



A.5 UAS Maintenance, Modification, Repair, Inspection, Training, and Certification Considerations

Task 6: Draft Technical Report of UAS Repair Station Criteria

30 June 2017

Final Report

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LIST OF ACRONYMS

ASI	Aviation Safety Inspector
CFR	Code of Federal Regulations
CS	Control Station
FAA	Federal Aviation Administration
FSIMS	Flight Standards Information Management System
GPU	Ground Power Unit
NAS	National Airspace System
PIC	Pilot in Command
SC1	Skill Class 1
SC2	Skill Class 2
SC3	Skill Class 3
sUAS	Small Unmanned Aircraft System
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System

EXECUTIVE SUMMARY

The purpose of this report is to examine the current state of practice for Unmanned Aircraft Systems (UAS) repair station operations as well as Federal Aviation Administration (FAA) Aviation Safety Investigator (ASI) training within the context of unmanned aircraft system (UAS) technology and regulations. While significant knowledge and process gaps exist for UAS within the regulations for repair stations and ASI training, much of the infrastructure and processes already exist due to the close relationship between the manned aviation industry and the growing UAS industry.

For manned aircraft repair stations, with a few exceptions, the facilities, equipment, and procedures currently used are applicable to UAS maintenance and business disruptions will be limited to any increased volume and capacity issues UAS maintenance will bring. The overall element of safety in UAS operations will be enhanced as this technology becomes integrated into well-established manned aircraft maintenance operations. Nonetheless, training, process, and facility integration accommodations will need to be made. A UAS repair station will require additional training on new applications of systems instead of individual vehicle airworthiness. These organizations must be prepared to become an adaptable part of the FAA's solution when new challenges arise as many of the regulatory guidance is still pending. Organizations that have the ability to adapt and flex will be the best positioned to become leaders in this emerging industry.

Currently FAA ASI's do not receive extensive UAS familiarization training. For Flight Standards, the integration of UAS into ASI training can be accommodated relatively easily. Some considerations for UAS familiarization training include increased knowledge of materials and software integration. Small UAS (sUAS) and larger-than-small UAS inspection efforts will need to be approached differently; however, there will be overlap and commonality between the two. The FAA will need to determine if UAS topics will be incorporated into existing inspector specialty areas or a new ASI specialty area.

In this research task, a gap analysis was performed analyzing the applicability of 14 CFR Part 145 to existing UAS operations. This analysis identified similarities and missing requirements specific to UAS. Recommendations for Part 145 additions include: add UAS definitions throughout, add new UAS ratings in § 145.59, update existing ratings in § 145.59 to include UAS technology, update all referenced regulations to include UAS definitions and limitations when applicable and add a new section defining segregation requirements in a repair station for UAS parts and materials from certified components.

1. SCOPE

Table 1 shows the relationship of this report to other tasks in the ASSURE A.5 project: UAS Maintenance, Modification, Repair, Inspection, Training, and Certification Considerations. This report, *Draft Technical Report of ASI Familiarization Training and Repair Station Criteria*, summarizes the efforts in Task 6: Support UAS Certification Efforts, Aviation Safety Inspector (ASI) Training, and Repair Station Criteria.

Task 6 aims to develop recommendations for training Aviation Safety Inspectors (ASIs), develop criteria for unmanned aircraft systems (UAS) repair stations after reviewing the applicability of Title 14 of the Code of Federal Regulations (CFR) Part 145, and inform airworthiness certification processes in development. Table 1 shows the work breakdown to accomplish these objectives.

Table 1. A.5 Work Breakdown Structure

Task	Description	Team
Task 1	Review of Existing Maintenance Programs and Data	KSU, ERAU
Task 2	Update Maintenance and Repair Prototype Database	KSU
Task 3	Review of Maintenance Technician Training	NCTC
Task 4	Update Maintenance and Repair Prototype Database	KSU, NCTC, ERAU, MSU
Task 5	Conduct Simulations Focused on UAS-Air Traffic Control Procedures	ERAU
Task 6	Support UAS Certification Efforts, ASI Training, and Repair Stations Criteria	KSU, ERAU
Task 6a	Review findings with appropriate FAA organizations to inform ongoing airworthiness certification processes under development	KSU, ERAU
Task 6b	Develop ASI familiarization training recommendation for UAS maintenance	ERAU
Task 6c	Review applicability of 14 CFR Part 145 (Repair Stations) to UAS maintenance	KSU
Task 6d	Develop criteria for repair stations to maintain UAS	KSU
<i>Deliverable</i>	<i>Draft Technical Report of ASI Familiarization Training and Repair Station Criteria</i>	<i>KSU, ERAU</i>
Task 7	Examine Requirements for Maintenance-related Accident Reporting	ERAU
Task 8	Final Report	KSU

2. INTRODUCTION

Aviation safety inspectors and repair stations are important components of ensuring safety and airworthiness in manned aviation. Repair stations provide the services required for continuing airworthiness of aircraft while ASIs ensure that repair stations, manufacturers and operators are conducting activities in compliance with regulatory requirements. These two components will continue to play an important role in ensuring safe integration of unmanned aircraft systems (UAS) into the United States airspace system whether they are type certified or uncertified.

Currently, regulations for traditional aircraft repair stations do not reference UAS technology. Nonetheless, the UAS industry is beginning to provide services for these aircraft systems and are eager to perform maintenance, modification, repair, and inspection services with technical direction comparable to manned aviation. However, there is no regulatory guidance on operation of a UAS repair station and ASIs have not been formally familiarized with the unique aspects of UAS that are essential for inspection, operations, and maintenance.

Information from industry and government sources have been gathered to develop specific recommendations for ASI familiarization training and repair station criteria. These recommendations are the goal of A.5's Task 6, and aim to support the process of integrating UAS into NAS.

3. DEVELOPMENT OF REPAIR STATION CRITERIA

Repair stations have played a vital role in keeping manned aircraft continuously airworthy. Using data from previous A.5 efforts and industry practices acquired through surveys, 14 CFR Part 145, which addresses requirements for aviation repair stations, was analyzed for applicability to UAS. Following this analysis, recommendations reflecting changes and additions to Part 145 were made to address UAS repair stations.

In order to discuss UAS repair station criteria, UAS were broken into different classes based on maintenance complexity. The initial consideration to delineate between different sizes and types of UAS when determining repair station criteria was the FAA's unpublished risk classification. The unpublished FAA UAS risk classification utilizes six separate classifications based on kinetic energy. This taxonomy is not well-suited to categorizing repair station criteria because kinetic energy and/or unmanned aircraft performance is not directly related to the equipment, other components, housing, facilities and personnel required to maintain an unmanned aircraft. Consequently, the research team proposes three categories of maintenance skill classes to frame the recommendation of UAS repair station criteria. The proposed maintenance skill classes detailed in Table 2 are based on the tasks required to perform maintenance on the UAS surveyed in the Task 4 report. Scalability of requirements based on system complexity allows maintenance technicians and repair stations to comply with less requirements than manned aircraft for SC1 and comply with requirements that are similar to manned aircraft in addition to UAS skillsets and equipment for SC3. If a repair station desired to only work on SC1 and SC2 systems, then they would not have the same requirements as a SC3 repair station

Table 2. UAS Skill Classes

	SKILL CLASS 1	SKILL CLASS 2	SKILL CLASS 3
1. UNMANNED AIRCRAFT (UA):			
Launch	Typically vertical take-off or landing or hand launch.	Typically dependent on a launch system or rolling takeoff.	May include vertical take-off or landing or a rolling takeoff.
Landing Gear	May have wheels, sometimes uses reinforced materials for belly landing, deep stall or parachute recovery process.	May have wheels, net or arresting gear.	Typically has wheels for a rolling landing.
Braking	Typically no independent braking system; throttle controls braking.	Typically has an active braking system if wheels are installed.	Active braking system or arresting gear.
Engine	Electric motor.	Liquid fuel engines are frequently integrated: piston, 2 stroke, rotary are standard.	Liquid fuel engines are frequently integrated: turbine, piston are standard.

Size	From micro to medium sizes: varies greatly from grams to ~50 lbs.	Size varies from small to medium: ~20lbs to ~300lbs.	Size and performance varies from medium to typical manned aircraft.
Redundancy	Usually a single controller, but can be configured for training to use a second controller in parallel.	Redundancy for communications and workstations is generally standard.	Redundancy for communications and workstations is standard between the unmanned aircraft, and the control station include extended line-of- sight and beyond line-of-sight.
Maintenance	Maintenance is typically line replaceable unit remove/replace: airframe, propellers, or other electronic devices.	Maintenance includes line replaceable unit remove/replace for most components and i-level for some unique electronic components. Composite repair tends to be more common than replacing airframe parts.	Maintenance of these systems is comparable to manned aircraft with the addition of systems unique to unmanned aircraft systems. Composite repair tends to be more common than replacing airframe parts.
Structure	Typical construction is made from a combination of the following: thermoplastics, polystyrene (EPS), composite, or fabric.	Typical construction is made from a combination of the following: wood, fabric, composite or aluminum.	Typical construction is most similar to manned using a combination of the following: composite or aluminum.
2. CONTROL STATION			
Configuration	Typically a consumer electronic device comprised of a single laptop or phone/tablet. Troubleshooting of the control station is usually unnecessary.	Typically a hand portable workstation. Pilots and sensor operators typically have a dedicated workstation and may or may not be dual configurable (redundant).	Typically a fixed or vehicle mounted workstation. Pilots and sensor operators typically have a dedicated workstation and are typically dual configurable (redundant) for multiple pilots, closely resembling the typical cockpit with pilot and copilot sitting beside each other.
Software	Software relies on an application to support function, but also has the greatest variability for open systems for larger variation for configuration.	Software is typically a combination of open systems and closed systems for some flight critical items allowing the most variation for configuration.	Software is typically a closed system designed for specific hardware devices, resembling manned aviation's approach for operations.

Networking	Little to no networking required.	Computer networking and the use of hubs, switches, or routers is generally necessary.	Computer networking and the use of hubs, switches, or routers is typical.
Maintenance	Maintenance is mostly all electronic, typically remove/replace for hardware components and re-install for software.	Maintenance is typically remove/replace for hardware components and re-install for software. Multiple "boxes" with specialty functions may be integrated into the control station: digital video disc player/burner, time code generator, data/communications recording devices, closed caption encoder/decoder, etc.	Maintenance requires computer troubleshooting, line replaceable unit sub-components, and typical aviation manuals.
Communication Links	WEP, WPA or no encryption; visual line of sight link.	Can be a combination of visual line of sight, radio line of sight, or satellite relay. Proprietary encryption is more common.	Communications are typically between the unmanned aircraft and control station include radio line of sight and satellite relay links, and even ground/air relay links. Encryption is standard.
Handover events	Atypical, unless training for the vehicle operations.	Complex handover events are frequent, but not standard.	Complex handover events for extended operations are standard.
3. SUPPORT EQUIPMENT			
Launch	Very little launch support equipment used, if any. Could be either hand launch or bungee.	Launch is generally assisted by a launcher, rolling takeoff may be used. Catapults are pneumatic, hydraulic, spring-loaded, car-top, takeoff cart, or even trebuchet.	Rolling takeoff may be used. Catapults are pneumatic or hydraulic.
Recovery	Recovery includes airborne capture (net/vertical cable), arresting gear, airbags or parachutes.	Recovery includes airborne capture (net/vertical cable), arresting gear, or parachutes.	Recovery includes rolling landing, arresting gear, or parachutes.

External Power	Not typically used.	Typical to external power for pre-flight, starting engines, etc. which are gas powered/building powered ground power unit (GPU).	
Engine Support	Not typically used.	Gas engines use fuel/defuel devices, fuel storage, external power for starting and sometimes a unique device to help start the engine: electric pump, compressed air.	
Active sensors	Not typically used.	Sometimes ground based radar is used for additional pilot awareness.	Ground based radar and other types of external technology is typically used for additional pilot awareness.
Passive Sensors	Sometimes targets are placed around an area for sensors on-board the UA to detect for tracking of information for the payload.	Sometimes targets are placed around an area for sensors on-board the UA to detect for additional pilot awareness and tracking of information for the payload.	Sometimes targets are placed around an area for sensors on-board the UA to detect for additional pilot awareness and tracking of information for the payload.
4. PAYLOAD			
	A separate viewing screen may be used for the sensor data but typically the output is viewable through the software on the computing device.	A separate viewing screen is traditionally used for the sensor data.	Largest payloads for all unmanned aircraft systems. Can include human payloads (e.g. Ehang 184).
5. OPERATIONS			
Part 107 (<55 lbs, <400 ft)	Typically Part 107 operations.	Typical.	Not typical.
333 Exemptions (>55 lbs)		Typical.	Typical.
Over People	Typical, based on use of exemptions.	Typical, based on use of exemptions.	Typical, traditionally military use.
Expanded Operations	Not typical, but exemptions are granted when used.	Beyond visual line of sight operations are common however the UA typically must retain radio line of sight.	Typical, traditionally military use.
Small Cargo	Not typical, but is in the infancy phase.	Not typical, but has immediate applications.	Not typical, but has immediate applications.

