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A Study on the Legal and Institutional Military UAV Rules in Korea

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Ⅰ. Introduction

1. Military Unmanned Aerial Vehicle (MUAV) piloted vehicle has been operated limitedly in military control airspace RC model UAV system level. But recently, high altitude and medium Unmanned Reconnaissance Aircraft (URA) that .ROKAF is planning on import is level of Remotely Piloted Vehicle and, so being required to arrange a criteria for airspace flight as follow.

2. Primary factors required to militancy remotely piloted vehicle are flight article and airspace management standard preparation to apply by entrance and exit, mission airspace navigation light airspace to mission airspace in course airspace, air terminal.[1)]

3. High altitude and medium Remotely Piloted Vehicle(RPV) is required airspace that mission airspace passes over military Special Use Airspace (SUA), therefore, they need airspace utility request and endorsement connection negotiation of Ministry of National Defense (MND) according to mission achievement length. Recently, remotely piloted or RC model UAV system that abroad government or army applies approves flight in airspace that national Ministry of Land, Infrastructure and Transportation (MOLIT) Secretary governs and prepare Safety Management Guidance for aviation safety supervision.

4. Advanced nations of UAV are mainly Europe nations including the United States. .In case of The United States, they operate with flight criteria each of all the airspaces by separating it to FAA, DoD, USAF in order to operate the RPV with expending the airspace area as mentioned.

Following this circumstance, The country Maritime-Fishries Affairs Ministry is also setting the safety manage standards including the airspace flight rules, and operating

1) ROK MOLIT, The Safety Management Criteria for a Foreign Nation Unmanned Aircraft, MOLIT, 2009.

plans in order for operation by national airspace system in Civil Unmanned Aerael Vehicle.

5. Domestic military aircraft is providing the flight standards and flight operation plans by keeping with aviation rules of rules, orders, and flight rules in order for flight operation in National Airspace system which is administrated by The country Maritime-Fishries Affairs Ministry and Military Special Airspace. Law about military aircraft operation is in a situation that needs to be applied with flight rules of UAV. And also, they are trying hard to secure the safety of Military UAV by setting the capability requirement whether Military UAV can flight safely. Recently, Remotely piloted vehicle militancy remotely piloted vehicle that operation is expected within near time secure and need connection law preparation for guarantee of smooth operation. Therefore, Will need to .look over the requirements in law through arranging the Military UAV flight operation standards in order to present standardized flight criteria that is applied each to airspaces ; high and medium RPV which ROKAF is planning on import.

Ⅱ. Main Subject

1. Necessity of Domestic Airspace Management Plan Preparation

(1) A Plan Domestic Airspace Management Arrange necessity

Because UAV is being developed with composition and capability of equipment following by various level, operation should be administrated following by section of airspace. RC model UAV system should apply in person's own view because it has no recognition and evasion capability itself. Although UAVs has differences

among then in species, recognition and evasion capability are superior relatively than RC model UAV system, so it needs to secure receiving validation about safety operation then, must equip possible level of operation. searching over the research plan based on this airspace management plan, UAV flight needs to work out scheme in reference to UAV level and airspace etc.

(2) Domestic Airspace Management Status

(1) Domestic airspace is administrated parting by peacetime and wartime. minister of MOLIT has an authority to designate and manage in airspace in NAS in a peacetime. Incheon FIR, standard of domestic airspace, divide by class G airspace that is class A, B, C, D, E airspace and pessimism ancestor memorial service airspace that is a controlled airspace by standard and administrate.[2)]

(2) Although U.S. American instance administrated airspace similarly with our national MOLIT, but difference is seen partially. The difference is as following.

First, Korea administrate airspace of low altitude flight path class D, U.S. American as class E

Second, High altitude more than 60,000 feet Korea administrate by uncontrolled airspace class G, U.S. American as class E

MND establish military special procurement utility airspace internal general control and operation procedure to use (Air Force operation commander general mandate) supervisory responsibility and authority about military special procurement utility airspace and is enforcing. Operation of wartime airspace is gone by from, fit, function that civil official is transferred by MND in national MOLIT secretary gradually according to deployment of war situation. Status of wartime airspace becomes omitted because do not connect with seeing research.

