，P150 无人飞机同样支持动态参数调整，其中无人飞机在作业过程中我们可以动态调整的基础参数包括：

In order to improve the operation efficiency and meet the operation requirements, the P150 drone also supports dynamic parameter adjustment. Basic parameters that can be dynamically adjusted during operation of the drone include:

- ① “雷达与避障”中的“雷达仿地和避障功能”的开关。
- ① ON/OFF status of "Radar terrain following and obstacle avoidance function" under "Radar and Obstacle Avoidance".

4.3 执行作业

4.3 Perform Operation

设置完成后点击右侧  按钮，返回作业页面后点击“开始作业”，确认起飞前检测以及周围环境的安全无误后并勾选相关提示，滑动起飞按钮,无人飞机将在自检倒计时后执行起飞作业任务。

After setting, tap the  button on the right to return to the Operation screen, and then tap "Start Operation". Confirm pre-flight checks and surrounding environment safety, check the relevant prompts, and swipe the takeoff button. The drone will take off after the self-testing countdown.

4.4 作业后清理

4.4 Cleaning After Operation

每日作业完成后：

Upon daily operation:

- 需要排空药箱及管路内药液，并用肥皂水和清水进行清洗。
- Drain the remaining chemicals in the liquid tank and tubes, and rinse with soapy water and clean water;

注意：我们在使用肥皂水或洗衣粉水对药箱和管路进行清洗后，需要用清水再次进行清洗至无泡沫状态。

Note: After rinsing the liquid tank and tube with soapy water or washing powder solution, you need to use clean water to clean again until there is no foam.

- 用拧干的湿抹布擦拭无人飞机表面，除去药渍与附着的泥土。
- Wipe the drone surface with a wrung out damp rag to remove chemical stains and soil affixed.

本章小结

Summary of this chapter

这一课，给大家介绍了“喷洒设置”和“航线设置”中各个参数的作用及设置方法。如有收获欢迎分享这门课程，让更多人学习了解。

This course introduces the functions and setting methods of various parameters in "Spraying Settings" and

"Route Settings". If this course has benefited you, please feel free to share to let more people learn and know about this course.

问答题

Questions

1. 在作业中是否使用安全点的设置方法可以在“作业设置-基础-安全区模式”下进行修改。()
1. Whether the "Safety point" setting method is used during operation can be changed under "Operation settings - Basic - Safety zone mode". ()
A. 对 B. 错
A. True B. False
2. 雷达仿地方式是默认打开的，所以每次进行地块参数设置时无需关注是否已符合当前地块作业设置需求。()
2. Radar terrain following is set to ON by default. Therefore, when setting field parameters each time, it is unnecessary to confirm whether the requirements for operation settings of the current field are satisfied. ()
A. 对 B. 错
A. True B. False
3. 请简述如何对已设置的地块参数进行保存和重复作业时进行调用。
3. Please briefly describe how to save field parameters having been set and how to call them during repeated operation.

章节 5 紧急情况处理

Chapter 5 Emergency Handling

本章重点：

Key points of this chapter:

本课程为你提供一套飞行过程中紧急情况的应对方案，以及事故发生的处理方法，保障你的权益。

This course provides you with a set of in-flight emergency response plans and accident handling measures to protect your rights.

常见紧急情况都有哪些呢？有哪些设备可在紧急情况使用？接下来给大家详细介绍下，不同场景可使用那些设备。

What are the common emergency situations? Which devices can be used for emergency situations? Next, let's know about in detail which devices can be used in different scenarios.

按照紧急操作内容可分为 4 大项，分别为悬停、迫降、返航、指点飞行。

There are four major types of emergency operation, namely hovering, forced landing, RTH, and Tap & Go.

常见功能使用对应场景应用

Use of common functions and their application scenarios

操作指令 Operation command	极飞农服 App、单/双手控 "XAG One" App, Control Stick/joystick remote controller
悬停 Hover	示例：作业过程中有闲杂人员闯入作业区域 Example: Irrelevant persons intrude into the operation zone during operation
迫降 Forced landing	示例：飞行过程中无人机异常（震动过大、动力系统异常） Example: Abnormalities occur to the drone during flight (excessive vibration, propulsion system abnormalities)
返航 RTH	示例：作业区域内有干扰继续进行作业的危险因素 Example: There are hazardous factors that may interfere with the operation in the operation zone
指点飞行 Tap & Go	示例：在没有绑定单/双手控时出现的紧急情况 Example: Emergency situations that occur when Control Stick/joystick remote controller is not bound

紧急操作方式按照操作无人机可分为 2 种，分别为极飞农服 App 和单/双手控：

Emergency operation of the drone can be performed via the "XAG One" App or by Control Stick/joystick remote controller, depending on the circumstance:

	悬停 Hover	迫降 Forced landing	返航 RTH	指点飞行 Tap & Go
极飞农服 App XAG One App	✓	✓	✓	✓
ACS4 智能手柄 XAG Agricultural Control Stick 4 (ACS4)	✓	✓	✓	
SRC4 双手控 Smart Remote Controller 4 (SRC4)	✓	✓	✓	

在日常作业过程中，如遇到：有人突然闯入作业区域、作业航线中有未标记的障碍物、无人机飞行时螺旋桨有明显震动等突发问题，应该如何进行紧急操作呢？接下来的课程为你详细说明。

How should emergency operations be carried out when encountering unexpected problems during daily operation, such as personnel intrusion into the operation zone, existence of unmarked obstacles on the operating route, and obvious vibration of the propeller during drone flight? The next course will elaborate on this subject in detail.