Passenger	N/A.	N/A.	Not typical, but is in the infant phase (e.g. Ehang 184).
6. MANUALS			
General	Usually one manual contains information for operations and maintenance for all UAS components.	Manuals are more specific to each component of the UAS and can include some component maintenance manuals for some items instead of the traditional aircraft maintenance manuals/illustrated parts catalogues for maintenance. Operation manuals are typically separated from maintenance.	Maintenance manual sets are typical, similar to manned aviation.
Owner/Operator	Typical for operations AND maintenance.	Not Typical.	Not Typical.
Flight Manual	Combined with Owner/Operator Manual.	Typical for operations.	Typical for operations.
Fault Isolation	Not typical.	Not as typical for maintenance - requires specialized maintenance approach and unique operational requirements.	Typical for maintenance.
Component Maintenance Manual	Not typical.	Typical for maintenance.	Typical for maintenance.
Engine Maintenance Manual	Not typical.	Typical for maintenance.	Typical for maintenance.
Aircraft Maintenance Manual	Combined with Owner/Operator Manual.	Typical for maintenance.	Typical for maintenance.
Illustrated Parts Catalog	Combined with Owner/Operator Manual.	Typical for maintenance.	Typical for maintenance.
7. VEHICLE EXAMPLES			
Example Unmanned Aircraft Systems	DJI Phantom, DJI S1000, Yuneec H920, Yuneec Typhoon H, 3DR Aero-M.	Penguin B, MQ-19 Aerosonde, RQ-7 Shadow, Northrop R-Bat, Bat 12, Bat 14.	RQ-4, MQ-1, MQ-9, K-MAX, Ehang 184, Northrop Firebird.

3.1 CURRENT UAS REPAIR STATION PRACTICES.

A review of current UAS repair station practices was conducted in order to determine how repair stations are currently operating. Data from previous A.5 efforts, including Tasks 1 and 4, were reviewed in the context of task requirements. Phone surveys were conducted with two major repair station businesses currently operating within the United States of America, both having a background in manned aviation with a repair station certificate under 14 CFR Part 145. One repair station was in the process of moving toward maintaining UAS, and the other is currently maintaining UAS as one of their primary services.

3.1.1 UAS REPAIR STATION HOUSING AND FACILITIES.

Neither the survey data nor data from previous A.5 efforts suggested that special housing or facilities are required to maintain UAS as compared to manned aircraft.

The entities interviewed noted that despite using similar facilities, their UAS maintenance operations are, or will be, segregated from manned aviation maintenance activities [2] [3]. The purpose of their strategy was to keep uncertified articles and maintenance separate from certified articles and maintenance. This practice is similar to what is required currently by 14 CFR 145.103, which requires that facilities have adequate space to segregate certain activities from others, separating articles and materials undergoing maintenance from those which are not.

3.1.2 UAS REPAIR STATION PERSONNEL.

Despite a lack of regulations for UAS maintenance personnel to acquire certification, data acquired from a survey of UAS maintainers during Task 3 found that 45% of maintainers surveyed held an airframe and/or powerplant rated Mechanic Certificate. The survey also indicated that Skill Class 2 and 3 maintainers were given hiring preference by their employer if they held a Part 65 Mechanic Certificate [4]. UAS repair stations expressed a preference for hiring aviation mechanics, as their UAS repair stations are operated under Part 145 criteria [2]. It was also noted during the survey that UAS repair stations showed preference to Part 65 certificated avionics repairmen. This allowed their repairmen to work in their manned aviation avionics repair stations as well as on UAS [3].

According to findings of Task 4, the holder of a 14 CFR Part 65 mechanic certificate does not have all of the skills and knowledge needed to maintain UAS. Repair stations have recognized the shortcomings in Part 65 certified mechanics. As such, they provide UAS training to most of their maintainers. This practice is captured in the findings of Task 3. Surveyed repair stations were approaching UAS training in two ways; cross training current employees [2] and requiring personnel be trained by UAS manufacturers [3].

3.1.3 UAS REPAIR STATION EQUIPMENT, TOOLS AND MATERIALS.

UAS repair stations stated that minimal additional equipment was required to work on UAS in their repair stations with the exception of additional electrical equipment such as power supplies and tools to connect parts of the UAS to diagnostic computers [3] [2]. In a situation wherein a UAS requires certain maintenance tasks to be performed, such as software updates without starting

up a control station (CS), a dedicated computer system called a maintenance terminal may be required as well [5].

While aftermarket parts are not uncommon for Skill Class 1 aircraft, UAS repair stations indicated that manufacturers of Skill Class 2 and 3 UAS are their primary source of parts. This can be considered typical for how UAS repair stations acquire materials as many of the components on UAS of all Skill Classes incorporate line replaceable units in their control stations [5], communication links [6], airframes [7], and autopilots [8].

3.1.4 UAS REPAIR STATION DOCUMENTATION AND RECORDKEEPING.

Surveys conducted during Task 1 indicated that most of the manufacturers surveyed provided some form of maintenance related manual even though regulation does not currently require such publications to be made available. Of those providing manuals, all Skill Class 3 and most Skill Class 2 UAS had a manual consistent with military or civilian aviation standards [9]. This means that Skill Class 1 UAS are not being maintained with data and documents equivalent to the standards of 145.109. Meanwhile the majority of Skill Class 2 and 3 aircraft are maintained using data and documents compliant with 145.109. Surveyed repair stations noted that many UAS manufacturers do not have experience building aircraft or creating the maintenance data for aircraft. To make up for this gap, their repair stations have worked with manufacturers to create the data and manuals needed to maintain certain UAS [3].

During the Task 1 surveys, it was also found that all Skill Class 3 and most Skill Class 2 UAS manufacturers provide a standardized maintenance logbook. Logbooks were not reviewed to determine if they are compliant with 145.219, which dictates the requirements for how maintenance records are to be kept for aircraft.

3.2 ANALYSIS OF PART 145 REGULATIONS.

Using data and information learned throughout the A.5 project and information gathered from repair station surveys, a gap analysis of 14 CFR Part 145 was conducted to determine where regulations do not adequately address UAS. This gap analysis was conducted using the Skill Class framework. This assessment was chosen because it varies across the spectrum of UAS. Regulations that will not change with UAS were deemed applicable. If a rule was deemed to apply to UAS in principle, but required revised wording to fully encompass the unique aspects of UAS, that rule was marked as applicable and suggested changes were recorded. If a rule did not apply to UAS in its original principle or intent, it was determined to be non-applicable to UAS and suggested changes were recorded. Appendix A includes a full copy of the gap analysis spreadsheet.

Subpart A – General. Sections 145.1 and 145.3 of Subpart A, which describe applicability and definition of terms, are limited in their application to UAS. Terms and definitions related to UAS, such as control stations and support equipment need to be addressed. Section 145.5 was determined to be adequate for UAS repair stations as this section simply states that repair stations cannot operate without certificates and must keep their certificates available for inspection.

Subpart B – Certification. The application process for a repair station certificate described in § 145.51 was seen as mostly applicable to UAS due to the generic nature of the rules and therefore, do not change with the type of aircraft operation. Sections 145.53 (regulates the issuance of repair station certificates), § 145.55 (regulates how long a certificate lasts and how a certificate is renewed), and § 145.57 (regulates how certificates can be amended or transferred) were also found to be applicable to UAS as they are generic rules that do not change with the type of aircraft operation.

Section 145.59 describes the repair station ratings offered under Part 145. Each rating includes a list of classes specific to certain types of articles. For example, a Powerplant Class 1 rating permits the holder to conduct maintenance on reciprocating engine powerplants making less than 400hp, while a Powerplant Class 3 permits the holder to conduct maintenance on Turbine Engines. Each rating and class was evaluated to determine their applicability to typical UAS of each Skill Class. Criteria found in Part 145 Subpart C - Housing, Facilities, Equipment, Materials, and Data and Subpart D – Personnel were referenced when deciding applicability. If a rating or class was found to partially meet the requirements of Part 145 Subpart C and D for a system of a UAS, then it was deemed applicable so long as inadequacies are addressed. Table 3 provides a summary of the applicability of repair station ratings and classes.

For UAs of composite construction in Skill Class 2 and 3, Airframe Class 1, Composite construction of small aircraft, was deemed applicable. Data previously gathered for Task 4 of the A.5 project determined that maintenance of UAS composite airframes was minimally different from that of manned aircraft [7]. Airframe classes 3 and 4, All metal construction of small aircraft and All metal construction of large aircraft, were determined to be adequate for only Skill Class 3 as Skill Class 1 and 2 aircraft are rarely constructed of primarily metal. An airframe rating was determined to be unnecessary for Skill Class 1 aircraft as airframe parts on Skill Class 1 aircraft are “remove and replace” [7].

Powerplant Class 1, Reciprocating engines of 400 horsepower or less, was found to have applicability to reciprocating engines on both Skill Class 2 and 3 aircraft as reciprocating engines on larger UAS are not different from those on manned aircraft. However, Skill Class 2 aircraft have engines that are much smaller and simpler than those found in even light sport aircraft, meaning that equipment and personnel criteria for a Powerplant Class 1 repair stations may be excessive for a repair station maintaining Skill Class 2 UAS. It is currently non-typical for UAS to utilize reciprocating engines that create more than 400 horsepower. However, UAS in Skill Class 3 may utilize reciprocating engines of this type in the future. For this reason, it was determined that the Powerplant Class 2, reciprocating engines of more than 400 horsepower, applies to UAS. Powerplant Class 3, Turbine engines, is applicable to turbine engines on Skill Class 3 UAS which is the only Skill Class to utilize turbine engines. The turbine engines on Skill Class 3 aircraft are not different from turbine engines found in manned aviation.

Propeller Class 1 and 2 ratings, Fixed-pitch and ground-adjustable propellers of wood, metal, or composite construction and Other propellers, by make, were found to all have applicability to Skill Class 3 UAS as the propellers on these aircraft are similar to manned aircraft. However on Skill

Class 1 and 2 aircraft, propellers are considered “remove and replace”. The criteria to receive a Propeller Class 1 or 2 rating currently will be excessive for systems using “remove and replace” propellers.

UAS communication links were determined during Task 4, and are different in purpose and approach when compared to the navigation and voice communication radios found onboard manned aircraft. However, many of the same skills and equipment required to maintain avionics and aviation radios can be applied to maintaining UAS communication links [6]. Therefore, a repair station with a Radio Class 1 and 2, Communication equipment and Navigational equipment, will be able to meet Subpart C and D criteria for UAS communication links and navigation equipment. Personnel will require additional training, however, as UAS communication links include equipment unique to UAS such as antenna tracking equipment and satellite relayed command and control [6]. Radio Class 3, Radar equipment, was determined to be adequate for UAS with radar altimeters and ground based radar equipment.

All Instrument Ratings were found to have some applicability to UAS. UAS utilize a means of electrical or electronic instrumentation, sometimes in combination with mechanical components or in the case of larger Skill Class 3 UAS, gyroscopic components to transfer information to the UA’s autopilot and the operator on the surface. Therefore, Instrument Class 2 and 4, Electrical and Electronic, will allow a repair station to meet Subpart C and D criteria. If a UAS has mechanical or gyroscopic aspects, the addition of a class 1 or 3, Mechanical and Gyroscopic, will be necessary for a repair station to maintain instrumentation on that system.

A repair station with an Accessory Class 1, Mechanical accessory, will be able to meet Subpart C and D criteria for Skill Class 2 and 3 aircraft. Unmanned aircraft have systems such as brakes (in the case of Skill Class 3), launch equipment (in the case of Skill Class 2), and wheels and tires (on Skill Class 2 and 3 aircraft) which are grouped into Accessory Class 1. An Accessory Class 1 rating however, will be excessive for Skill Class 1 UAS which utilize very simple mechanical components and are heavily electrical and electronic. This aspect of Skill Class 1 is shared among most UAS and is why an Accessory Class 2 or 3, Electrical accessory and Electronic Accessory, will be adequate for maintaining electrical and electronic accessories on all UAS. This includes electric retractable landing gear, climate control in CSs, and the electric motors which are a primary source of propulsion for Skill Class 1 aircraft.

Even with several ratings that can be applied to UAS, or modified to apply to UAS, there are still systems of a UAS which are not fully covered by the current repair station rating classification system. For example, control stations, which utilize computing devices and computer networks not common in manned aviation, are not covered by any of the current ratings [5]. UAS autopilots are also not covered under any current repair station ratings. Even with the electrical equipment and training for personnel required to acquire a radio, instrument or accessory rating, a repair station will still lack personnel with skills in computing and computer networks as well as equipment such as maintenance terminals, interfacing devices and networking equipment required to maintain UAS control stations and autopilots.