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2) ROK MOLIT, Airspace Management Regulation (MOLIT Notification 2009-307), MOLIT, 2009.

(3) Unmanned Aerial Vehicle

UAV is an aircraft that can fly itself without pilot boarding in the airplane. If explain UAV via operation pilot do not board and recognize surrounding environment by flight and dictionary input program or flier doing by Remote control on ground, judge and is an aircraft that fly autonomously. UAV is classified for standard of standard-weight, altitude operation, military operation, and classification by availability dependability capability and wing loading form, fit, function is possible by addition.

- Classification by weight-standard parts by RC model UAV flight system, unmanned light weight aircraft, UAV rating.
- Classification by operation altitude parts are specified by low altitude, medium, high altitude.
- Also, Classification by military operation object parts to back for reconnaissance, electric warfare, deception, attack, target. In this research, the focus to reconnaissance drone of Air Force that gross-weight standard is a UAV rating and I progressed research.

(4) UAV Operation

Highest priority subject of aircraft service is safe operation. national MOLIT safe air passage secure of aircraft owner and aviation employees safety level that should be superior and refined decide and in safe air passage of aircraft third enlargement do. In the case of manned aircraft, national MOLIT sort to secure safe air passage by qualification certification, aviation training, aircraft register, airworthiness certificate, maintenance system validation, instrument for aircraft and equipment, aircraft navigation light that long systematic civil official. Instance of unmanned aircraft is same with manned aircraft or similar civil official is required. Specially, Standard about flight article need separately to apply by personnel qualification standard about member and airspace to operate flight. Characteristic of UAV flight is achieved by flight that is established by bulk dictionary program. Internal type

GPS is placed Global Hawk's instance, and I am flown by dictionary program establish Inertial Navigation System (INS) approach.

(5) Unmanned Aircraft Operation Status

Military UAV is recently applied RC model UAV system, and is controlling in Air Force by temporary control airspace in military special procurement utility airspace. Military department request UAV operation in military special procurement utility airspace to Air Force operation command and Air Force operation command specify by temporary control airspace after examine airspace status and apply UAV for the common people in eye observation distance. Therefore, militancy and everybody for the common people are applying RC model UAV system in minute domestic, if examine operation status of UAV for the common people, is as following.

First, a qualification certificate is issued by the UAV association.

Second, recently MOLIT has divided UAV users into pilots and naked eye observers, and has been preparing a following management plan like allowing a qualification certification, maintenance of qualification, recovery of qualification, etc.

Table 1. UAV Flight Standards in Each Airspace Level by the ROK MOLIT

Airspace Section		UAV flight rules
controlled airspace	A	Should only be flown IFR.
controlled airspace	B	UAV flight disapproval.
controlled airspace	C	Flight approval investigated, and issued by each cases. Flight approval by establishing a risk reducing plan.
controlled airspace	D	Flight approval investigated, and issued by each cases. Flight approval by establishing a risk reducing plan.
controlled airspace	E	Flight by class E airspace demanded regulation.
uncontrolled airspace (G)		Flight by class E airspace demanded regulation (within visual distance)

(a) UAV safety management system construction promote by the ROK MOLIT.

The ROK MOLIT has classified the UAV flight standards in each airspace level according to the weight of the UAV, and indicates the main particulars of system possession for each classified UAVs, and promotes flight approvals for the plans that fulfill these particulars.

Table 2. UAV Classification according to the Weight by the ROK MOLIT

Section	RC Model UAV	Unmanned Light Aircraft	Unmanned Aircraft
UAV Classification	• 12Kg(self weight)~ 150Kg(self weight)	• Over 150Kg (self weight) ~ 600Kg (max gross weight)	• Over 600Kg (max' gross weight)

(b) UAV Management Standard Promote by ICAO[3)]

ICAO Air Navigation Committee has recently approved the establishment of international standard about UAV system upon the investigation through Unmanned Aircraft System Study Group (UASSG). The main approved content is the general principle in chapter 3 of attachment 2 Rules of the Air, which emphasizes the management of the way to minimize the danger of life, property, or a different aircraft. And the details are based on Appendix 4, which describes Remotely-Piloted Aircraft Systems general management regulation clearly.

The main contents are

- for international flights, acquire a flight approval by the take-off country.
- To flight in other countries, acquire a special approval by the corresponding country.