5.1 紧急情况发生时几种处理办法

5.1 Emergency Handling Methods

5.1.1 极飞农服 App 应急操作

5.1.1 Emergency operation by "XAG One" App

注意事项

Precautions

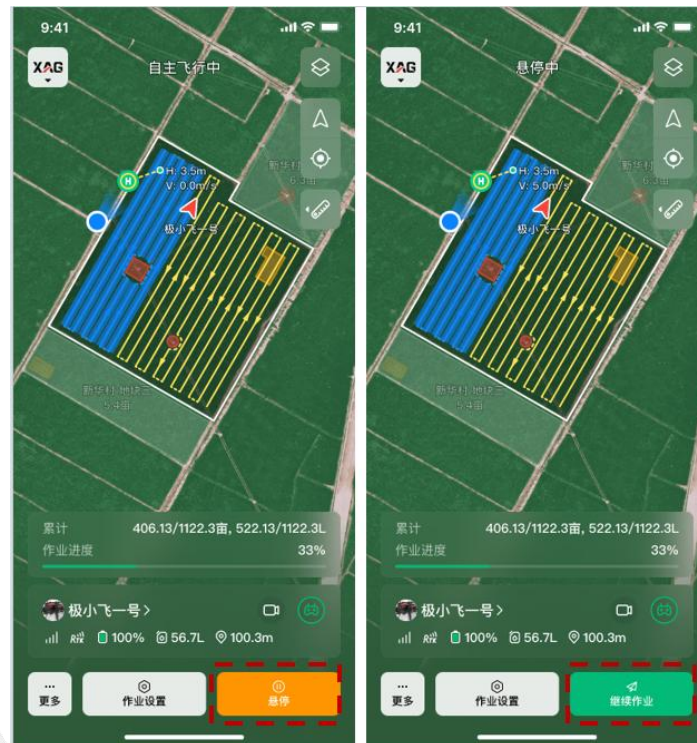
- 1) 在选择迫降时应注意迫降场地是否平坦，必要时可降落在农作物上。
1) When choosing to perform forced landing, attention should be paid to checking whether the forced landing site selected is flat, and if necessary, the drone can be landed on crops.
- 2) 无人机在返回时应确保起降区无人，返航航线安全。
2) When choosing to perform RTH, ensure that there are no people in the takeoff/landing area, and RTH route is safe.
- 3) 在指点飞行过程中，需把作业地图放大，拖动地图使十字光标至需要指点位置，准确打点才能精准飞行；
3) During the Tap & Go process, zoom in on the operation map, and drag the map to place the crosshair cursor at the position to be marked; accurate tapping is essential for precise flight;
- 4) 在打点时需和实际地形进行对比，找好地形参照点，避免无人机往反方向飞行；
4) When marking, compare with the actual terrain and find the terrain reference point to prevent the drone flying in the opposite direction;
- 5) 指点飞行过程中如遇特殊情况可点击“停止”，指点飞行完成后点击“退出”返回到自主飞行界面。
5) In case of special circumstances during Tap & Go process, you can tap "Stop"; After Tap & Go process is completed, you can tap "Exit" to return to "Autonomous flight" screen.
- 6) 指点飞行时不能自主避障，因此要注意观察指点飞行的航段不能有障碍物，规划指点飞行航段时需要特别注意，此时避障功能默认关闭无法打开。
6) During Tap & Go process, obstacles cannot be avoided autonomously. Therefore, there should be no obstacles in the Tap & Go flight segment, to which special attention must be paid when planning the Tap & Go flight segment. During Tap & Go process, the obstacle avoidance function is disabled by default and cannot be enabled.

悬停：为避免安全问题发生，在作业过程中有人员闯入作业区域等突发紧急情况时，必须快速做出反应，悬停无人机，如不快速处理，可能会出现人伤物损的安全事件发生。

Hover: To avoid safety issues, in case of sudden emergencies, such as personnel intrusion into the operation area during operation, a quick response must be made to hover the drone; otherwise, safety incidents that cause personal injury and property damage may occur.

操作方法：无人飞机在飞行过程中，点击左下角【悬停】，待安全风险过后点击【继续】，无人飞机会继续作业。

Operating method: During flight of drone, tap the [Hover] button in the lower left corner; after the safety risk is resolved, tap the [Continue] button to enable agricultural drone to continue to operate.

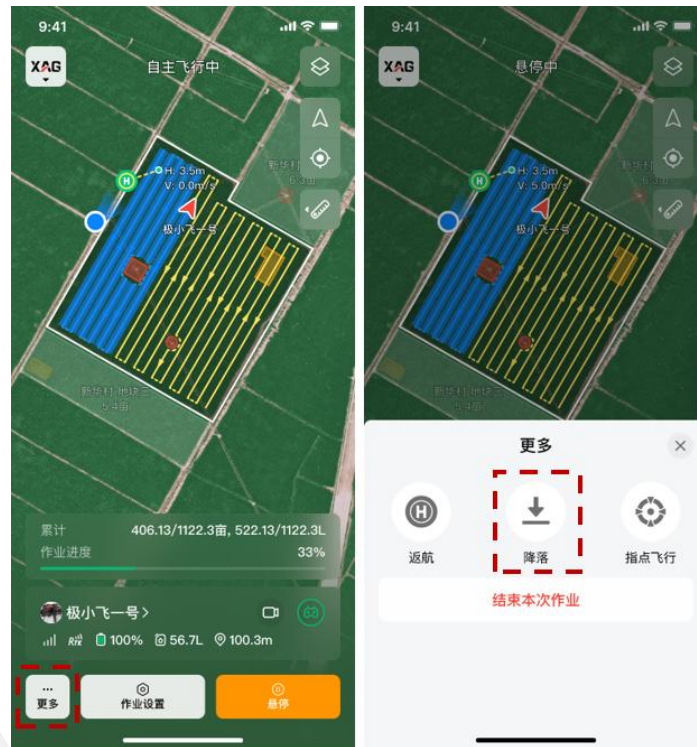


迫降：在长期作业过程中，因操作员维护保养不到位，如螺旋桨螺丝松动，导致飞行时能很直观看到无人机出现晃动，抖动，此时应该立即停止飞行，进行紧急迫降，如不紧急处理可能会出现无人机损坏炸机等情况发生。

Forced landing: In the long-term operation process, if the operator fails to carry out adequate maintenance (i.e., loose propeller screws are not tightened), resulting in that, during flight, visible shaking and jitter of the drone occur, the flight should be stopped immediately for emergency forced landing; in case of failure to handle the problem urgently, accidents like fall of the drone may occur.

操作方法：无人飞机在飞行过程中，点击【更多】，点击【降落】，无人机会原地降落；

Operating method: During flight of drone, tap [More] and [Land] in sequence to make the drone land in situ.

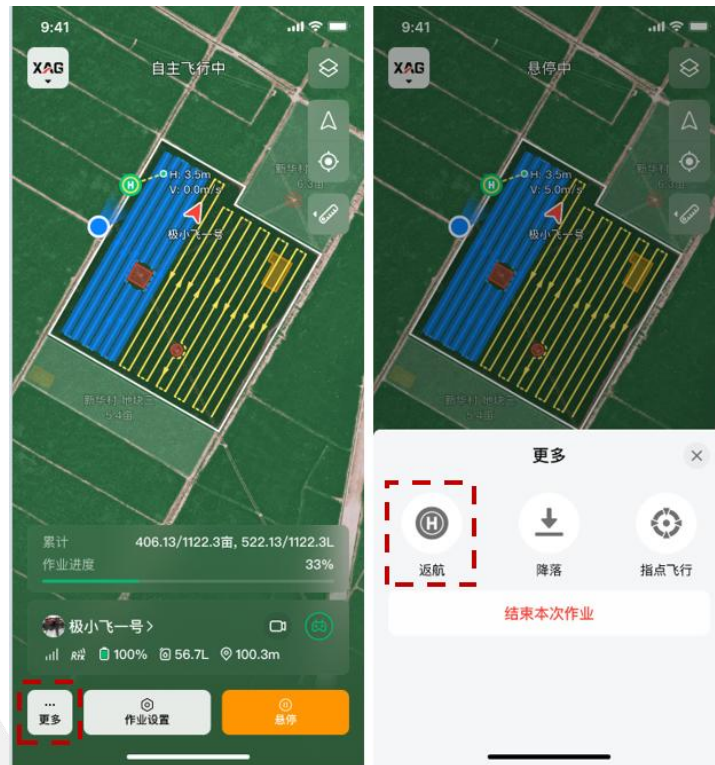


返航: 为保证飞行安全，在飞行过程中，因操作员大意疏忽导致作业区域内有未测绘障碍物，此时应该立即停止飞行，否则会出现炸机现象。需进行紧急返航操作，待障碍物测绘完成后方可继续作业，如不紧急处理无人机可能会撞到障碍物，导致无人机损坏严重。

RTH: For flight safety, during flight, if there are obstacles that have not been mapped in the operation area due to the operator's carelessness or negligence, the flight should be stopped immediately; otherwise, fall of the drone will be caused. In this case, emergency RTH is required, and only after obstacle mapping is completed, can the operation be continued. In case of failing to handle urgently, the drone may collide against obstacles, resulting in severe drone damage.