Limited ratings were determined to apply to UAS as they are specific to a particular article by make and/or model. This means limited ratings are flexible enough to include UAS so long as the repair station can prove they can meet the requirements of Subpart C.

It is worth noting that the existing classification structure of 14 CFR 145 does not account adequately for the diversity of ground support equipment associated with most UAS associated with systems that fall within the parameters specified herein for SC2 and SC3. Ground support equipment includes the ground-based communication infrastructure, launch/recovery equipment, and the power generation and delivery system.

Table 3. Repair Station Rating Applicability to UAS

Rating	Class	Applicability	Shortcomings
Airframe	1 – Small composite airframes	Applies to Skill Class 2 and 3 composite airframes.	
	2 – Large composite airframes	Applies to Skill Class 3 composite airframes.	
	3 – Small metal airframes	Applies to Skill Class 3 metal airframes.	
	4 – Large metal airframes	Applies to Skill Class 3 metal airframes.	
Powerplant	1 – Reciprocating engines <400hp	Applies to Skill Class 2 and 3 engines.	Excessive equipment and personnel for Skill Class 2 engines.
	2 – Reciprocating engines >400hp	Applies to Skill Class 3 engines >400hp.	Few UAS with >400hp reciprocating engines exist.
	3 – Turbine engines	Applies to Skill Class 3 turbine engines.	
Propeller	1 – Fixed and ground adjustable	Applies to Skill Class 3 propellers.	Excessive for Skill Class 1 and 2 “remove and replace” propellers.
	2 – Propellers by make	Applies to Skill Class 3 propellers.	Excessive for Skill Class 1 and 2 “remove and replace” propellers.
Radio	1 – Communication equipment	Applies to UAS communication links and avionics in a limited fashion.	Personnel will not be trained to work on satellite relay links and antenna trackers.
	2 – Navigational equipment	Applies to UAS communication links and avionics in a limited fashion.	Personnel will not be trained to work on satellite relay links and antenna trackers.
	3 – Radar equipment	Applies to radar equipment onboard UAs and on the ground.	

Instrument	1 – Mechanical instruments	Applies to UAS in combination with electrical and electronic ratings.	UAs do not use mechanical instruments by themselves.
	2 – Electrical instruments	Applies to UAS instrumentation and sensors	
	3 – Gyroscopic instruments	Applies to UAS in combination with electrical and electronic ratings.	UAs do not use gyroscopic instruments by themselves.
	4 – Electronic instruments	Applies to UAS instrumentation and sensors.	
Accessory	1 – Mechanical accessories	Applies to mechanical accessories as well as some support equipment.	May be excessive for the simple mechanical components on Skill Class 1 UAS.
	2 – Electrical accessories	Applies to electrical accessories on UAS.	
	3 – Electronic accessories	Applies to electronic accessories on UAS.	

Subpart C – Housing, Facilities, Equipment, Materials, and Data. Much of Part 145 Subpart C was applicable to UAS as the principle intent behind each section is to ensure that a repair station has the right equipment, tools, materials, facilities, housing, facilities and data to perform maintenance under their certificates and ratings. The type of aircraft system being maintained does not affect these rules. Subpart C however, has several references to 14 CFR Parts 65, 121 and 135. These rules do not currently apply to UAS but may in the future, and similar rules will be specifically tailored for UAS at that time.

Subpart D – Personnel. Similar to Subpart C, Subpart D of Part 145 was determined to apply to UAS as these rules are not changed with the type of aircraft system. The intent and principle behind Subpart D is to ensure personnel at repair stations are capable, trained, supervised, organized and safe, as well as provide a process for recommending employees for repairman certification. These same principles apply to UAS personnel. Subpart D also references several other parts, such as 14 CFR Parts 43, 121 and 135. These rules do not currently apply to UAS but may in the future, and similar rules will be specifically tailored for UAS at that time.

Subpart E – Operating Rules. Similar to Subparts C and D, Part 145 Subpart E was applicable to UAS as the principle intent does not change with the type of aircraft system in question. The intent and principle behind Subpart E is to ensure repair stations operate in an acceptable manner by having the correct manuals, performing inspection of maintenance, keeping proper record, making the correct reports and requests to the FAA when necessary, and ensuring repair stations know the privileges and limitations of their certificates. These same principles can be applied to UAS. Subpart E also references several other parts such as 14 CFR Parts 121, 125 and 135. These rules do not currently apply to UAS but may in the future, and similar rules will be specifically tailored for UAS at that time.

3.3 RECOMMENDATIONS FOR REPAIR STATION CRITERIA.

Recommendations for repair station criteria were created based on information from previous efforts in the A.5 project, information provided by UAS repair stations, and the analysis of 14 CFR Part 145 found in the previous section. A summarized list of recommended changes to Part 145 can be found in Table 4.

The first change recommended is to include the terms “control station” and “UAS support equipment” in § 145.1 and § 145.3 (b). §145.1 describes the applicability of Part 145 and must include UAS terminology if Part 145 is to be applied to UAS. §145.3 defines how the word article is utilized throughout Part 145. If UAS are to be included in Part 145 this definition needs to include examples of UAS articles. Control stations and support equipment are a significant component of UAS and it is necessary that they are included in these lines.

Another recommended change is to update Subparts B-E to include applicable UAS regulations where necessary in the future. Any time Part 145 references another regulation, consideration must be given to including references to potentially applicable UAS regulations as well. For example, § 145.221 (d) (1-3) states that “A certificated repair station may submit a service difficulty report for the following: A Part 121 certificate holder, provided the report meets the requirements of Part 121 of this chapter, as appropriate, a Part 125 certificate holder, provided the report meets the requirements of Part 125 of this chapter, as appropriate or a part 135 certificate holder, provided the report meets the requirements of part 135 of the chapter, as appropriate.” In the case that a repair station was permitted to submit a service difficulty report for a UAS operator, an additional line will need to be added to § 145.221 (d) to reference the regulation that UAS is operated under.

While several of the ratings in § 145.59 apply to UAS, a few crucial articles are not covered. These include control stations, UAS autopilots and small UAS reciprocating engines. The majority of the training for personnel and electrical maintenance equipment required to maintain control stations and autopilots are already found in avionics repair stations [3]. However, items such as maintenance terminals for autopilots, UAS computer software and computer networking equipment are not required for avionics repair stations to possess. Additionally, personnel are not trained to work on control stations, consumer electronics, computer networks or UAS software [5]. Therefore a rating for UAS control stations and autopilots is recommended.

Small UAS reciprocating engines onboard Skill Class 2 aircraft are another rating that is recommended. While Powerplant Class 1 repair stations can adequately maintain the small reciprocating engines onboard Skill Class 2 UAS, Skill Class 2 UAS do not require as much housing or expertise of personnel to maintain. Creating a rating for this class of engine will allow repair stations to be rated for maintenance of small engines onboard Skill Class 2 aircraft but negate the need for the same level of equipment required for much larger aircraft engines.

Currently all Powerplant classes do not encompass the tools and personnel needed to maintain electric propulsion systems. The electric motors and electric motor accessories found on UAS often require tools used for avionics maintenance in order to diagnose and repair these systems

and would be more familiar to an avionics repairman than a Powerplant rated mechanic. Therefore, a repair station rating for electric propulsion systems is necessary.

Also in § 145.59, Radio Class 1, Instrument Class 2 and Instrument Class 4 need UAS terminology to be included. Radio Class 1, communications equipment, needs the addition of the term “UAS communication links” or “command and control links” to ensure the rating encompasses communication links for UAS. Instrument Class 2, Electrical, needs to be updated to include the term analog sensor so that UAS sensors, such as analog rangefinders and optical sensors, are included. Instrument Class 4, Electronic, also needs to be updated to include UAS terms such as “air data computers”, “attitude heading and reference system” and “microelectromechanical systems”. Inclusion of these terms will ensure that these ratings include UAS. In § 145.59 (d)(1), both ground and air-based communication systems need to be added, and in § 145.59 (f)(1), the language should be modified to include mechanical ground-based support equipment.

The final change recommended to Part 145 is to add a new rule to § 145.103 (a) (2). This rule will require repair stations to provide adequate space to segregate certified and non-certified articles and maintenance similar to current UAS repair stations practice [3] [2]. Not all UAS will be certified in the future and uncertified UAS maintenance must be separated from manned aviation and certified UAS maintenance operations.

Table 4. Recommended Updates to 14 CFR Part 145 for UAS

Subpart	Section	Recommendation
A	§145.1	Update to include UAS terms including: <ul style="list-style-type: none"> • Control station • UAS Support Equipment
A	§145.3 (b)	Update definition of article to include: <ul style="list-style-type: none"> • Control station • UAS Support Equipment
B, C, D, E	§145.51 (c)(1)(ii) §145.109 (a) §145.109 (d) §145.159 (b) §145.165 (b) §145.201 (a) (1,3) §145.201 (c)(3) §145.205 (all) §145.206 (all) §145.221 (c) §145.221 (d) (1,2,3,4)	Update the list of Parts referenced to include Parts applicable to UAS as seen fit.

B	§145.59	Create ratings for the following: <ul style="list-style-type: none"> • UAS Control Stations • UAS Autopilots • Small UAS Reciprocating Engines (50hp or less) • Electric Propulsion
B	§145.59 (d) (1)	Update to include UAS terminology to include ground and air-based communication infrastructure, telemetry and command/control.
B	§145.59 (e)(2)	Update to include UAS terminology such as analog sensors
B	§145.59 (e)(4)	Update to include UAS terminology such as air data computers, attitude heading and reference system and micro-electromechanical systems.
B	§145.59 (f)(1)	Modify language to include UAS ground support equipment.
C	§145.103 (a)(2)	Add a new line requiring repair stations to provide adequate space to segregate certified articles and maintenance from uncertified articles and maintenance.

4. ASI FAMILIARIZATION TRAINING

In the past, Aviation Safety Inspector (ASI) training standards have been developed for the operation of manned aircraft. However, the rapid expansion of UAS technologies has created unique issues relevant to aircraft size, design, systems integration, materials, etc. The research conducted as part of this task has examined current ASI standards to define gaps where enhanced training or skill development must be addressed.

The growth of UAS technologies has flourished over the past several years due to the miniaturization of technologies and remote-sensing capabilities. The Federal Aviation Administration (FAA) has categorized sUAS as those weighing less than 55 pounds, however work is being done to address larger airframes that will mimic manned aircraft operations in many ways. As part of this research, the team worked to define operational differences between sUAS and their larger counterparts. The development of ASI standards appropriate to all theorized categories of UAS has been addressed through the analysis of applicable Parts of the Code of Federal Regulations (CFR) along with actual discussion between the research team and current ASIs.

4.1 CURRENT FAA ASI TRAINING REQUIREMENTS FOR MANNED AVIATION

In order to recommend ASI training for unmanned aircraft, it is imperative to understand the training requirements, terminology, and aviation standards for manned aircraft.

4.1.1 AVIATION SAFETY INSPECTORS.

The ASI roles are segmented into four primary sections: operations, airworthiness, avionics, and maintenance safety. The responsibilities and qualifications for each are based on whether the ASI will be working with air carriers, general or military aviation. In any of the ASI positions, a broad knowledge of the aviation industry is needed: an understanding of the general principles of aviation safety, and Federal laws, regulations, and policies affecting aviation. ASIs also need to have an in-depth technical knowledge of, and skill set in aircraft operations and maintenance [10].

4.1.2 AIRWORTHINESS INSPECTORS.

The Airworthiness ASI administers regulations and safety standards concerning the airworthiness of aircraft and related equipment. This includes evaluating certificated mechanics and repair facilities for initial certification and continuing compliance with the regulations. The ASI also evaluates technician training programs and inspects aircraft and equipment for airworthiness and other maintenance elements of 14 CFR Part 121 air carrier operations. These aspects may include the adequacy of the air carrier's maintenance facilities, equipment, procedures, and competence of the employees [10].

4.1.3 AVIONICS INSPECTORS.

The Avionics ASI is responsible for surveillance of avionics technicians and applicable training programs as well as repair facilities. Their job is to ensure compliance with FAA regulations, including general aviation and air carrier industries and to investigate any potential compliance violations. [10].

4.1.4 MAINTENANCE INSPECTORS.

The Maintenance ASI evaluates aviation mechanics, facilities, training programs, as well as inspect aircraft and related equipment for airworthiness. The ASI investigates incidents/accidents involving both general and air carrier industries for compliance with Federal Aviation Regulations [10].