3) ICAO Air Navigation Commission RPA(Remotely Piloted Aircraft) System Criteria, 2011, 11. 17.

Table 3. UAV Safety Management Standard by the ROK MOLIT

Section	RC Model UAV	Unmanned Light Aircraft	Unmanned Aircraft
Qualification Management	• No request for qualification certification, training course completion • Exclusion of hysical inspection certification	• Light aircraft qualification certification required • Application of physical inspection certification	• More than a private pilot qualification certification required • Application of physical inspection certification
Flight Management	• Certificating safety of ultra light flight system	• Certificating safety by developing a technical standard	• Liability to submit special airworthiness certification identical with the piloted aircraft
Airspace Management	• Flight approval only in visual conformed areas (approved airspace)	• Flight to the airspace which the flight plan is approved • Safety management Measures when operating outside the visual distance	• Flight to the airspace which the flight plan is approved • Also possible to flight outside visual distance
Note	• Notification needed • Contact system maintenance with the control facility • No obligation equipment	• need for registration • Radio communication maintenance with the control facility • Transponder embarkation	• need for registration • Radio communication maintenance with the control facility • Transponder embarkation

- Flight is impossible in the open seas unless a pre-discussion is made with the control country.
- Observe the rules made by the registered country.
- Present pre-Flight Plan.
- Required capacity and equipment possession in the airspace intended for the flight.

Also, related with the certification as well as license according to attachment 8 airworthiness certification and remote control aircraft system user's user certification acquisition is required.

(c) FAA UAV Standards.

Classifying into 3 parts similar to the ROK MOLIT and practices the management standards by establishing particulars such as speed, airspace management. FAA classifies UAV users into pilot and naked eye observer, a ground crew and the others and managing the follow by qualification certification allowance maintenance, and recovery. and

Table 4. FAA UAV Management Standards.

Section	RC Model UAS	Nonstandard UAS	Certified UAS
Speed	•100 knots	•250knots	No limitation
Airspace management	•Flight within naked eye visual distance	•Flight within separated airspaces	Flight to manned aircraft operation airspace

(d) MUAV Operating Present State

MUAV are currently possessed by the Army, Navy, and the Marines, and are managed well according to the specific character of each forces.[4] The Air Force is administrating a management plan preparation for the high altitude and mid altitude UAV importation. The qualifiers are classified into pilots (inside / outside), sensor operators and ground crews, and their qualification endowment / maintenance and re-qualification management are being done by themselves. The Air Force is presenting the qualification endowment plan of pilots, sensor operators and ground crews through investigation preparing for the high altitude and mid altitude UAV importance.

In the case of the U.S. Forces, various UAVs are qualified and managed fit to each armed force's individualities. U.S. Air Force qualifies and manages by classifying into RPA pilot, sensor operators and ground crews. U.S. Army qualified and manages by classifying into pilots (inside / outside), ground crews and engineers. U.S. Navy

4) ROK Army Headquarter, unmanned aircraft operation regulation (Army regulation 201), Army Headquarter, 2008 and UAS Reconnaissance RQ-101 (Technical Manual K11(4)-1552-400), Army Head Quarter, 2002.

qualified and manages by classifying into pilots (inside / outside), machinery ground crews and engineers. UAVs under SUA are operated by the feature of the UAV and under the application concept of each armed forces. UAVs operating under NAS follows the FAA standards which regulates the general operations of UAV and Manned Aerial Vehicle (MAV).

2. System Establishment and Characteristics for Unmanned Aircraft

(1) Unmanned Aircraft System Configuration.

The UAV system is somewhat different from compared to a manned aircraft. First, UAV system is composed of and operated by airframe and ground system. An airframe consists of on-board equipment based on the fuselage and missions and flight is accomplished though a control of a ground system. A ground system controlling an airframe is variously composed of take-off / landing control Element (LRE), Mission Control Element (MCE), broadcasting station, ground support equipment on the basis of characteristics and controls flights of an airframe. Unmanned flight equipment currently operating Military-spec UAV is only operated within a military SUA and establishes and operates a system in accordance with mission characteristics.

(2) Ministry of Land, Infrastructure and Transportation (MOLIT) UAV System Establishment Requirements.[5)]

MOLIT presents a UAVs system establishment and safety management criteria to operate UAVs within the Incheon FIR NAS following.