操作方法: 无人飞机在飞行过程中，点击【更多】，点击【返航】，无人机会按照设定好的参数返回起降点。

Operating method: During flight of drone, tap [More] and [RTH] in sequence to make the drone return to the takeoff/landing point according to the set parameters.



指点飞行：作业过程中没有绑定遥控器，但又遇突发状况，需要紧急灵活处理，此时应该选择【指点飞行】功能，指点飞行以无人机为中心半径 50 米范围进行飞行，指点飞行具有一定的安全操作风险，操作时需要注意指定位置的环境情况，如操作失误会出现炸机情况发生，严重的会造成其他人员或物品损伤损坏。

Tap & Go: During operation, if no remote controller is bound, but an emergency occurs, which requires urgent flexible handling, you should select the [Tap & Go] function to guide the drone to fly within a radius of 50m from the drone; The use of Tap & Go function has certain safety operation risks; attention should be paid to the environmental conditions at the designated location during operation. Operational errors may cause flight abnormality, and in severe cases, may result in personal injury or property damage.

操作方法：无人飞机在飞行过程中，点击【更多】，选择【指点飞行】，可设置指点飞行【高度/速度】，在地图上将圆心点移动到目标位置，点击【前往】，无人机将会按照设定好参数飞往目标位置。

Operating method: During flight of drone, tap [More] and then select [Tap & Go] to set the [Altitude/Speed] for Tap & Go; Move the center point to the target location on the map, and then tap [Go], after which the drone will fly to the target location according to the set parameters.

5.1.2 SRC4 带屏遥控器应急操作

5.1.2 Emergency Operation by SRC4

如在作业过程遇到紧急情况，且 App 与无人机通讯信号中断，导致 App 无法给无人飞机发送指令时，可用双手控进行应急操作。

If an emergency occurs and the communication signal between the App and the drone is interrupted during operation, causing failure of the App to send commands to the drone, the joystick remote controller can be used for emergency operations.



悬停：为避免安全问题发生，在作业过程中有闲杂人员闯入作业区域等突发紧急情况时，必须快速做出反应，悬停无人机，如不快速处理，可能会出现人伤物损的安全事件发生。

Hovering: To avoid safety issues, in case of sudden emergencies, such as intrusion of irrelevant persons into the operation area during operation, a quick response must be made to hover the drone; otherwise, safety incidents such as personal injury and property damage may occur.

操作方法：无人机飞行中短按遥控器右侧“”键，无人机将停止作业并悬停，待安全风险过后再次短按“”键，可继续作业。

Operation method: When the drone is flying, short press the “” button on the right side of the remote controller; the drone will stop operation and hover. When the safety risk disappears, short press the “” button again to continue the operation.

灵活操作：悬停过程中也可通过双手控摇杆控制方向，灵活移动农业无人飞机位置，规避安全事故发生。

Flexible operation: During hovering, you can also use the joysticks of remote controller to flexibly move the drone position, thus to avoid safety accidents.

注意：遥控器摇杆操控方式分为日本手、美国手和中国手，选择不同摇杆功能会有所不同，遥控器出厂默认操控模式为美国手（Mode 2）。

Note: The joysticks of remote controller can be controlled in three modes, i.e. Japanese Hand (Mode 1), American Hand (Mode 2), and Chinese Hand (Mode 3). The joystick function may vary depending on the selected joystick control mode. The factory default joystick control mode is American Hand (Mode 2).

操作方法：短按遥控器上“”键无人机悬停，通过操控摇杆可前后左右移动无人机，再短按遥控器上“”键无人机恢复自主作业。

Operation method: Short press the “” button on the remote controller to command the drone to hover, and then control the drone to move forward, backward, left or right by operating the joysticks; short press the “” button again to resume autonomous operation.

返航：为保证飞行安全，在飞行作业过程中，如遇到紧急情况，建议使用手控接管尽快迫降到近平坦的地势中，从而降低炸机或损坏风险，当无人机出现异常悬停情况或发现地块内存在有影响飞行作业安全未圈出障碍物，此时应该立即停止飞行，进行紧急返航操作，待障碍物测绘完成后方可继续作业。

RTH: For flight safety, in case of an emergency during flight, it is suggested to take control by remote controller and realize forced landing to a flat ground nearby as soon as possible, thus to reduce the risk of fall or damage of the drone. In case of abnormal hovering or when there is any uncircled obstacle that could affect the flight operation within the field, the flight should be stopped immediately and emergency RTH is required. Operation can be resumed only after completion of obstacle mapping.

操作方法：无人飞机在飞行过程中或手动模式下，长按遥控器左侧的“”键即可触发返航，无人机会按照设定好的参数返回起降点。

Operation method: When the drone is flying or in Manual mode, long press the “” button on the left side of the remote controller to trigger RTH; the drone will return to the takeoff/landing point according to the set parameters.

注意：无人机在返回时应确保起降区无人，返航航线安全。

Note: When the drone returns, ensure that the takeoff/landing area is clear of people and the RTH route is safe.

【知识拓展】

[Knowledge Extension]

注意事项

Precautions

- 1) 手动控制飞机飞行时要保证飞机机头的朝向，保证机头的朝向在自己的正前方。
1) During manual control of the flight of the drone, make sure the nose orientation is straight ahead of you.
- 2) 操控无人机上升/下降时，请确保无人机 10 米范围内无人。
2) When controlling the drone to ascend/descend, confirm that the area within 10m of the drone is clear of people.
- 3) 禁止在无人机正常飞行过程中执行启动电机的掰杆动作（同时内八或外八掰杆），此动作会导致电机在空中停转造成无人机坠毁。
3) During normal flight of the drone, it is forbidden to turn the joysticks in a position (simultaneously toe-in or toe-out) that will start the motor since this action will cause motor stalling in the air, further resulting in crash of the drone.

功能一：控制无人飞机原地起飞

Function 1: Control the drone to take off in situ

同时外八或内八两种掰杆动作启动电机，可控制无人机螺旋桨急速旋转，再缓慢向前推动“油门杆”控制无人机起飞高度。若 3 秒内未推动油门杆，电机将自动停转。

Start the motor by turning the joysticks of the remote controller in toe-in or toe-out position to control the drone propellers to idle; then slowly push the “throttle” forward to control the takeoff altitude of the drone. If the throttle is not pushed within 3s, the motor will automatically stop rotation.

功能二：控制无人飞机原地降落

Function 2: Control the drone to land in situ

使用方法：这里我们以摇杆模式中的“美国手”为例。

How to use: Here let's take “American Hand (Mode 2)” in the joystick modes for example.

1、左边摇杆：用来控制无人机的升降与旋转，向前推杆飞行器上升，向后推杆飞行器下降，向左推杆飞行器逆时针旋转，向右推杆飞行器顺时针旋转。

1. Left joystick: Control the ascending/descending and rotation of the drone. When it is pushed forward, the drone will ascend; when it is pushed backward, the drone will descend; when it is pushed leftward, the drone will spin counter-clockwise; when it is pushed rightward, the drone will spin clockwise.