4.1.5 OPERATIONS INSPECTORS.

Operations inspectors evaluate airmen, training programs, equipment, and facilities. Duties also include the investigation of accidents and violations involving major air carriers. Operations inspectors are required to have at least 1,500 total flight hours in multi-engine aircraft with a takeoff weight of more than 12,500 pounds and must also possess airmen certificates and ratings commensurate with the type of operation they are responsible for. For instance, air carrier operations inspectors must hold a minimum commercial pilot certificate, with an airline transport rating preferred.

4.1.6 INSPECTOR TRAINING REQUIREMENTS FOR MANNED AIRCRAFT.

According to the FAA [11], the Administration publishes a “General Inspector Guidance and Information” document to address inspector responsibilities, ethics, and conduct of ASIs. This document provides a perspective to ensure that these inspectors have the required training. Newly hired ASIs are assigned tasks and receive training to support the Flight Standards Service function of the FAA. The primary positions for which inspectors are hired include General Aviation Operations, Air Carrier Operations, General Aviation Airworthiness, Air Carrier Airworthiness, General Aviation Avionics, and Air Carrier Avionics. Typically, new inspectors follow a standard progression path from trainee to journeymen to principal inspector.

4.1.7 PRELIMINARY TRAINING FOR MANNED AIRCRAFT.

Newly hired inspectors are scheduled for initial and ongoing training based on their specific job assignment. The ASI must successfully complete basic indoctrination training. This training provides the ASI with relevant background and familiarization specific to the area of operations they will be working in. All ASI training is facilitated, monitored, and tracked using the FAA’s Training Needs Assessment and Electronic Learning Management System [11].

4.1.8 ON-THE-JOB TRAINING FOR MANNED AIRCRAFT.

Newly hired ASIs are assigned an On-the-Job Training instructor who is jointly responsible along with the ASI for completion of ON-THE-JOB TRAINING requirements. There are several levels of ON-THE-JOB TRAINING; the first level is familiarization with FAA guidance relevant to the specific job or tasks assigned to the ASI. The second level of ON-THE-JOB TRAINING is where the ASI observes a qualified inspector while performing the job. During the next level of training, a qualified inspector observes the trainee perform the job. The ON-THE-JOB TRAINING record is certified at each level and signed off when the inspector is competent at performing the task. Newly hired ASIs are considered qualified to complete job functions associated within their specialty when all training requirements, airman qualifications, and certifications have been satisfactorily completed, verified and documented [11].

4.1.9 STANDARD METHODS USED FOR MANNED AIRCRAFT.

According to the FAA [11], a portion of ASI training is accomplished at the FAA Mike Monroney Aeronautical Training Center in Oklahoma. Continuous development of the ASI is completed using Web-based/Interactive Video Training, on-site continuing education, and out-of-agency training.

4.2 UNMANNED AVIATION MAINTENANCE STANDARDS

4.2.1 PREFLIGHT INSPECTIONS.

To establish a sound Aviation Safety Inspector (ASI) training program for UAS, the ASI needs to be familiar with a multitude of UAS systems and regulations including the current required preflight inspection items set forth in 14 CFR Part 107. This inspection is performed by the remote pilot in command (PIC) of the small unmanned aircraft systems (sUAS), however, enforcement responsibility will be placed upon the ASI. The ASI must be familiar with each line item to effectively enforce proper and thorough inspections. Prior to each flight, the remote PIC must inspect all items listed in Part 107-2 to ensure that it is in a condition for safe operation. The preflight inspection must be conducted in accordance with the sUAS manufacturer's inspection procedures when available. These procedures are typically found in the manufacturer's owner or maintenance manual and/or an inspection procedure developed by the sUAS owner or operator [12]. Required items for pre-flight inspections of sUAS are referenced in ASI training recommendations.

4.2.2 RECORDKEEPING.

Owners and operators of sUAS will find recordkeeping to be an extremely valuable asset. Recordkeeping may be accomplished by documenting repairs, alterations, overhauls, replacement of system components, and recording the time-in-service for that component at the time of the maintenance action. The operator will be able to establish a reliable maintenance schedule for the sUAS and its components. Recordkeeping that includes a record of all periodic inspections, maintenance, preventative maintenance, repairs, and alterations performed on the sUAS can be documented in either hardcopy and/or electronic format [12].

Recordkeeping must include all components of the sUAS, including the control station (CS), launch and recovery equipment, communication link equipment, payload, and any other components required to safely operate the sUAS. Methodical recordkeeping of all maintenance and inspection tasks will prove to be exceptionally helpful in the data mining of sUAS component service life and structural failure investigations [12].

4.3 UAS ASI Maintenance Training Gaps.

The researchers of this report conducted a survey to determine the training currently being conducted for Federal Aviation Administration (FAA) Aviation Safety Inspectors (ASI) for Unmanned Aircraft Systems (UAS). The survey was comprehensive in nature and believed to be a good representation of the current training.

The response from the survey shows the only training currently being offered to the ASI for UAS is a 2-hour Computer-Based Training module. Computer-Based Training is a basic overview of UAS regulations, safety concerns, and basic systems. However, there is a 3-5 day course in development at the Mike Monroney Aeronautical Center - FAA Training Academy in Oklahoma (OKC). The specific content, data and time of this training is unknown.

In comparison to current ASI training requirements for manned aviation, the gap between the ASI training for manned versus unmanned aircraft is immense. The computer-based training offered to ASIs is a well-defined starting point that will complement the FAA's proposed training course in OKC. Further recommendations are listed in Table 5.

4.4 ASI FAMILIARIZATION TRAINING RECOMMENDATIONS

4.4.1 INITIAL TRAINING.

In the case that new ASIs are trained to inspect UAS specifically, this new category of ASIs must be trained in a manner comparable to manned aircraft inspectors. Newly hired inspectors and newly assigned inspectors moving from manned aircraft (trainee) must be an FAA Certificated Mechanic, certificated UAS pilot, with a deep understanding of Human Factors. In addition, they must have strong "*People Skills*" to include the ability to relate to others with patience, while establishing a relationship through positive communication techniques. An ASI inspecting UAS must have knowledge of how that system was certified, given a type certificate has been awarded to applicable equipment, as well as which pieces of equipment can be used to create a certified UAS. Additionally, the inspector must have operational and technical knowledge of UAS including key concepts and terminology used by the UAS industry.

The training needs to continue as mandatory and must be completed satisfactorily to continue in the program. Training of new UAS ASIs need to consist of a thorough understanding of all rules and regulations relevant with UAS. The recommended documents for this training are:

- 14 CFR Part 107 (Small Unmanned Aircraft)
- 14 CFR Part 101 (Air Traffic and General Operating Rules for Certain Model Aircraft)
- Advisory Circular 107-2, as amended (Small Unmanned Aircraft Systems)
- Advisory Circular 120-72, amended (Maintenance Resource Management-Human Factors)
- FAA Orders including:
 - Flight Standards Information Management System (FSIMS) 8900.1, Volume 16 (Unmanned Aircraft Systems)
 - FSIMS 8900.1, Volume 7 (Investigation)
 - FSIMS 8900.1, Volume 14 (Compliance and Enforcement)
 - FAA Order 8130.34, as amended (Airworthiness Certification of Unmanned Aircraft Systems and Optionally Piloted Aircraft)
 - FAA Order 2150.3, as amended (FAA Compliance and Enforcement Program)

It is vital to have the ASI become familiar with UAS construction and operational techniques through sponsored workshops, computer based training, or on-the-job training methodologies.

Materials and techniques commonly used to construct UAS are often different than those used for manned aircraft. Materials such as foam, carbon-fiber, and other composites are common which will require enhanced training for familiarity. From an operational standard there is high variability in the way these aircraft are operated. The development of training modules or written materials to educate ASI's on new technologies may include, but are not limited to:

- UAS construction techniques
- UAS adhesives and chemical applications
- UAS coverings and coatings
- UAS materials maintenance and repair
- UAS hardware applications
- UAS software applications
- UAS operational considerations for varying mission types
- Sensor types and integration techniques

The ASI needs to be familiar with high failure items as tracked by the recommendations proposed for reporting maintenance-related accidents found in Task 7 of this research project. The review of existing materials such as 333 Certificate of Waiver or Authorization and Part 107 reports will enable statistical tracking of high failure rate items and allow the ASI to be proactive in accident/incident prevention.

It will be impractical to have detailed knowledge of every UAS operating in the United States due to the numerous manufacturers and constant rate of technological change in the UAS industry. However, by the use of on-site and out-of-agency training, the ASI must have a high level of overview and general knowledge and operation of Commercial-off-the-Shelf and custom UAS systems, hardware, and software.

The ultimate goal of ASI training in this area is to provide the ASI with sufficient knowledge to ask the right questions in the field while on compliance visits and to determine if the UAS is in a condition for safe operation. After completing the training listed above, the ASI must have knowledge of the systems and potential failures associated with those systems listed in Table 5.

Table 5. ASI Training Recommendations

Provide the ASI with the training and knowledge to ask the right questions when in the field	
Training Element	Learning Objectives
Unmanned aircraft construction including linkage, brackets, supports, struts, booms, covers, fasteners, bushings, bearings, gimbal mounts, lighting, clamps, and other associated components.	Familiarize ASI with the procedures to effectively inspect for corrosion, wear, fatigue, appropriate component usage, safety and security, and mounting of equipment. Train the ASI to identify the types of plastics and materials used and their damage tolerances.

<p>Landing Gear including linkage, brackets, supports, struts, wheels, skids, booms, covers, fasteners, bushings, bearings, and clamps, cables, wires, connections, and other associated components.</p>	<p>Familiarize ASI with the procedures to effectively inspect for proper operation, safety and security, appropriate component usage, overheating, fatigue, impact damage, wear, corrosion, lubrication, proper mounting of equipment, and shorted components on UAS landing gear and retract systems.</p>
<p>Electrical Power Systems including batteries, alternators, generators, cables, wires, connections, and other associated components.</p>	<p>Familiarize ASI with the procedures to effectively inspect for proper operation, determine lithium battery life, lithium battery fatigue (battery degradation), safety and security, appropriate component usage, overheating, wear, corrosion, and shorted components on UAS electrical systems.</p>
<p>Electronic Speed Control and motor controllers including cables, wires, connections, and other associated components.</p>	<p>Familiarize ASI with the procedures to effectively inspect for proper operation, safety and security, appropriate component usage, overheating, wear, corrosion, and shorted components on UAS motor controllers and electronic speed controllers.</p>
<p>Electric motors including cables, wires, connections, and other associated components.</p>	<p>Familiarize ASI with the procedures to effectively inspect for proper operation, safety and security, appropriate component usage, overheating, wear, fatigue, corrosion, and shorted components on UAS electric motors.</p>
<p>Internal combustion engines including Ignition System, Engine Controls, Exhaust, Oil System, Starting System, cables, wires, connections, and other associated components.</p>	<p>Familiarize ASI with the procedures to effectively inspect for proper operation, safety and security, appropriate component usage, overheating, wear, fatigue, corrosion, leakage, contamination, and shorted components on UAS internal combustion engines.</p>
<p>Propellers/Rotors including mounting hardware, quick release, and other associated components.</p>	<p>Familiarize ASI with the procedures to effectively inspect for proper operation, safety and security, appropriate component usage, impact damage, wear, fatigue, and erosion on UAS propellers and rotors.</p>
<p>Fuel Systems including lines, hardware, cables, wires, connections and other associated components.</p>	<p>Familiarize ASI with the procedures to effectively inspect for proper operation, safety and security, appropriate component usage, wear, fatigue, corrosion, leakage, contamination, and shorted components on UAS fuel systems.</p>
<p>Flight Controls including hardware, cables, wires, connections, and other associated components.</p>	<p>Familiarize ASI with the procedures to effectively inspect for proper operation, proper rigging, safety and security, appropriate component usage, impact damage, fatigue, wear, corrosion, lubrication, proper mounting of equipment, and shorted components on UAS flight control systems.</p>
<p>Servo motors including cables, wires, connections, hardware, and other associated components.</p>	<p>Familiarize ASI with the procedures to effectively inspect for proper operation, safety and security, appropriate component usage, overheating, wear, fatigue, corrosion, and shorted components on UAS servo motors.</p>
<p>Avionics including GPS modules, Autopilot Systems, accelerometers, cables, wires, connections, and other associated components.</p>	<p>Familiarize ASI with the procedures to effectively inspect for proper operation, accuracy, updates, communication with the control station, Return-to-Home function, safety and security, appropriate component usage, overheating, wear, fatigue, corrosion, and shorted components on UAS avionics.</p>