- Requires appropriate essential instruments for flight types and airspaces such as airspeed indicator, precision altimeters, vertical velocity indicator, turn and slip indicator, attitude and heading indicator and secondary attitude Indicator.

5) Choi Young-Jae, “UAV System Establishment in the Safety Management System Set Study”, Transportation Safety Corporation, 2009.

- Requires radio navigation instruments enables flights while receiving navigational signal up to the designated location when operating under the Instrument Meteorological Conditions (IMC) or conducting flight in nighttime.
- Requires mounting two individual two-way radio communica- tion devises (including contingency frequencies) able to communicate with broadcasting stations within the effect volume and a mode C transponder.
- Requires on-board cameras and sensors consistent identifica- tion of other tracks and aids in potential collision clearance.
- Requires navigational lighting, anti-collision lighting, position lighting, flight instrument / equipment lighting and lighting equipment inside ground-based control center, individual flashlights for each aircrew's.
- Requires flight recording or audio recording instrument and ground control station recording instrument.

(3) System Component of U.S. Air Force Global Hawk

Since Korea lacks development and operation experience regarding certified UAS level, U.S. Air Force global hawk will be used as an example in explaining UAV operation-related systems. Global hawk follows a completely automatic flight from taxi to take-off, mission accomplishment, return, and landing and taxi, according to pre-determined programs. If any contingency happen during the mission, it automatically moves to the pre-programmed position, and makes a return flight after the MCE modifies the program. If it is left in a situation in which it needs to land at an alternative base, the UAV returns to the pre-programmed base. Training flights are not accomplished with actual aircraft, but education and training should be executed with simulation devices. Communication with ATC should be held using remote communication broadcast systems on board the UAV. Additionally, ground-based control center such as LRE and MCE should keep improper communication with ATC in order to prepare for contingency situations. The global hawk meets IFR criteria, and holds a FAA IFR class A, class A requirement include

communication ability with ATC, acceptance of ATC instructions, obtain-ability of altitude transmission available mode S / C, and the pilot's ability to operate on IFR. The global hawk's system components are as follow.

(a) The global hawk system is divided into aircraft and ground systems.

- The aircraft system is composed of the aircraft if-self, and loaded equipment for mission use.
- The ground system is composed of LRE, MCE, relay stations, and ground support devices.
- For smooth operation, the global hawk is assembled, and composed in the following way.
  - The aircraft system is composed of the aircraft it-self and loaded equipment, and operation is possible under the control of the ground system.
  - The ground system is composed of LRE, MCE, relay stations and ground support devices, and control the aircraft's mission and operation.
  - In order to aid safe operation of the UAV, ATC takes control over its operation, and supports other track boundaries.
  - Necessary weather support section is operated to UAV flight plan and operation support.

(b) Flier system is consisted of flier and air-borne equipment.

- To fit in mission usage and performance criteria flier design air frame and manufacture.
- Flier is air frame, main plane and fin stabilizer engine etc, and radome according to mission included.
- Air-borne equipment parts by air-borne equipment by basic equipment and mission personality.
  - Equip voice for automatic flight and flight auxiliary storage, mission computer, INS, radar altimeter.

- Equip collision avoidance system, radio set etc, flight situation awareness and front starting gage cafe for action.
- Equip Electric Optics (EO), Infra Red (IR), Synthetic Aperture Radar (SAR).

(c) Ground system is consisted of take-off and landing, mission controlling point, relay station, and ground support equipment.

- LRE
  - Locate to take-off of UAV and landing area and control mission program participation and take-off and landing.
  - Control flight whole course including take-off and landing in case of there in no take-off and landing controlling point.
- MCE
  - Relay equipment install relay equipment since UAV or visual line secure is possible and relay dissemination between mission controlling point and UAV.
  - Long distance remaining in the air style UAV achieves artificial earth satellite relay station role.
- Equipped maintenance equipment, discharge and call back equipment, image processing equipment, maintenance equipment has filer maintenance support, power and hydraulic pressure provision, filer examination and determination, other maintenance support equipment. There is image processing equipment for image processing and consisted of blip memorandum for, image processing, blip transmission equipment.