2、右边摇杆：用来控制飞行器的水平移动，以机头方向为基准。向前推杆，无人机向前飞行，向后推杆无人机则向后飞行，向左推杆无人机向左移动，向右推杆无人机向右移动。

2. Right joystick: Control horizontal movement of the drone, taking the nose direction as the reference. When it is pushed forward, the drone will fly forward; when it is pushed backward, the drone will fly backward; when it is pushed leftward, the drone will move leftward; when it is pushed rightward, the drone will move rightward.

5.2 紧急情况发生后三种处理方法

5.2 Three Solutions After Occurrence of Emergency

5.2.1 自主维修

5.2.1 Autonomous maintenance

无人飞机损坏时，建议具备一定维修能力的飞手，在极飞商城购买配件自主完成换件维修；

For damage of the drone, a pilot having a certain ability to repair it is suggested to buy the necessary parts from XAG Store to replace or repair the damaged parts by him/herself;

进入极飞商城路径：

Path for accessing XAG Store:

进入极飞商城的方式有以下两种方式：

You can access XAG Store in the following two ways:

- 1) 微信“极飞服务”小程序--应用--极飞商城；
- 1) WeChat “XAG Service” Mini Program -- Apps -- XAG Store;
- 2) “极飞衣服”APP --我的--商城。
- 2) “XAG One” App -- Me -- Shopping.

在极飞商城首页下拉选择“产品配件”分类，即可根据产品类型选择所需要购买的零配件。

On the Home screen of XAG Store, pull down to select “Product parts”; you can select the parts required according to the product type.

维修完成后，我们需要进行试飞测试，确保无人机无异常再作业。

After repair, we need to perform test flight to ensure that the drone has no abnormality before operation.

5.2.2 故障报修

5.2.2 Fault Repair Request

注意事项

Precautions

- 1) 故障报修工单的提交需在事故发生 72 小时内完成提交。
1) The Fault Repair Request Form should be submitted within 72h after the occurrence of an accident.
- 2) 每个故障报修工单仅支持一台设备报修，如名下有多台设备需要申请报修，需按设备分开提单。
2) Each Fault Repair Request Form supports repair of only one device. If there is more than one device requesting repair, separate forms should be submitted.

若事故对无人机造成损坏，且不具备自主维修条件（无配件、无人机损坏严重或没有维修能力），可在提交故障报修工单后，自行到就近的服务站、授权服务网点或选择寄修的方式完成维修；

If the accident causes damage of the drone, and conditions for self-servicing are not available (e.g., lack of parts, serious damage of the drone, incompetence for repair), after submitting the Fault Repair Request Form, you can go to a nearby service station or authorized service outlet or send the drone for repair;

故障报修路径：“极飞衣服” App--我的--服务--故障报修；

Path for fault repair request: "XAG" App -- Me -- Services - Fault repair request;

选择或添加完成需要报修的设备，并点击“下一步”进入故障报修工单填写；

Select or add the device(s) requesting repair, and tap "Next" to complete the Fault Repair Request Form;

故障报修工单填写：

Complete the Fault Repair Request Form:

- 1) 据页面提示上传设备故障照片，填写故障描述，选择就近的售后维修网点；
1) Upload photos of the device fault according to the prompts on the screen; complete the fault description; select a nearby after-sales service outlet;
- 2) 上传设备故障照片不少于 3 张，上传照片需包括第一事故现场照片、事故现场环境照片、损坏部位照片；
2) At least three photos of the device fault should be uploaded, including photo of the first scene of accident, photo of the environment of the scene of accident, and photo of the damaged part;
- 3) 如设备完成维修后需回寄，可按需填写回寄地址；
3) If it is needed to send back the device after repair, please provide the receiving address;
- 4) 点击“故障日志”并选择对应架次的故障日志（只能选择 1 个故障日志）；
4) Tap "Fault log", and select the fault log corresponding to the drone operation (only one fault log can be selected);
- 5) 材料填写完毕后点击“立即提交”，系统将自动生成服务工单，待维修网点接单安排维修。
5) After filling out the form, tap "Submit now"; the system will automatically generate a service order, waiting for the service outlet to accept the order and arrange repair service.

5.2.3 保险理赔

5.2.3 Insurance Claim

若事故造成人员伤亡或财产损失，申购了《第三者责任险》的用户可以申请保险理赔。

If an accident results in personal injury or property damage, user having purchased the Third Party Liability Insurance may make a claim under the insurance policy.

注意事项

Precautions

- 1) 用户报案时需提供保单号；
- 1) User shall provide the policy number when reporting a case;
- 2) 保险公司理赔人员接到报案后会联系报案人，告知需提供理赔资料；
- 2) After receiving the report, the claim adjuster from the insurer will contact the reporter and inform him of the claim materials that should be provided;
- 3) 出险单位按要求提供理赔资料，保险公司收到完整资料后安排支付赔款。
- 3) The claimer shall provide the claim materials as required; after receiving the complete materials, the insurer will arrange payment for the compensation.
- 4) 官方报案电话：95511。
- 4) Official reporting hotline: 95511.

理赔流程如下图：

Below shows the claim process:



本章小结

Summary of this chapter

以上是极飞农业无人机在紧急情况下的应对操作，以及紧急情况发生后的处理办法。

The above describes what to do when an emergency occurs to the XAG agricultural drone, and how to handle the emergency after occurrence.

测试

Test

1. 在无人机作业过程中，忽然发现有人闯入作业区，此时需如何正确处理？
 1. What to do if a person unexpectedly intrudes into the operation zone during operation of the drone?
 2. 在使用指点飞行时，指点距离是以无人机为中心半径（ ）范围进行飞行，指点飞行具有一定的安全风险，操作时需要注意指定位置的环境情况。
 2. When the "Tap & Go" function is used, the drone will be guided to fly within a radius of () from the drone. The use of Tap & Go function has certain safety operation risks, and attention should be paid to the environmental conditions at the designated location during operation.
- A. 10 米 B. 0.5 米 C. 50 米 D. 15 米
A. 10m B. 0.5m C. 50m D. 15m

章节 6 维护保养

Chapter 6 Maintenance

本章重点：

Key points of this chapter:

本课程将带你一站式解决极飞 2024 款农业无人飞机、B13970S 电池、GC4000 燃油超充站的维护保养问题，让每一次飞行作业更安心、更高效。

This lecture will provide you with one-stop solutions for maintenance issues related to XAG 2024 agricultural drone, B13970S battery and GC4000 supercharge station, thus to improve the safety and efficiency in each flight operation.

我们发现，有很多用户因为不重视无人飞机维护保养，导致造成不必要的损失，甚至是飞行事故。大家来看一个案例：

It is found that many users have ignored maintenance of their drones, resulting in unnecessary losses or even flight accidents. Let's see a case here:

某飞手长期作业且从未清理过电机，漆包线上附着了很多泥土和沙石，导致电机转动异常，无人飞机失去动力而坠落。最终飞手不但要承担维修费用，还要赔付农场主的误时费用。

A pilot had performed operation for a long period of time but had never cleaned the motors. As a result, the enamel wires were adhered with plenty of soil, sand and stones, causing abnormal rotation of the motors and further fall of the drone due to loss of power. In the end, the pilot had to bear the repair cost and also compensate the farmer for delay.