<p>Control Stations</p>	<p>Pursuant to conducting a meaningful compliance audit (ramp check) ASIs must become familiar with the procedures to effectively inspect for proper operation, accuracy, updates, and communication with the UAS. Communications must include content areas such as datalinks, networking, encryption, displays, antennas, input devices, and arrays. ASIs must also be familiarized with any documents and information federal regulations may require in order to operate including proper display of appropriate documentation such as: Airworthiness Certificate, Registration, Radio Operator/Station license, Owner/operations manual, and Weight and Balance. Also, ASIs should be familiar with appropriate procedures to verify compliance with appropriate FCC frequency permissions.</p>
<p>Control and Communication, Controlling Hardware and systems, Program Language, Software Applications, including cables, wires, connections, hardware, and other associated components.</p>	<p>Familiarize ASI with the procedures to effectively inspect for proper operation, proper installation, accuracy, updates, when updates occur, communication with the control station, communication with service provider (data link), lost link precautions, appropriate software usage, potential viruses and hacks, overheating, wear, corrosion, and shorted components. Train the ASI to determine how the software/hardware are programmed and to confirm communication between all systems. Identify the proper command and control functions and to test components individually as well as an entire unit.</p>
<p>Video, Heat Signature, First-Person-View hardware, Camera signals (types and range capabilities), Sensor payload information including cables, wires, connections, hardware, and other associated components.</p>	<p>Familiarize ASI with the procedures to effectively inspect for communication with the control station, safety and security, appropriate component usage, overheating, wear, fatigue, corrosion, and shorted components. Prepare the ASI to determine the payload weight limit of the aircraft.</p>
<p>UAS Recordkeeping</p>	<p>Clarify the ASI knows the regulations and procedures to confirm recommended recordkeeping per Part 107 is being conducted.</p>
<p>UAS Accident Reporting</p>	<p>Clarify the ASI knows the regulations and procedures to confirm mandated accident/incident reporting is being accomplished and enough detailed information is being supplied to be useful in the data-mining process to use as a predictive tool of maintenance failures.</p>
<p>UAS Accident Database</p>	<p>Clarify the ASI knows the accident/incident database(s) for UA and how to ascertain the detailed information for proper data-mining to predict maintenance failures.</p>
<p>UAS Accident Investigation</p>	<p>Clarify the ASI knows the accident/incident investigation procedures to ensure a thorough and accurate investigation of the accident to find the cause(s) of the accident to provide guidelines, recommendations, advisories, and/or regulation changes to prevent future accidents. Additionally, confirm proper inspections are being performed by operators of UA after an accident/incident if the aircraft has minimal damage.</p>

4.4.2 ON-THE-JOB TRAINING.

Once the trainee successfully completes preliminary training, the trainee must be assigned an on-the-job training mentor as previously outlined for manned ASI training.

Regional Flight Standards division managers needs to continue to be responsible for ensuring that each of their field offices has implemented an appropriate on-the-job training program designed to meet the needs of their specific office. Each office manager needs to continue to be responsible for designating an on-the-job training program coordinator, instructor, or on-the-job training program manager to develop and monitor the effectiveness of the offices on-the-job training programs.

It is recommended that written, oral, and practical examinations be administered to determine if the ASI has obtained the knowledge necessary to advance to the next level of training. As in the manned training, Inspector training must continue to be facilitated, monitored, and tracked via the FAA's Training Needs Assessment and Electronic Learning Management System.

4.4.3 CONTINUOUS DEVELOPMENT.

In order to keep abreast with the rapidly growing UAS technology, the ASI must continue to participate in continuous development training using Web-based/Interactive Video Training, on-site facilitation, and out-of-agency training. However, it is recommended this training be conducted annually and on an as needed basis.

4.5 ASI FAMILIARIZATION TRAINING CONCLUSIONS

The results of this study indicate that there are current gaps between manned and unmanned aircraft standards, however, ongoing efforts in the certification and airworthiness of aircraft will greatly affect outcomes. It is assumed that larger unmanned airframes will be developed and certified by many of the same standards and conditions as manned aircraft of the same class. Smaller systems, such as those constructed of foam, composites, laminates, etc. have much higher variability in maintenance considerations and knowledge requirements.

It is important for the reader to consider the constructive feedback received through in-depth analysis of Parts 43, 65, and 147. The researchers were able to tie in relationships that exist between sUAS and those classified outside the sUAS standard by comparing existing regulatory guidelines and determining their applicability to respective platforms. The feedback received from ASI's indicate the importance of generalized training on technologies they may come across in the field. Considerations include, but are not limited to, increased knowledge of materials with strong importance placed on software integration and use in UAS equipment. They also stressed the importance of understanding what questions are relevant when exploring UAS requirements.

The overall results of the study are indicated by insights and recommendations developed throughout the report and are consistent with the findings reported through both a review of relevant literature and verbal synopsis.

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APPENDICES

APPENDIX A—GAP ANALYSIS OF APPLICABILITY OF PART 145 TO UAS

*SC1 is not intended to affect or relate to operations under 14 CFR Part 107

	Y=Yes N=No	1=Applies Blank=Does not apply				
	Apply to UAS?	*Skill Class 1	Skill Class 2	Skill Class 3	Reasoning	Changes Suggested
Subpart A—General						
§ 145.1 Applicability.						
This part describes how to obtain a repair station certificate. This part also contains the rules a certificated repair station must follow related to its performance of maintenance, preventive maintenance, or alterations of an aircraft, airframe, aircraft engine, propeller, appliance, or component part to which Part 43 applies. It also applies to any person who holds, or is required to hold, a repair station certificate issued under this part.	Y	1	1	1	Generic applicability that applies to UAS but needs changes.	Needs updated to include all UAS components: CS, support equipment, etc.
§ 145.3 Definition of terms.						
For the purposes of this part, the following definitions apply:	Y	1	1	1		
(a) Accountable manager means the person designated by the certificated repair station who is responsible for and has the authority over all repair station operations that are conducted under Part 145, including ensuring that repair station personnel follow the regulations and serving as the primary contact with the FAA.	Y	1	1	1	Definition(s) apply to UAS the same as manned aircraft.	

(b) Article means an aircraft, airframe, aircraft engine, propeller, appliance, or component part.	Y	1	1	1		Article must be updated to include UAS specific components: CS, support equipment, etc. Might be, " <i>Article means an aircraft, airframe, aircraft engine, propeller, appliance, component part, ground control station, or related UAS support equipment necessary for operations.</i> "
(c) Directly in charge means having the responsibility for the work of a certificated repair station that performs maintenance, preventive maintenance, alterations, or other functions affecting aircraft airworthiness. A person directly in charge does not need to physically observe and direct each worker constantly but must be available for consultation on matters requiring instruction or decision from higher authority.	Y	1	1	1		
(d) Line maintenance means—	Y	1	1	1		
(1) Any unscheduled maintenance resulting from unforeseen events; or	Y	1	1	1		
(2) Scheduled checks that contain servicing and/or inspections that do not require specialized training, equipment, or facilities.	Y	1	1	1		
§ 145.5 Certificate and operations specifications requirements.						
(a) No person may operate as a certificated repair station without, or in violation of, a repair station certificate, ratings, or operations specifications issued under this part.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(b) The certificate and operations specifications issued to a certificated repair station must be available on the premises for inspection by the public and the FAA.	Y	1	1	1		

Subpart B—Certification						
§ 145.51 Application for certificate.						
(a) An application for a repair station certificate and rating must be made in a format acceptable to the FAA and must include the following:	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(1) A repair station manual acceptable to the FAA as required by § 145.207;	Y	1	1	1		
(2) A quality control manual acceptable to the FAA as required by § 145.211(c);	Y	1	1	1		
(3) A list by type, make, or model, as appropriate, of each article for which the application is made;	Y	1	1	1		Add an exception for Skill Class 1 vehicles.
(4) An organizational chart of the repair station and the names and titles of managing and supervisory personnel;	Y	1	1	1		
(5) A description of the housing and facilities, including the physical address, in accordance with § 145.103;	Y	1	1	1		
(6) A list of the maintenance functions, for approval by the FAA, to be performed for the repair station under contract by another person in accordance with § 145.217; and	Y	1	1	1		
(7) A training program for approval by the FAA in accordance with § 145.163.	Y	1	1	1		
(b) The equipment, personnel, technical data, and housing and facilities required for the certificate and rating, or for an additional rating must be in place for inspection at the time of certification or rating approval by the FAA. An applicant may meet the equipment requirement of this paragraph if the applicant has a contract acceptable to the FAA with another person to make the	Y	1	1	1		

equipment available to the applicant at the time of certification and at any time that it is necessary when the relevant work is being performed by the repair station.						
(c) In addition to meeting the other applicable requirements for a repair station certificate and rating, an applicant for a repair station certificate and rating located outside the United States must meet the following requirements:	Y	1	1	1		
(1) The applicant must show that the repair station certificate and/or rating is necessary for maintaining or altering the following:	Y	1	1	1		
(i) U.S.-registered aircraft and articles for use on U.S.-registered aircraft, or	Y	1	1	1		
(ii) Foreign-registered aircraft operated under the provisions of Part 121 or Part 135, and articles for use on these aircraft.	Y	1	1	1	Even though Part 121 or 135 were examined, the point is still applicable: foreign-registered aircraft operating under FAA regulation will relate to the repair station.	Would need updated to include mention of commercial UAS regulations.
(2) The applicant must show that the fee prescribed by the FAA has been paid.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(d) An application for an additional rating, amended repair station certificate, or renewal of a repair station certificate must be made in a format acceptable to the FAA. The application must include only that information necessary to substantiate the change or renewal of the certificate.	Y	1	1	1		
§ 145.53 Issue of certificate.						

<p>(a) Except as provided in paragraph (b), (c), or (d) of this section, a person who meets the requirements of this part is entitled to a repair station certificate with appropriate ratings prescribing such operations specifications and limitations as are necessary in the interest of safety.</p>	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
<p>(b) If the person is in a country with which the United States has a bilateral aviation safety agreement, the FAA may find that the person meets the requirements of this part based on a certification from the civil aviation authority of that country. This certification must be made in accordance with implementation procedures signed by the Administrator or the Administrator's designee.</p>	Y	1	1	1		
<p>(c) Before a repair station certificate can be issued for a repair station that is located within the United States, the applicant shall certify in writing that all "hazmat employees" (see 49 CFR 171.8) for the repair station, its contractors, or subcontractors are trained as required in 49 CFR Part 172 subpart H.</p>	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations. HAZMAT will still apply to SC1 because of glues, solvents and batteries.	
<p>(d) Before a repair station certificate can be issued for a repair station that is located outside the United States, the applicant shall certify in writing that all employees for the repair station, its contractors, or subcontractors performing a job function concerning the transport of dangerous goods (hazardous material) are trained as outlined in the most current edition of the International Civil Aviation Organization Technical Instructions for the Safe Transport of Dangerous Goods by Air.</p>	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations. See above comment.	

§ 145.55 Duration and renewal of certificate.						
(a) A certificate or rating issued to a repair station located in the United States is effective from the date of issue until the repair station surrenders it or the FAA suspends or revokes it.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(b) A certificate or rating issued to a repair station located outside the United States is effective from the date of issue until the last day of the 12th month after the date of issue unless the repair station surrenders the certificate or the FAA suspends or revokes it. The FAA may renew the certificate or rating for 24 months if the repair station has operated in compliance with the applicable requirements of Part 145 within the preceding certificate duration period.	Y	1	1	1		
(c) A certificated repair station located outside the United States that applies for a renewal of its repair station certificate must—	Y	1	1	1		
(1) Submit its request for renewal no later than 30 days before the repair station's current certificate expires. If a request for renewal is not made within this period, the repair station must follow the application procedures in § 145.51.	Y	1	1	1		
(2) Send its request for renewal to the FAA office that has jurisdiction over the certificated repair station.	Y	1	1	1		
(d) The holder of an expired, surrendered, suspended, or revoked certificate must return it to the FAA.	Y	1	1	1		
§ 145.57 Amendment to or transfer of certificate.						
(a) The holder of a repair station certificate must apply for a change to its certificate in a format acceptable to the Administrator. A change to	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	

the certificate must include certification in compliance with § 145.53(c) or (d), if not previously submitted. A certificate change is necessary if the certificate holder—						
(1) Changes the location of the repair station, or	Y	1	1	1		
(2) Requests to add or amend a rating.	Y	1	1	1		
(b) If the holder of a repair station certificate sells or transfers its assets, the new owner must apply for an amended certificate in accordance with § 145.51.	Y	1	1	1		
§ 145.59 Ratings.						
The following ratings are issued under this subpart:	Y					
(a) Airframe ratings.	Y					
(1) Class 1: Composite construction of small aircraft.	Y	1	1	1	Fully composite frames found on SC2 and 3 aircraft are maintained similarly to manned operations. SC1 composite airframes are often remove and replace but still repairable.	
(2) Class 2: Composite construction of large aircraft.	Y		1	1	Though uncommon this will only apply to aircraft the size of a Global Hawk including heavy lift UAS that may come in the future.	
(3) Class 3: All-metal construction of small aircraft.	Y			1	Metal is uncommonly used on SC1 and 2 aircraft for the majority of the vehicles construction.	
(4) Class 4: All-metal construction of large aircraft.	Y			1	Though uncommon this will only apply to aircraft the size of a Global Hawk including heavy lift UAS that may come in the future.	
(b) Powerplant ratings.	Y				Electric propulsion is not adequately	Add a 4 th classification for an electric propulsion rating.