相信大家都不愿让此事发生在自己身上，所以请认真学完这门课，按照规范流程做好设备的定期维护保养。
It is definite that none of you would like to see that thing happening to yourself. Therefore, please finish this course carefully, and carry out regular maintenance of the device according to the standard process.

6.1 无人飞机定期保养，提前发现安全隐患

6.1 Regular Maintenance of Drone for Early Detection of Safety Hazards

随着无人飞机作业亩数的增加，需要维护保养的项目也会逐渐增加。大家要在这两个阶段进行保养，分别是每次作业完、作业达到 3 千亩。下面我们将依次介绍每个阶段的保养项目。

With the increase of operation hectares, there will be more maintenance items required for the drone. Maintenance should be carried out after each operation, or after operation covering an area of 200 hectares. Here we will introduce the maintenance items in each stage.

6.1.1 每次作业结束后的保养项目

6.1.1 Maintenance Items after Each Operation

(1) 清洁及检查机身、作业执行系统

(1) Clean and Check Airframe and Application System

● 机身清洁及检查

● Clean and check the fuselage

清洁检查机身是为了在日常作业过程中，使飞行平台能保持最佳状态，让机体震动减少，间接性保护机体其他零部件，可检查维护保养以下零部件：

Cleaning and checking the airframe is to enable the drone to maintain the optimal condition during daily operation, thus reducing vibrations and indirectly protecting other components of the drone. The parts needing check, maintenance and upkeep are as follows:

第一步，检查螺旋桨的桨叶，保持表面清洁、无附着物，检查是否无裂痕、无缺口，如有裂纹或缺损，需更换桨叶；

Step 1: Check the propeller blades to ensure surface is clean, free of adhered substances, and there is not any crack or notch; replace the blades if any crack or notch is found;



第二步，检查螺旋桨的桨夹是否变形，轴承是否存在虚位；上下摇晃桨夹如有晃动，需紧固螺丝或更换损坏的桨夹、桨夹固定座后，紧固螺丝后，需要再次进行复查，如果还存在虚位，需要检查桨夹是否存在变形，轴承是否虚位。

Step 2: Check propeller clamps for deformation and bearings for backlash; wobble the propeller clamps up and down, and if any shaking is found, tighten the screws or replace the damaged propeller clamps or propeller clamp mount; after tightening the screws, check again, and if backlash still exists, re-check propeller clamps for deformation and bearings for backlash.



第三步，检查电调表面、机臂如有附着物，使用软毛刷将表面的药液及污渍刷干净；

Step 3: Check ESC surface and arm for adhered substances, and remove the chemicals and stains on the surface with a soft-bristled brush;

第四步，使用高压水枪冲洗机身，确保清洁无污渍，并将无人飞机晾干。

Step 4: Rinse the airframe with a high-pressure spray gun to ensure cleanliness and no stains, and air dry the drone.

● 睿喷系统清洁及检查

● Cleaning and Check of RevoSpray System

及时清洁药箱可使药箱管路不容易磨损及腐蚀药箱管路，那应该如何进行维护保养喷洒系统呢，可以检查维护以下零部件。

Timely cleaning of liquid tank can make the liquid tank tubes less prone to wear and corrosion. Then how to maintain the spraying system? You can check and maintain the following parts.

第一步，打开“极飞农服”App，进入喷洒系统，点击“排出剩余药液”，排空药箱和管道内剩余药液；

Step 1: Launch the "XAG One" App; enter the spraying system; tap "Discharge remaining chemicals" to drain the remaining chemicals in the liquid tank and tubes;

第二步，装入肥皂水或皂粉水，中和残留农药，再次排空；

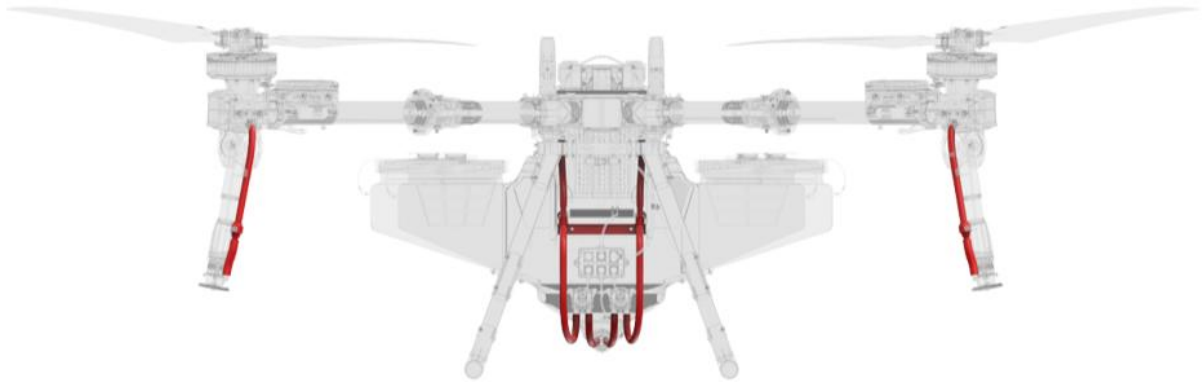
Step 2: Add soapy water or powdered soap solution to neutralize residual pesticides, and empty the liquid tank again;

第三步，将清水倒入药箱，点击“排出剩余药液”，排空药箱、管路；

Step 3: Pour clean water into the liquid tank, and then tap "Discharge remaining chemicals" to empty the liquid tank and tube;

第四步，检查药管各接口扎带，如有松动，使用扎带紧固；药管如有磨损，需缠“布基胶布”进行防护；如有龟裂、老化现象，需及时更换药管。

Step 4: Check the cable tie at each joint of liquid tube; if looseness is found, tighten with a cable tie. If wear of liquid tube is found, wrap it with "duct tape" for protection. If crack or aging exists, replace the liquid tube timely.

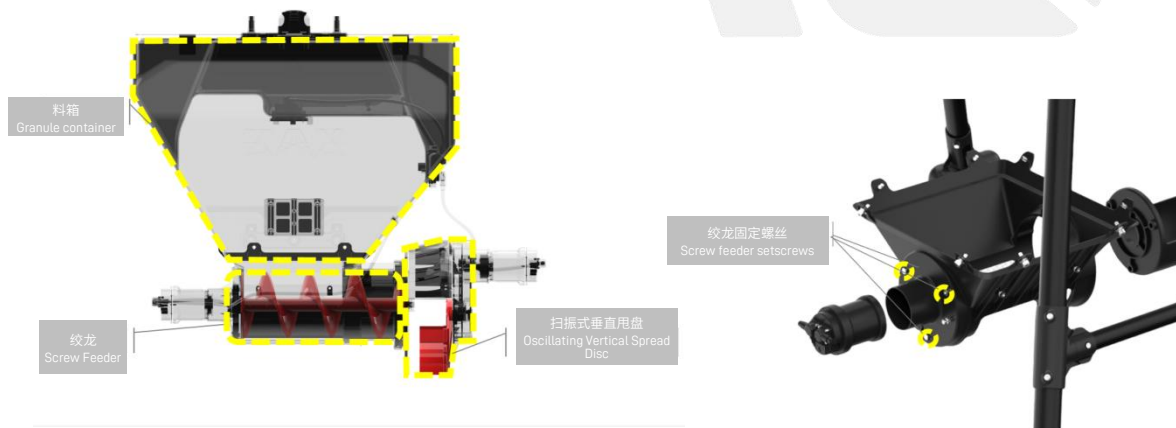


- 睿播系统清洁及检查
- Cleaning and Check of RevoCast System

为减少化肥腐蚀，防止肥料板结，长时间不维护保养播撒器可使播撒器腐蚀磨损容易卡料、绞龙损坏，为保证后期播撒作业的顺利进行，每日作业结束后，需清理料箱、绞龙、甩盘上的残留肥料，可有效防止肥料腐蚀零配件，延长睿播系统的使用寿命。

Long term neglect of maintenance and upkeep of the spreader can cause corrosion and wear, which can easily result in jamming and screw feeder damage. To reduce fertilizer corrosion, prevent fertilizer compaction, and ensure the smooth progress of later spreading operation, it is necessary to clean the residual fertilizer on the granule container, screw feeder, and spread disc after operation every day, which can effectively prevent fertilizer corrosion on parts and extend the service life of RevoCast system.

第一步，无人飞机关机断电，拆除甩盘连接线，拧下绞龙固定螺丝，将绞龙放置在肥皂水中进行浸泡；
Step 1: Shut down and power off the drone; remove the spread disc cable, remove the screw feeder setscrews; and then soak the screw feeder in soapy water;



第二步，用清水将料箱清理干净；

Step 2: Clean the granule container with clean water;

第三步，绞龙浸泡完成后，再用清水冲洗，最后擦干；

Step 3: After soaking, rinse the screw feeder with clean water and finally wipe it dry;

第四步，最后装回绞龙，拧上固定螺丝，安装甩盘连接线。

Step 4: Finally fit the screw feeder again, tighten the setscrews, and connect the spread disc cable.

注意：睿播曲轴齿轮箱里面的各个零部件在长期的机械性动作中会产生一定的磨损，建议以作业时间 15 天为一个周期，对齿轮箱内部各个零件使用齿轮润滑脂进行涂抹维护，在拆卸齿轮箱盖固定螺丝时应注意是否有细小零部件不慎掉落。

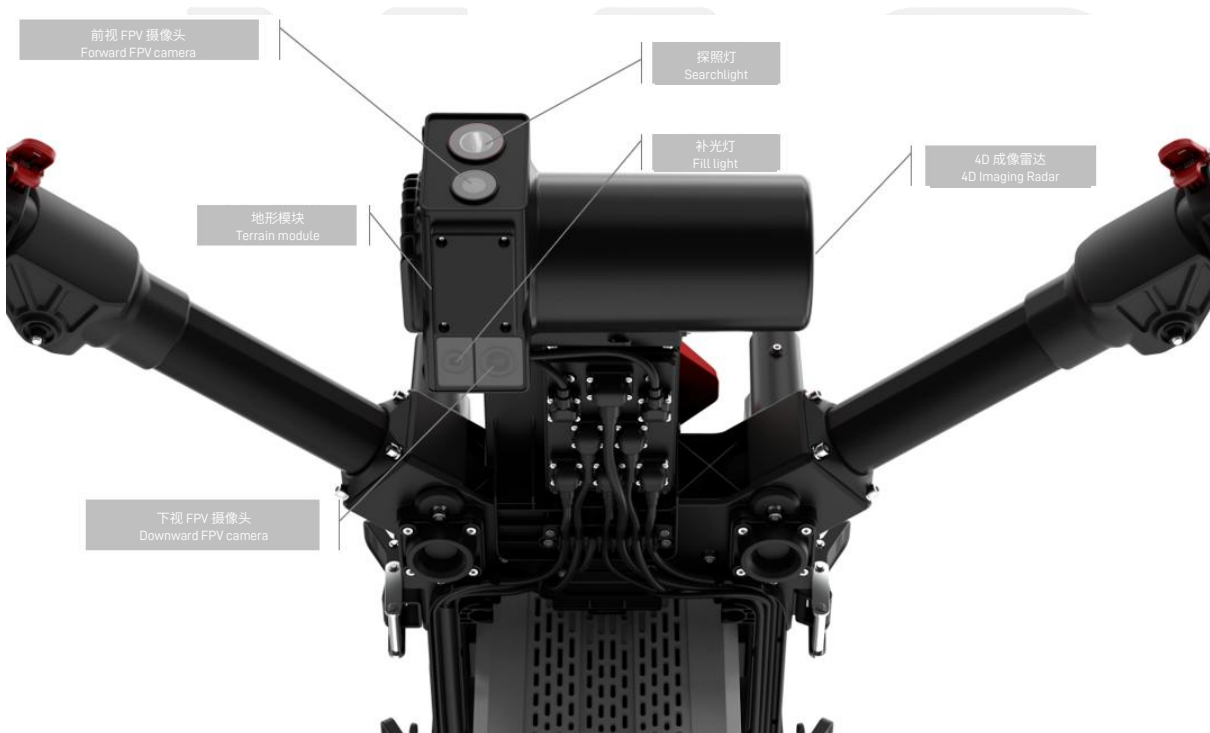
Note: The parts inside the RevoCast crank gearbox will experience certain wear and tear during long-term mechanical action. It is recommended to apply gear grease onto the parts inside the gearbox every 15 days of operation. When removing the gearbox cover setscrews, observe whether any small parts accidentally fall off.

(2) 清洁及检查感知系统

(2) Clean and Check Sensor System

感知系统就像人的眼睛，在超远距离作业或地形不平坦的地形，能让设备以最快的作业速度保证飞行安全，如 4D 成像雷达上有异物，可能会造成雷达误判影响作业效率，可使用镜头布，擦拭雷达、FPV 镜头，确保干净无异物。

The sensor system is like the human eyes, which can ensure flight safety in ultra-long distance operations or uneven terrain operations at the fastest operational speed; any foreign objects on 4D Imaging Radar may cause radar misjudgment and affect operation efficiency; lens cloth can be used to wipe the radar and FPV lens to ensure cleanliness and absence of foreign objects.



6.1.2 作业达 3 千亩的保养项目

6.1.2 Maintenance Items after Operation Covering an Area of 200 Hectares

1) 检查机身

1) Check Airframe

在长时间作业过程中，因机体轻微震动会导致机体螺旋松动，在运输过程会经常与其他物品进行碰撞或压机体，都会导致机结构出现变形或损坏，出现异常后再次飞行会增大作业安全风险，需尽快维护保养，主要步骤：

In the long-term operation process, slight vibration of the airframe can cause the propeller looseness; thus, during transportation, it often collides against other objects or presses the airframe, which can cause deformation or damage of the airframe structure. Flying again after an abnormality occurs will increase the safety risk of operation. Therefore, in this case, prompt maintenance is required. Here are the main steps:

- ① 目视检查机臂、边梁是否变形，如有变形或断裂，需要及时更换。
- ① Visually check the arms and side beams for deformation; if any deformation or breakage is found, replace in time.
- ② 检查机身各固定螺丝是否松动、滑丝、生锈或断裂，如有则需更换螺丝。
- ② Check whether any setscrews of fuselage are loose, stripped, rusted or broken; if so, replace the screws.
- ③ 取下机头罩，逐一检查飞控处线材是否磨损或断裂，接口是否故障，如有则需更换线材。
- ③ Remove the nose cover and check one by one whether the cables at the flight control point are worn or broken, and whether the interface has faults; if so, replace the cables.
- ④ 检查执行系统、料箱、脚架的固定螺丝是否松动、滑丝、生锈或断裂，如有则需更换螺丝。
- ④ Check whether any setscrews of the application system, the granule container and the landing gears are loose, stripped, rusted, or broken; if so, replace the screws.