					addressed currently in this subpart.	
(1) Class 1: Reciprocating engines of 400 horsepower or less.	Y		1	1	Personnel may be insufficient for the small engines on SC2 including Wankel rotary engines.	Ensure personnel are trained on small engines and Wankel rotary engines or add additional rating for small engines.
(2) Class 2: Reciprocating engines of more than 400 horsepower.	Y			1	Engines of this type are not typical for UAS but may be in the future.	
(3) Class 3: Turbine engines.	Y			1	Turbine engines are only found in class 3 and do not differ greatly from manned aviation turbine engines.	
(c) Propeller ratings.	Y					
(1) Class 1: Fixed-pitch and ground-adjustable propellers of wood, metal, or composite construction.	Y			1	Even though SC1 and SC2 propellers are "remove and replace" a typical shop with a propeller rating must have the correct equipment to work on these.	
(2) Class 2: Other propellers, by make.	Y			1	If original intent is a catch all then applies but if not may not apply.	
(d) Radio ratings.	Y					
(1) Class 1: Communication equipment. Radio transmitting and/or receiving equipment used in an aircraft to send or receive communications in flight, regardless of carrier frequency or type of modulation used. This equipment includes auxiliary and related aircraft interphone systems, amplifier systems, electrical or electronic inter-crew signaling devices, and similar equipment. This equipment does not include equipment used for navigating or aiding navigation of aircraft, equipment used for measuring altitude or terrain clearance, other measuring equipment operated on radio or radar principles, or	Y	1	1	1	This class will apply to any voice communication equipment found in the ground control station. Could be applied to UAS communication links in a limited fashion.	Ensure personnel are trained to maintain UAS communication links or create a new radio class.

mechanical, electrical, gyroscopic, or electronic instruments that are a part of communications radio equipment.						
(2) Class 2: Navigational equipment. A radio system used in an aircraft for enroute or approach navigation. This does not include equipment operated on radar or pulsed radio frequency principles, or equipment used for measuring altitude or terrain clearance.	Y	1	1	1	Many of the criteria for this class of repair station can apply to UAS but personnel will still be inadequate for maintaining UAS radio navigation equipment.	Ensure personnel are trained to maintain UAS communication links or create a new radio class.
(3) Class 3: Radar equipment. An aircraft electronic system operated on radar or pulsed radio frequency principles.	Y		1	1	Rating must be adequate to test ground based radar and possibly radar altimeters used with some UAS and the radar systems onboard some SC3 aircraft.	Ensure personnel are trained to test and operate UAS in addition to radar equipment.
(e) Instrument ratings.	Y					
(1) Class 1: Mechanical. A diaphragm, bourdon tube, aneroid, optical, or mechanically driven centrifugal instrument used on aircraft or to operate aircraft, including tachometers, airspeed indicators, pressure gauges drift sights, magnetic compasses, altimeters, or similar mechanical instruments.	Y	1	1	1	While aspects of some UAS instrumentation are mechanical they are always in combination with an electrical or electronic system.	Require a combination of this class with electrical or electronic classes. Personnel must be trained to work on UAS.

(2) Class 2: Electrical. Self-synchronous and electrical-indicating instruments and systems, including remote indicating instruments, cylinder head temperature gauges, or similar electrical instruments.	Y	1	1	1	This class can apply to electrical analog indicating systems in UAS but personnel in this class are not trained to work on UAS.	Personnel must be trained to work on UAS.
(3) Class 3: Gyroscopic. An instrument or system using gyroscopic principles and motivated by air pressure or electrical energy, including automatic pilot control units, turn and bank indicators, directional gyros, and their parts, and flux gate and gyrosyn compasses.	Y			1	This class can apply to UAS with gyroscopic instruments but those systems always work with some form of electrical or electronic system.	Require a combination of this class with electrical or electronic classes. Personnel must be trained to work on UAS.
(4) Class 4: Electronic. An instrument whose operation depends on electron tubes, transistors, or similar devices, including capacitance type quantity gauges, system amplifiers, and engine analyzers.	Y	1	1	1	This class can apply to electronic systems in UAS but personnel are not trained to work on UAS.	Personnel must be trained to work on UAS.
(f) Accessory ratings.	Y					
(1) Class 1: A mechanical accessory that depends on friction, hydraulics, mechanical linkage, or pneumatic pressure for operation, including aircraft wheel brakes, mechanically driven pumps, carburetors, aircraft wheel assemblies, shock absorber struts and hydraulic servo units.	Y		1	1	Many of these accessories are the same as manned aviation if present but scaled. Excessive for Skill Class 1 which is very simple.	
(2) Class 2: An electrical accessory that depends on electrical energy for its operation, and a generator, including starters, voltage regulators, electric motors, electrically driven fuel pumps magnetos, or similar electrical accessories.	Y	1	1	1	Many of these accessories are the same as manned aviation if present.	

(3) Class 3: An electronic accessory that depends on the use of an electron tube transistor, or similar device, including supercharger, temperature, air conditioning controls, or similar electronic controls.	Y	1	1	1	This class can be applied to aspects of some ground control stations. However, personnel will not be trained in maintenance of ground control stations.	Ensure personnel are trained to work on UAS.
§ 145.61 Limited ratings.						
(a) The FAA may issue a limited rating to a certificated repair station that maintains or alters only a particular type of airframe, powerplant, propeller, radio, instrument, or accessory, or part thereof, or performs only specialized maintenance requiring equipment and skills not ordinarily performed under other repair station ratings. Such a rating may be limited to a specific model aircraft, engine, or constituent part, or to any number of parts made by a particular manufacturer.	Y				Limited ratings are flexible enough to apply to any type of aircraft manned or unmanned.	
(b) The FAA issues limited ratings for—	Y					
(1) Airframes of a particular make and model;	Y	1	1	1		
(2) Engines of a particular make and model;	Y	1	1	1		
(3) Propellers of a particular make and model;	Y	1	1	1		
(4) Instruments of a particular make and model;	Y	1	1	1		
(5) Radio equipment of a particular make and model;	Y	1	1	1		

(6) Accessories of a particular make and model;	Y	1	1	1		
(7) Landing gear components;	Y	1	1	1		
(8) Floats, by make;	Y	1	1	1		
(9) Nondestructive inspection, testing, and processing;	Y	1	1	1		
(10) Emergency equipment;	Y	1	1	1		
(11) Rotor blades, by make and model; and	Y	1	1	1		
(12) Aircraft fabric work.	Y	1	1	1	Fabric is not typical on UAS currently but a rating for fabric or covering may apply if the design of an aircraft warrants such a rating.	
(c) For a limited rating for specialized services, the operations specifications of the repair station must contain the specification used to perform the specialized service. The specification may be—	Y	1	1	1	This rule will make sure limited ratings for UAS repair stations include appropriate specifications.	
(1) A civil or military specification currently used by industry and approved by the FAA, or	Y	1	1	1		
(2) A specification developed by the applicant and approved by the FAA.	Y	1	1	1		
Subpart C—Housing, Facilities, Equipment, Materials, and Data						
§ 145.101 General.						
A certificated repair station must provide housing, facilities, equipment, materials, and data that meet the applicable requirements for the issuance of the certificate	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	

and ratings the repair station holds.						
§ 145.103 Housing and facilities requirements.						
(a) Each certificated repair station must provide—	Y				Generic rules for all repair stations regardless of vehicle operations.	
(1) Housing for the facilities, equipment, materials, and personnel consistent with its ratings.	Y	1	1	1		
(2) Facilities for properly performing the maintenance, preventive maintenance, or alterations of articles or the specialized services for which it is rated. Facilities must include the following:	Y	1	1	1		
(i) Sufficient work space and areas for the proper segregation and protection of articles during all maintenance, preventive maintenance, or alterations;	Y	1	1	1		
(ii) Segregated work areas enabling environmentally hazardous or sensitive operations such as painting, cleaning, welding, avionics work, electronic work, and machining to be done properly and in a manner that does not adversely affect other maintenance or alteration articles or activities;	Y	1	1	1		Include language that requires that certified parts and maintenance items be kept separate from uncertified ones.
(iii) Suitable racks, hoists, trays, stands, and other segregation means for the storage and protection of all articles undergoing maintenance, preventive maintenance, or alterations;	Y	1	1	1		
(iv) Space sufficient to segregate articles and materials stocked for installation from those articles undergoing maintenance, preventive maintenance, or alterations; and	Y	1	1	1		

(v) Ventilation, lighting, and control of temperature, humidity, and other climatic conditions sufficient to ensure personnel perform maintenance, preventive maintenance, or alterations to the standards required by this part.	Y	1	1	1		
(b) A certificated repair station with an airframe rating must provide suitable permanent housing to enclose the largest type and model of aircraft listed on its operations specifications.	Y	1	1	1		
(c) A certificated repair station may perform maintenance, preventive maintenance, or alterations on articles outside of its housing if it provides suitable facilities that are acceptable to the FAA and meet the requirements of § 145.103(a) so that the work can be done in accordance with the requirements of Part 43 of this chapter.	Y	1	1	1		
§ 145.105 Change of location, housing, or facilities.						
(a) A certificated repair station may not change the location of its housing without written approval from the FAA.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(b) A certificated repair station may not make any changes to its housing or facilities required by § 145.103 that could have a significant effect on its ability to perform the maintenance, preventive maintenance, or alterations under its repair station certificate and operations specifications without written approval from the FAA.	Y	1	1	1		
(c) The FAA may prescribe the conditions, including any limitations, under which a certificated repair station must operate while it is changing its location, housing, or facilities.	Y	1	1	1		
§ 145.107 Satellite repair stations.						

(a) A certificated repair station under the managerial control of another certificated repair station may operate as a satellite repair station with its own certificate issued by the FAA. A satellite repair station—	Y				Generic rules for all repair stations regardless of vehicle operations.	
(1) May not hold a rating not held by the certificated repair station with managerial control;	Y	1	1	1		
(2) Must meet the requirements for each rating it holds;	Y	1	1	1		
(3) Must submit a repair station manual acceptable to the FAA as required by § 145.207; and	Y	1	1	1		
(4) Must submit a quality control manual acceptable to the FAA as required by § 145.211(c).	Y	1	1	1		
(b) Unless the FAA indicates otherwise, personnel and equipment from the certificated repair station with managerial control and from each of the satellite repair stations may be shared. However, inspection personnel must be designated for each satellite repair station and available at the satellite repair station any time a determination of airworthiness or return to service is made. In other circumstances, inspection personnel may be away from the premises but must be available by telephone, radio, or other electronic means.	Y	1	1	1		
(c) A satellite repair station may not be located in a country other than the domicile country of the certificated repair station with managerial control.	Y	1	1	1		
§ 145.109 Equipment, materials, and data requirements.						