2) 检查动力系统

2) Check the propulsion system

- 电机
- Motor

电机是整个动力系统最关键的零部件，电机的损耗程度直接决定了动力输出及载重，如维护保养不到位在高速飞行过程中电机可能会停止转动，导致设备会直接炸机，一般受损程度较为严重，为避免这一现象需要做好维护保养工作，主要步骤：

Motors constitute the most critical part of the entire propulsion system, and the degree of wear and tear of motors directly determines the power output and load capacity. In the case of lack of maintenance, the motors may stop rotating during high-speed flight, resulting in fall of the drone directly; generally, the degree of damage is severe in such case; to avoid this phenomenon, maintenance must be performed appropriately. Here are the main steps:

① 转动电机，如有异响、卡滞，则使用软毛刷清理电机漆包线上残留的异物或灰尘（动力电机下部挡圈可拆卸）；目视检查电机漆包线，如有变黑，需更换电机。

① Rotate the motor; if any abnormal noise or jamming is found, remove foreign objects or dust remaining on the motor enamel wire (the lower retaining ring of main motor can be removed) by a soft-bristled brush; visually check the motor enamel wire, and if it turns black, replace the motor.

② 检查电机三相线及端子连接电调处 3 颗螺丝是否拧紧，如有磨损，需用“醋酸胶布”将电机三相线包裹 2 层，确保线皮不外露；如有断裂，需更换线路或端子损坏的电机。

② Check whether motor three-phase cable and 3pcs of screw at the connection between ESC and terminal are tightened; if there is wear, wrap the motor three-phase cable with two layers of "acetic acid cloth tape" to ensure that the cable skin is not exposed; if there is breakage, the motor with damaged wiring or terminal needs to be replaced.



● 电调：

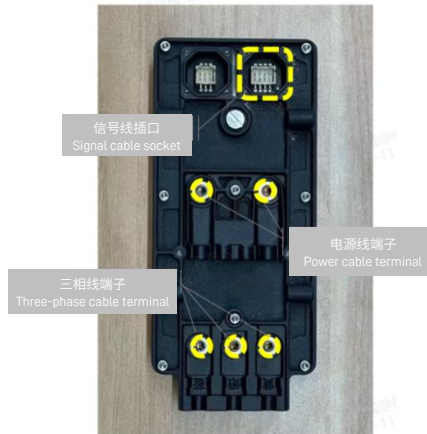
● ESC:

电调设备保养是否到位也直接决定动力系统是否可以发挥最佳的工作效率，在日常作业过程中，出现磨损会导致电调放电电流过小，电机转速低，载重低，作业效率低下，电调过热严重会导致飞行过程中停止电流输出，导致电机没动力产生炸机，一般情况炸机较为严重。

Whether ESC receives adequate maintenance directly determines whether the propulsion system can achieve its optimal work efficiency. In daily operation, wear and tear can lead to ESC undercurrent, low motor speed, low load capacity, and low operational efficiency. Severe ESC overheating will cause stop of current output during flight, resulting in no power for the motors and fall of the drone. Generally the drone will get damaged seriously.

取下固定电调的 4 颗螺丝，检查电调三相线端口螺丝，如有松动需及时拧紧，检查电调信号线、电源线接口螺丝，如有松动及时拧紧。

Remove the 4 screws that fix ESC; check the screws at the three-phase cable port of ESC, and tighten them in time if looseness is found; check ESC signal cable and power cable socket screws, and tighten them in time if looseness is found.



3) 检查睿喷系统的叶轮泵

3) Check Impeller Pump of RevoSpray System

叶轮泵决定喷洒系统喷洒量是否精准，在长时间的工作中，难免会有磨损堵塞，需及时处理，具体操作步骤如下：

The impeller pump determines whether the spray volume is accurate; wear and jamming are inevitable during long-time operation, which should be handled in time. Here are the operation steps:

① 拆卸叶轮泵，观察柔性叶轮，如存在药垢附着现象，需及时拆卸清洗，如存在腐蚀、开裂现象需要及时更换（建议每作业一万五千亩更换柔性叶轮）。

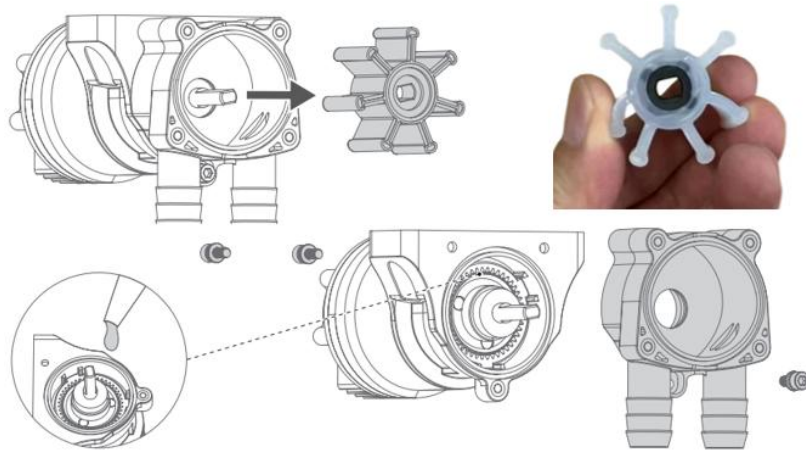
① Remove the impeller pump and observe the flexible impeller; if adhered chemical scale is found, disassemble and clean it in time; if corrosion or cracking is found, replace in time (it is suggested to replace the flexible impeller every 1,000 hectares of operation).

② 观察泵壳内壁，如出现药垢沉积现象，需尽快清理干净，并用肥皂水进行冲洗，同时也要注意泵外部的清洁，防止农药腐蚀导致电器元件故障。

② Observe the inner wall of pump casing; if any deposition of chemical scale is found, clean it as soon as possible and rinse with soapy water; also pay attention to the outside cleanliness of the pump to prevent failure of electrical parts in case of pesticide corrosion.

③ 拆开泵壳，为行星齿轮添加润滑脂（建议每作业一万亩至少添加一次）。

③ Disassemble the pump casing and add grease to the planetary gears (it is suggested to add grease every 666.67 hectares of operation).



6.2 智能电池保养维护

6.2 Maintenance of Smart Battery

6.2.1 清洁及检查电池

6.2.1 Clean and Check the Battery

为保证放电电流正常稳定，充电效率高，需做好以下维护保养流程：

To ensure normal and stable discharging current and high charging efficiency, the maintenance process below should be followed:

- ① 检查电池插头，如存在异物或杂质，需使用棉签蘸上酒精进行擦拭处理；
- ① Check the battery plug. If there are foreign objects or impurities, use a cotton swab dipped in alcohol for cleaning.



② 检查电池外壳、尾插卡扣，如有破损或变形，则需到服务站进行更换；

② Check the battery shell and socket hasp. If any damage or deformation is found, replace at the service station;

③ 检查电池散热孔洞，如有沙石等杂物，需及时清理，防止磨损电芯；

③ Inspect the battery heat dissipation holes and clean them promptly if there are any debris such as sand and stones to prevent wear of the battery cells.

④ 检查电芯，如有鼓包、漏液情况，要及时送服务站维修；

④ Check the cells. If bulge or leakage is found, timely send them to the service station for repair;

⑤ 如果飞行结束后电池出现绿灯单闪，需及时将电池充电到 50%~60% 进行存放。若未及时充电即存放可能导致电池损坏或影响寿命。若电池闲置时，每隔 90 日须对电池重新充放电以保持电池活性；否则电池可能基于活性衰竭影响正常使用。

⑤ If the battery indicator flashes green once when the flight is ended, it is needed to timely charge the battery to the level of 50%~60% for storage. Storage of the battery without timely charging could cause damage of the battery or affects its service life. If the battery is left idle, it should be charged and discharged again every 90 days to maintain its activity; otherwise, normal use of the battery could be affected due to exhaustion.

6.3 燃油超充常维护，电能供应有保障

6.3 Routine Maintenance of Supercharge Station to Guarantee Power Supply

燃油超充站作为无人飞机的能源供给设备，发挥着至关重要的作用。而它的工作环境通常比较恶劣，为保证设备正常运转，必须要进行定期的维护保养。大家要按照以下五个项目进行保养。

The Supercharge Station plays a crucial role as the energy supply device for drones. Since the environment where it works is often harsh, maintenance must be carried out at regular intervals to guarantee normal operation of the device. Please complete the following five maintenance items.



6.3.1 定期清理空滤器

6.3.1 Clean the Air Filter at Regular Intervals

正常情况下，每 50 小时进行清理，沙尘严重地区缩短为每 20 小时清理。建议使用风筒或其他物品进行清理。
Normally, the air filter should be cleaned every 50h; in heavy dust areas, the interval should be reduced to 20h. It is recommended to use a blower or other tools for cleaning.

6.3.2 定期更换机油

6.3.2 Change Oil at Regular Intervals

首次运行 20 小时需更换机油，后续每运行 50 小时更换一次。
Oil should be changed after 20h of initial operation, and every 50h of operation thereafter.

- ① 拧开放油螺丝，排空废机油后，紧固放油螺丝；
① Unscrew the oil drain screw; after fully draining the waste oil, tighten the oil drain screw;
- ② 拧开机油尺，加注 600 毫升 10W-40 极飞燃油超充站专用机油，完成加注后，拧紧机油尺。
② Unscrew the oil dipstick and add 600ml of 10W-40 oil special for XAG supercharge station; after filling, tighten the oil dipstick.

6.3.3 检查燃油系统

6.3.3 Check the Fuel System

- ① 检查燃油管，如存在老化或者开裂，及时更换。
① Check the fuel tube. If aging or crack is found, replace it timely.
- ② 如作业期结束或长时间不使用，需排空油箱及管道内的燃油。
② If the operation period is over or the device is to be left unused for a long period of time, it is needed to fully discharge the fuel in the fuel tank and tube.
- ③ 关闭汽油阀，检查油箱、油箱盖、化油器、燃油开关等，如有损坏、泄露，需及时更换。
③ Close the gasoline valve; check the fuel tank, tank cap, carburetor, fuel cock and other parts. If damage or leakage is found, replace the corresponding part timely.

6.3.4 检查火花塞

6.3.4 Check the Spark Plug

每运行 500 小时需要更换火花塞。
The spark plug should be replaced every 500h of operation.

6.3.5 检查气门间隙

6.3.5 Check the Valve Clearance

每运行 500 小时，需让专业人员调整气门间隙。
The valve lash should be adjusted by a professional every 500 hours of operation.

以上就是燃油超充站的五个保养项目，每完成一次保养，都需进行一次充电，确保充电功能可正常使用。
The five maintenance items for the supercharge station have been listed above. Charging is required each time a maintenance is completed, thus to ensure that the charging function can be used normally.

本章小结

Summary of this chapter

这一课，给大家讲了 2024 款农业无人飞机、B13970S 智能电池、燃油超充站在不同时间需进行的维护保养事项。重视维护保养工作，让无人飞机能够更加安全、高效地作业；做好维护保养，能够延长无人飞机的使用寿命，减少维修的成本，让它真正成为提升农业生产效率的好工具。

This lecture introduces the maintenance items required for 2024 agricultural drone, B13970S smart battery and supercharge station at different points of time. Attach importance to maintenance so that drones will operate in a safer and more efficient manner. Proper maintenance will extend the service life of drones, reduce repair costs, and truly make them a valuable tool for improving agricultural productivity.

思考题 Questions

你为你的无人飞机做过保养吗？

Have you maintained your drone?

每次的维护保养你做到位了吗？

Is each maintenance properly carried out?

模块 7 附件

Module 7 Appendices

7.1 学员学习确认表

7.1 Confirmation Form for Trainees' Learning

项目 Item	内容 Content	是否掌握 Already mastered or not
安全使用须知 Instructions for safe use	您是否已了解作业前的安全注意事项 Have you known about the safety precautions before operation?	
	您是否掌握作业后的安全处理措施 Have you mastered the safety measures after operation?	
航前检查 Preflight checks	您是否掌握环境安全检查 Have you mastered the environmental safety checks?	
	您是否掌握设备外观检查 Have you mastered the exterior inspection?	
	您是否掌握设备系统检查 Have you mastered the system checks?	
XRTK6 测绘器完成地块测绘 Field Mapping by XRTK6 Ground Module	您是否是否已了解测绘地块注意事项 Have you known about the precautions for field mapping?	
	您是否掌握 XRTK6 手持测绘器操作步骤 Have you mastered the operation steps for XRTK6 ground module?	
	您是否掌握常见障碍物打点技巧 Have you mastered the techniques for marking common obstacles?	
自主作业 Auto Operation	您是否已了解作业前准备 Have you known about the preparation before operation?	

	您是否掌握喷洒作业参数设置-基础参数 Have you mastered the parameter setting for spraying operation - basic parameters?	
	您是否掌握执行作业 Have you mastered how to perform operation?	
	您是否掌握作业后清理 Have you mastered the cleaning after operation?	
紧急情况处理 Emergency handling	您是否掌握紧急情况发生时几种处理办法 Have you mastered emergency handling methods?	
	您是否掌握紧急情况发生后三种处理方法 Have you mastered the three solutions after occurrence of emergency?	
维护保养 Maintenance	您是否掌握无人飞机定期保养，提前发现安全隐患 Have you mastered the regular maintenance of drone for early detection of safety hazards?	
	您是否掌握智能电池保养维护 Have you mastered the maintenance and upkeep of smart battery?	
	您是否掌握燃油超充常维护，电能供应有保障 Have you mastered the content in Routine Maintenance of Supercharge Station to Guarantee Power Supply?	

以上是学员手册课程的全部内容，谢谢！

Above is the full content of the course for the Operator Manual. thank you!