(a) Except as otherwise prescribed by the FAA, a certificated repair station must have the equipment, tools, and materials necessary to perform the maintenance, preventive maintenance, or alterations under its repair station certificate and operations specifications in accordance with Part 43. The equipment, tools, and material must be located on the premises and under the repair station's control when the work is being done.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations. All limitations as defined by prior analysis of UAS of Part 43 apply.	
(b) A certificated repair station must ensure all test and inspection equipment and tools used to make airworthiness determinations on articles are calibrated to a standard acceptable to the FAA.	Y	1	1	1		
(c) The equipment, tools, and material must be those recommended by the manufacturer of the article or must be at least equivalent to those recommended by the manufacturer and acceptable to the FAA.	Y	1	1	1		It must be ensured that manufacturers provided these recommendations for UAS.
(d) A certificated repair station must maintain, in a format acceptable to the FAA, the documents and data required for the performance of maintenance, preventive maintenance, or alterations under its repair station certificate and operations specifications in accordance with Part 43. The following documents and data must be current and accessible when the relevant work is being done:	Y	1	1	1		
(1) Airworthiness directives,	Y	1	1	1	Airworthiness Directives are yet to be defined for UAS, but once defined must be kept available.	Define Airworthiness Directives for UAS.
(2) Instructions for continued airworthiness,	Y	1	1	1	Instructions for continued airworthiness are yet to be defined for UAS,	Define Instructions for continued airworthiness for UAS.

					but once defined must be kept available.	
(3) Maintenance manuals,	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(4) Overhaul manuals,	Y		1	1	Generic rules for all repair stations regardless of vehicle operations. SC1 is likely to not have overhaul manuals as parts are throw away.	
(5) Standard practice manuals,	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(6) Service bulletins, and	Y	1	1	1	Service Bulletins are yet to be defined for UAS, but once defined must be kept available.	Define Service Bulletins for UAS.
(7) Other applicable data acceptable to or approved by the FAA.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
Subpart D—Personnel						
§ 145.151 Personnel requirements.						
Each certificated repair station must—	Y				Generic rules for all repair stations regardless of vehicle operations.	
(a) Designate a repair station employee as the accountable manager;	Y	1	1	1		
(b) Provide qualified personnel to plan, supervise, perform, and approve for return to service the maintenance, preventive maintenance, or alterations performed under the repair station certificate and operations specifications;	Y	1	1	1		
(c) Ensure it has a sufficient number of employees with the training or knowledge and experience in the performance of maintenance, preventive maintenance, or alterations authorized by the repair	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations. All limitations as defined by prior analysis of UAS of Part 43 apply.	

station certificate and operations specifications to ensure all work is performed in accordance with part 43; and						
(d) Determine the abilities of its noncertificated employees performing maintenance functions based on training, knowledge, experience, or practical tests.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
§ 145.153 Supervisory personnel requirements.						
(a) A certificated repair station must ensure it has a sufficient number of supervisors to direct the work performed under the repair station certificate and operations specifications. The supervisors must oversee the work performed by any individuals who are unfamiliar with the methods, techniques, practices, aids, equipment, and tools used to perform the maintenance, preventive maintenance, or alterations.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(b) Each supervisor must—	Y	1	1	1		
(1) If employed by a repair station located inside the United States, be certificated under Part 65.	Y	1	1	1	Applies but Part 65 is currently insufficient.	Ensure employees are certified to maintain UAS under an updated Part 65.
(2) If employed by a repair station located outside the United States—	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(i) Have a minimum of 18 months of practical experience in the work being performed; or	Y			1	18 months is too long for some of the lower Skill Classes.	The number of months must be different based on the Skill Class personnel are trained for. We suggest 3 months for Skill Class 1, 9 months for Skill Class 2 and 18 months for Skill Class 3.
(ii) Be trained in or thoroughly familiar with the methods, techniques, practices, aids, equipment,	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	

and tools used to perform the maintenance, preventive maintenance, or alterations.						
(c) A certificated repair station must ensure its supervisors understand, read, and write English.	Y	1	1	1		
§ 145.155 Inspection personnel requirements.						
(a) A certificated repair station must ensure that persons performing inspections under the repair station certificate and operations specifications are—	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(1) Thoroughly familiar with the applicable regulations in this chapter and with the inspection methods, techniques, practices, aids, equipment, and tools used to determine the airworthiness of the article on which maintenance, preventive maintenance, or alterations are being performed; and	Y	1	1	1		
(2) Proficient in using the various types of inspection equipment and visual inspection aids appropriate for the article being inspected; and	Y	1	1	1		
(b) A certificated repair station must ensure its inspectors understand, read, and write English.	Y	1	1	1		
§ 145.157 Personnel authorized to approve an article for return to service.						
(a) A certificated repair station located inside the United States must ensure each person authorized to approve an article for return to service under the repair station certificate and operations specifications is certificated under Part 65.	Y	1	1	1	Applies but Part 65 is currently insufficient.	Ensure persons authorized to return an article of a UAS to service are certified to return UAS to service under an updated Part 65.
(b) A certificated repair station located outside the United States must ensure each person authorized to approve an article for return to service under the repair station certificate and operations specifications is—	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	

(1) Trained in or has 18 months practical experience with the methods, techniques, practices, aids, equipment, and tools used to perform the maintenance, preventive maintenance, or alterations; and	Y			1	18 months is too long for some of the lesser Skill Classes.	The number of months must be different based on the Skill Class personnel are trained for. We suggest 3 months for Skill Class 1, 9 months for Skill Class 2 and 18 months for Skill Class 3.
(2) Thoroughly familiar with the applicable regulations in this chapter and proficient in the use of the various inspection methods, techniques, practices, aids, equipment, and tools appropriate for the work being performed and approved for return to service.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(c) A certificated repair station must ensure each person authorized to approve an article for return to service understands, reads, and writes English.	Y	1	1	1		
§ 145.159 Recommendation of a person for certification as a repairman.						
A certificated repair station that chooses to use repairmen to meet the applicable personnel requirements of this part must certify in a format acceptable to the FAA that each person recommended for certification as a repairman—	Y	1			There are currently no provisions to allow certified UAS repairmen but this may change in the future.	Update Part 65 to include UAS repairmen certification.
(a) Is employed by the repair station, and	Y	1				
(b) Meets the eligibility requirements of § 65.101.	Y	1	1	1		
§ 145.161 Records of management, supervisory, and inspection personnel.						
(a) A certificated repair station must maintain and make available in a format acceptable to the FAA the following:	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(1) A roster of management and supervisory personnel that includes the names of the repair station officials who are responsible for its management and the names of its supervisors who oversee maintenance functions.	Y	1	1	1		

(2) A roster with the names of all inspection personnel.	Y	1	1	1		
(3) A roster of personnel authorized to sign a maintenance release for approving a maintained or altered article for return to service.	Y	1	1	1		
(4) A summary of the employment of each individual whose name is on the personnel rosters required by paragraphs (a)(1) through (a)(3) of this section. The summary must contain enough information on each individual listed on the roster to show compliance with the experience requirements of this part and must include the following:	Y	1	1	1		
(i) Present title,	Y	1	1	1		
(ii) Total years of experience and the type of maintenance work performed,	Y	1	1	1		
(iii) Past relevant employment with names of employers and periods of employment,	Y	1	1	1		
(iv) Scope of present employment, and	Y	1	1	1		
(v) The type of mechanic or repairman certificate held and the ratings on that certificate, if applicable.	Y	1	1	1		
(b) Within 5 business days of the change, the rosters required by this section must reflect changes caused by termination, reassignment, change in duties or scope of assignment, or addition of personnel.	Y	1	1	1		
§ 145.163 Training requirements.						
(a) A certificated repair station must have an employee training program approved by the FAA that consists of initial and recurrent training. For purposes of meeting the requirements of this	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	

paragraph, beginning April 6, 2006—						
(1) An applicant for a repair station certificate must submit a training program for approval by the FAA as required by § 145.51(a)(7).	Y	1	1	1		
(2) A repair station certificated before that date must submit its training program to the FAA for approval by the last day of the month in which its repair station certificate was issued.	Y	1	1	1		
(b) The training program must ensure each employee assigned to perform maintenance, preventive maintenance, or alterations, and inspection functions is capable of performing the assigned task.	Y	1	1	1		
(c) A certificated repair station must document, in a format acceptable to the FAA, the individual employee training required under paragraph (a) of this section. These training records must be retained for a minimum of 2 years.	Y	1	1	1		
(d) A certificated repair station must submit revisions to its training program to its certificate holding district office in accordance with the procedures required by § 145.209(e).	Y	1	1	1		
§ 145.165 Hazardous materials training.						
(a) Each repair station that meets the definition of a hazmat employer under 49 CFR 171.8 must have a hazardous materials training program that meets the training requirements of 49 CFR Part 172 Subpart H.	Y	1	1	1	Even though 171.8 and 172 were not examined, HAZMAT requirements must remain the same as applicable for UAS.	

(b) A repair station employee may not perform or directly supervise a job function listed in § 121.1001 or § 135.501 for, or on behalf of the Part 121 or 135 operator including loading of items for transport on an aircraft operated by a Part 121 or Part 135 certificate holder unless that person has received training in accordance with the Part 121 or Part 135 operator's FAA approved hazardous materials training program.	Y	1	1	1	Part 121 and 135 were not fully examined but the principle of this line applies to UAS.	Update to include UAS commercial operation regulations in the future.
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Subpart E—Operating Rules

§ 145.201 Privileges and limitations of certificate.

(a) A certificated repair station may—	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(1) Perform maintenance, preventive maintenance, or alterations in accordance with Part 43 on any article for which it is rated and within the limitations in its operations specifications.	Y	1	1	1	The eligibility requirements will apply differently to each Skill Class. All limitations as defined by prior analysis of UAS of Part 43 apply.	
(2) Arrange for another person to perform the maintenance, preventive maintenance, or alterations of any article for which the certificated repair station is rated. If that person is not certificated under Part 145, the certificated repair station must ensure that the non-certificated person follows a quality control system equivalent to the system followed by the certificated repair station.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(3) Approve for return to service any article for which it is rated after it has performed maintenance, preventive maintenance, or an alteration in accordance with Part 43.	Y	1	1	1	The eligibility requirements will apply differently to each Skill Class. All limitations as defined by prior analysis of UAS of Part 43 apply.	

(b) A certificated repair station may not maintain or alter any article for which it is not rated, and may not maintain or alter any article for which it is rated if it requires special technical data, equipment, or facilities that are not available to it.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations. There might be a special consideration for SC1, but this will require very specific instruction. Airbus allows some parts to be 3D printed for their 380, which might be replacement parts, not alterations.	
(c) A certificated repair station may not approve for return to service'	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(1) Any article unless the maintenance, preventive maintenance, or alteration was performed in accordance with the applicable approved technical data or data acceptable to the FAA.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(2) Any article after a major repair or major alteration unless the major repair or major alteration was performed in accordance with applicable approved technical data; and	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(3) Any experimental aircraft after a major repair or major alteration performed under § 43.1(b) unless the major repair or major alteration was performed in accordance with methods and applicable technical data acceptable to the FAA.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations. All limitations as defined by prior analysis of UAS of Part 43 apply.	
§ 145.203 Work performed at another location.						
A certificated repair station may temporarily transport material, equipment, and personnel needed to perform maintenance, preventive maintenance, alterations, or certain specialized services on an article for which it is rated to a place other than the repair station's fixed location if the following requirements are met:	Y		1	1	Generic rules for all repair stations regardless of vehicle operations.	May need exceptions for Skill Class 1 of which is transported often including by mail.

(a) The work is necessary due to a special circumstance, as determined by the FAA; or	Y		1	1		
(b) It is necessary to perform such work on a recurring basis, and the repair station's manual includes the procedures for accomplishing maintenance, preventive maintenance, alterations, or specialized services at a place other than the repair station's fixed location.	Y		1	1		
§ 145.205 Maintenance, preventive maintenance, and alterations performed for certificate holders under parts 121, 125, and 135, and for foreign air carriers or foreign persons operating a U.S.-registered aircraft in common carriage under part 129.						
(a) A certificated repair station that performs maintenance, preventive maintenance, or alterations for an air carrier or commercial operator that has a continuous airworthiness maintenance program under Part 121 or Part 135 must follow the air carrier's or commercial operator's program and applicable sections of its maintenance manual.	Y	1	1	1	IF all classes of UAS had commercial operations, these rules will probably still apply.	Modify to include parts applicable to UAS when they are created.
(b) A certificated repair station that performs inspections for a certificate holder conducting operations under Part 125 must follow the operator's FAA-approved inspection program.	N				Part 125 was not examined.	
(c) A certificated repair station that performs maintenance, preventive maintenance, or alterations for a foreign air carrier or foreign person operating a U.S.-registered aircraft under Part 129 must follow the operator's FAA-approved maintenance program.	Y	1	1	1	Even though Part 129 was not examined, the rule will still probably apply for maintenance permissions to a foreign air carrier operating US registered vehicles.	Modify to include parts applicable to UAS when they are created.

(d) Notwithstanding the housing requirement of § 145.103(b), the FAA may grant approval for a certificated repair station to perform line maintenance for an air carrier certificated under Part 121 or Part 135, or a foreign air carrier or foreign person operating a U.S.-registered aircraft in common carriage under Part 129 on any aircraft of that air carrier or person, provided—	Y	1	1	1		
(1) The certificated repair station performs such line maintenance in accordance with the operator's manual, if applicable, and approved maintenance program;	Y	1	1	1	These three sub-statements are general application to all operations.	
(2) The certificated repair station has the necessary equipment, trained personnel, and technical data to perform such line maintenance; and	Y	1	1	1		
(3) The certificated repair station's operations specifications include an authorization to perform line maintenance.	Y	1	1	1		
§ 145.206 Notification of hazardous materials authorizations.						
(a) Each repair station must acknowledge receipt of the Part 121 or Part 135 operator notification required under §§ 121.1005(e) and 135.505(e) of this chapter prior to performing work for, or on behalf of that certificate holder.	Y	1	1	1	May apply to certain types of UAS operations in the future.	Modify to include parts applicable to UAS when they are created.
(b) Prior to performing work for or on behalf of a Part 121 or Part 135 operator, each repair station must notify its employees, contractors, or subcontractors that handle or replace aircraft components or other items regulated by 49 CFR Parts 171 through 180 of each certificate holder's operations specifications authorization permitting, or prohibition against, carrying hazardous materials. This	Y	1	1	1		

notification must be provided subsequent to the notification by the Part 121 or Part 135 operator of such operations specifications authorization/designation.						
§ 145.207 Repair station manual.						
(a) A certificated repair station must prepare and follow a repair station manual acceptable to the FAA.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(b) A certificated repair station must maintain a current repair station manual.	Y	1	1	1		
(c) A certificated repair station's current repair station manual must be accessible for use by repair station personnel required by Subpart D of this Part.	Y	1	1	1		
(d) A certificated repair station must provide to its certificate holding district office the current repair station manual in a format acceptable to the FAA.	Y	1	1	1		
(e) A certificated repair station must notify its certificate holding district office of each revision of its repair station manual in accordance with the procedures required by § 145.209(j).	Y	1	1	1		
§ 145.209 Repair station manual contents.						
A certificated repair station's manual must include the following:	Y				Generic rules for all repair stations regardless of vehicle operations.	
(a) An organizational chart identifying—	Y	1	1	1		

(1) Each management position with authority to act on behalf of the repair station,	Y	1	1	1		
(2) The area of responsibility assigned to each management position, and	Y	1	1	1		
(3) The duties, responsibilities, and authority of each management position;	Y	1	1	1		
(b) Procedures for maintaining and revising the rosters required by § 145.161;	Y	1	1	1		
(c) A description of the certificated repair station's operations, including the housing, facilities, equipment, and materials as required by Subpart C of this part;	Y	1	1	1		
(d) Procedures for—	Y					
(1) Revising the capability list provided for in § 145.215 and notifying the certificate holding district office of revisions to the list, including how often the certificate holding district office will be notified of revisions; and	Y	1	1	1		
(2) The self-evaluation required under § 145.215(c) for revising the capability list, including methods and frequency of such evaluations, and procedures for reporting the results to the appropriate manager for review and action;	Y	1	1	1		
(e) Procedures for revising the training program required by § 145.163 and submitting revisions to the certificate holding district office for approval;	Y	1	1	1		
(f) Procedures to govern work performed at another location in accordance with § 145.203;	Y	1	1	1		
(g) Procedures for maintenance, preventive maintenance, or alterations performed under § 145.205;	Y	1	1	1		

(h) Procedures for—	Y	1	1	1		
(1) Maintaining and revising the contract maintenance information required by § 145.217(a)(2)(i), including submitting revisions to the certificate holding district office for approval; and	Y	1	1	1		
(2) Maintaining and revising the contract maintenance information required by § 145.217(a)(2)(ii) and notifying the certificate holding district office of revisions to this information, including how often the certificate holding district office will be notified of revisions;	Y	1	1	1		
(i) A description of the required records and the recordkeeping system used to obtain, store, and retrieve the required records;	Y	1	1	1		
(j) Procedures for revising the repair station's manual and notifying its certificate holding district office of revisions to the manual, including how often the certificate holding district office will be notified of revisions; and	Y	1	1	1		
(k) A description of the system used to identify and control sections of the repair station manual.	Y	1	1	1		
§ 145.211 Quality control system.						
(a) A certificated repair station must establish and maintain a quality control system acceptable to the FAA that ensures the airworthiness of the articles on which the repair station or any of its contractors performs maintenance, preventive maintenance, or alterations.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(b) Repair station personnel must follow the quality control system when performing maintenance, preventive maintenance, or alterations under the repair	Y	1	1	1		

station certificate and operations specifications.						
(c) A certificated repair station must prepare and keep current a quality control manual in a format acceptable to the FAA that includes the following:	Y	1	1	1		
(1) A description of the system and procedures used for—	Y	1	1	1		
(i) Inspecting incoming raw materials to ensure acceptable quality;	Y	1	1	1		
(ii) Performing preliminary inspection of all articles that are maintained;	Y	1	1	1		
(iii) Inspecting all articles that have been involved in an accident for hidden damage before maintenance, preventive maintenance, or alteration is performed;	Y	1	1	1		
(iv) Establishing and maintaining proficiency of inspection personnel;	Y	1	1	1		
(v) Establishing and maintaining current technical data for maintaining articles;	Y	1	1	1		
(vi) Qualifying and surveilling noncertificated persons who perform maintenance, prevention maintenance, or alterations for the repair station;	Y	1	1	1		
(vii) Performing final inspection and return to service of maintained articles;	Y	1	1	1		
(viii) Calibrating measuring and test equipment used in maintaining articles, including the intervals at which the equipment will be calibrated; and	Y	1	1	1		

(ix) Taking corrective action on deficiencies;	Y	1	1	1		
(2) References, where applicable, to the manufacturer's inspection standards for a particular article, including reference to any data specified by that manufacturer;	Y	1	1	1		Ensure OEMs provide inspection criteria. Could be developed in house if approved by FAA/OEM.
(3) A sample of the inspection and maintenance forms and instructions for completing such forms or a reference to a separate forms manual; and	Y	1	1	1		
(4) Procedures for revising the quality control manual required under this section and notifying the certificate holding district office of the revisions, including how often the certificate holding district office will be notified of revisions.	Y	1	1	1		
(d) A certificated repair station must notify its certificate holding district office of revisions to its quality control manual.	Y	1	1	1		
§ 145.213 Inspection of maintenance, preventive maintenance, or alterations.						
(a) A certificated repair station must inspect each article upon which it has performed maintenance, preventive maintenance, or alterations as described in paragraphs (b) and (c) of this section before approving that article for return to service.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(b) A certificated repair station must certify on an article's maintenance release that the article is airworthy with respect to the maintenance, preventive maintenance, or alterations performed after—	Y	1	1	1		
(1) The repair station performs work on the article; and	Y	1	1	1		
(2) An inspector inspects the article on which the repair station has performed work and determines it to	Y	1	1	1		

be airworthy with respect to the work performed.						
(c) For the purposes of paragraphs (a) and (b) of this section, an inspector must meet the requirements of § 145.155.	Y	1	1	1		
(d) Except for individuals employed by a repair station located outside the United States, only an employee certificated under Part 65 is authorized to sign off on final inspections and maintenance releases for the repair station.	Y	1	1	1	Applies but Part 65 is currently insufficient.	Update Part 65 to include UAS mechanic certification.
§ 145.215 Capability list.						
(a) A certificated repair station with a limited rating may perform maintenance, preventive maintenance, or alterations on an article if the article is listed on a current capability list acceptable to the FAA or on the repair station's operations specifications.	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	
(b) The capability list must identify each article by make and model or other nomenclature designated by the article's manufacturer and be available in a format acceptable to the FAA.	Y	1	1	1	This will be an issue for most sUAS, but must still be a requirement to protect liabilities for the repair station. It will be difficult for a lot of sUAS companies to create the capabilities list. The FAA must provide a format to help OEM's create this list.	Provide exceptions or easier rules for Skill Class 1.
(c) An article may be listed on the capability list only if the article is within the scope of the ratings of the repair station's certificate, and only after the repair station has performed a self-evaluation in accordance with the procedures under § 145.209(d)(2). The repair station must perform this self-evaluation to determine that the repair station has all of the housing, facilities, equipment, material,	Y	1	1	1	Generic rules for all repair stations regardless of vehicle operations.	

technical data, processes, and trained personnel in place to perform the work on the article as required by Part 145. The repair station must retain on file documentation of the evaluation.						
(d) Upon listing an additional article on its capability list, the repair station must provide its certificate holding district office with a copy of the revised list in accordance with the procedures required in § 145.209(d)(1).	Y	1	1	1		
§ 145.217 Contract maintenance.						
(a) A certificated repair station may contract a maintenance function pertaining to an article to an outside source provided—	Y	1	1	1	Contract maintenance is unaffected by the type of aircraft operated.	
(1) The FAA approves the maintenance function to be contracted to the outside source; and	Y	1	1	1		
(2) The repair station maintains and makes available to its certificate holding district office, in a format acceptable to the FAA, the following information:	Y	1	1	1		
(i) The maintenance functions contracted to each outside facility; and	Y	1	1	1		
(ii) The name of each outside facility to whom the repair station contracts maintenance functions and the type of certificate and ratings, if any, held by each facility.	Y	1	1	1		
(b) A certificated repair station may contract a maintenance function pertaining to an article to a non-certificated person provided—	Y	1	1	1		
(1) The non-certificated person follows a quality control system equivalent to the system followed by the certificated repair station;	Y	1	1	1		

(2) The certificated repair station remains directly in charge of the work performed by the non-certificated person; and	Y	1	1	1		
(3) The certificated repair station verifies, by test and/or inspection, that the work has been performed satisfactorily by the non-certificated person and that the article is airworthy before approving it for return to service.	Y	1	1	1		
(c) A certificated repair station may not provide only approval for return to service of a complete type-certificated product following contract maintenance, preventive maintenance, or alterations.	Y	1	1	1		
§ 145.219 Recordkeeping.						
(a) A certificated repair station must retain records in English that demonstrate compliance with the requirements of Part 43. The records must be retained in a format acceptable to the FAA.	Y	1	1	1	Generic process applicable to all operations.	
(b) A certificated repair station must provide a copy of the maintenance release to the owner or operator of the article on which the maintenance, preventive maintenance, or alteration was performed.	Y	1	1	1		
(c) A certificated repair station must retain the records required by this section for at least 2 years from the date the article was approved for return to service.	Y	1	1	1		
(d) A certificated repair station must make all required records available for inspection by the FAA and the National Transportation Safety Board.	Y	1	1	1		
§ 145.221 Service difficulty reports.						
(a) A certificated repair station must report to the FAA within 96 hours after it discovers any serious	Y	1	1	1	Generic process applicable to all operations.	

failure, malfunction, or defect of an article. The report must be in a format acceptable to the FAA.						
(b) The report required under paragraph (a) of this section must include as much of the following information as is available:	Y	1	1	1		
(1) Aircraft registration number;	Y	1	1	1		
(2) Type, make, and model of the article;	Y	1	1	1		
(3) Date of the discovery of the failure, malfunction, or defect;	Y	1	1	1		
(4) Nature of the failure, malfunction, or defect;	Y	1	1	1		
(5) Time since last overhaul, if applicable;	Y	1	1	1		
(6) Apparent cause of the failure, malfunction, or defect; and	Y	1	1	1		
(7) Other pertinent information that is necessary for more complete identification, determination of seriousness, or corrective action.	Y	1	1	1		
(c) The holder of a repair station certificate that is also the holder of a Part 121, 125, or 135 certificate; type certificate (including a supplemental type certificate); parts manufacturer approval; or technical standard order authorization, or that is the licensee of a type certificate holder, does not need to report a failure, malfunction, or defect under this section if the failure, malfunction, or defect has been reported under Parts 21, 121, 125, or 135 of this chapter.	N				Parts 21, 121, 125 and 135 currently do not apply to UAS. sUAS does not have PMA, which only applies to certified aircraft. The rule will still apply as the logic is using prior regulation for reporting a defect (e.g. 21, 121, 125, 135) once UAS are certified airworthy	Update with mention of commercial UAS regulations as they are released.

(d) A certificated repair station may submit a service difficulty report for the following:	Y	1	1	1	Service difficulty reports will have to be evaluated separately since this refers to Part 121, 125 and 135 operations.	Service difficulty reports need to be evaluated for applicability to UAS. If adequate add a (d4) for UAS certified operations.
(1) A Part 121 certificate holder, provided the report meets the requirements of Part 121 of this chapter, as appropriate.	N				Part 121 currently does not apply to UAS.	
(2) A Part 125 certificate holder, provided the report meets the requirements of Part 125 of this chapter, as appropriate.	N				Part 125 currently does not apply to UAS.	
(3) A Part 135 certificate holder, provided the report meets the requirements of Part 135 of the chapter, as appropriate.	N				Part 135 currently does not apply to UAS.	
(e) A certificated repair station authorized to report a failure, malfunction, or defect under paragraph (d) of this section must not report the same failure, malfunction, or defect under paragraph (a) of this section. A copy of the report submitted under paragraph (d) of this section must be forwarded to the certificate holder.	Y	1	1	1	Generic process applicable to all operations.	
§ 145.223 FAA inspections.						
(a) A certificated repair station must allow the FAA to inspect that repair station at any time to determine compliance with this chapter.	Y	1	1	1	FAA inspections will not change from manned to UAS.	
(b) A certificated repair station may not contract for the performance of a maintenance function on an article with a non-certificated person unless it provides in its contract with the non-certificated person that the FAA may make an inspection and observe the performance of the non-certificated person's work on the article.	Y	1	1	1		

<p>(c) A certificated repair station may not return to service any article on which a maintenance function was performed by a non-certificated person if the non-certificated person does not permit the FAA to make the inspection described in paragraph (b) of this section.</p>	<p>Y</p>	<p>1</p>	<p>1</p>	<p>1</p>		
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