(4) Individuality Analysis and Solution for Limited Particulars.

(a) UAS Individuality Analysis.

UAS has the following individualities related with communication, collision evasion, system stability insufficiency, limited particulars about operating crews management standard establishment.

- It has a weakness in frequency interference, radio-wave disturbance, cyber attack, recovery in emergency conditions since it's operated by wireless communication at the ground control agency.
- It has a limited feature of cognition and evasion capacity of other aircraft comparing to MAV.
- Low reliability compared to MAV. (MAV : over 98%, UAV 85%).

Table 5. MAV and UAV reliability comparison

Section		Fusibility (%)	Reliability (%)	Accident Rates Per 10 Hours
UAV	Predator	93	89	32 cases
UAV	Pioneer	74	78	334 cases
UAV	Pioneer	78	91	334 cases
UAV	Hunter	98	82	55 cases
MAV	F-16	-	96.6	3.5 cases
MAV	B-747	98.6	98.7	0.13 cases
MAV	B-777	99.1	99.2	0.13 cases

(b) Solutions Following to UAS Limited Particulars.

Following solution for limited particulars such as communication, collision evasion of management standards about application concept, regulation, procedures related with UAV operators (pilots, controllers, observers, etc.) are required.

- Frequency interference and emergency situation recovery plans fit to MUAV operation features are required.
- Solution arrangement for cognition and evasion problems are required through collision evasion equipment development and close communication between the pilot and the air traffic controller.
- Reliability improvement solution such as design simplicity, multiplex structure flight management system design are required for UAV developers.

- Flight regulation / procedure standard arrangements for operator (pilots, controllers, observers, etc.) are required. Various factors should be considered in deciding a flight regulation. Current investigation presents a flight regulation considering system features, classification and management of domestic airspace, private UAV management.

3. MUAV Flight Rules and Airspace Management Criteria3.

(1) Unmanned Aircraft Flight Rules

Flight rules for unmanned aircraft should be in line with those for manned aircraft, and are established as follows :

(a) unmanned aircraft should fly in accordance to criteria, procedures, and rules (flight rules) which of MND of the Republic of Korea has assigned.

MUAV Flight and

- General flight procedure and flight rules.
- Visual Flight Rules (VFR)
- Instrument Flight Rules (IFR)
- Rules for writing, submitting, sending and notifying flight plans.
- Rules needed for flight safety such as operation of air collision prevention equipment for transportation aircraft.

(b) Should comply with the law, enforcement law, enforcement rules for military aircraft airworthiness approval.

(c) In accordance to ACCR 55-3 for recognition of military aircraft and IFF procedure, all aircraft should be given a mode-2 code by operation command (defense division).

(2) Flight Criteria for Unmanned Aircraft

The flight criteria for unmanned aircraft should be handled by pilots, visual observers, maintenance crew according to differing military types, aircraft types. It provides pilots and visual observers with direct duty flight criteria.

(a) Pilot Duty Flight Criteria.

- The pilot in command holds direct responsibility regarding the applicable unmanned aircraft.
- Full acknowledgement of meteorological observation reporting, weather forecasts, fuel usage, alternative flight paths and other information concerned important for flight.
- The latest fight information, charts and other information which the pilot should be aware of should be obtained.
- Contingency recovery procedures, procedures for loss of link, collision prevention measure with other aircraft should be maintained.
- Flight should be attempted by using see and avoid (sense and avoid) equipment, and other devices which do not bare pressure on the manned aircraft.
- Alert should be given as to ensure that no damage is done to person and/or property, and that collision with other moving objects and aircraft does not occur.
- Acquirement of Air Traffic Control (ATC) clearance, flight status and transmission records with ATC should always be monitored, and instructions should always be given strong emphasis.

(b) Visual Observer Flight Criteria.

- When operating unmanned aircraft outside of limited, restricted, warning areas and class A airspace, aerial or ground-based visual observers should be dispatched.
- The observer should use visual sight for surveillance and evasion mission, and should assist the pilot in avoiding collision with other aircraft.

- The observer should use always keep aware of the probability of potential collision and should continually keep an eye of the situation. The unmanned aircraft should always be operated where it can be seen by the observer.

(3) Unmanned Aircraft Operator Position.

(a) Pre-designated positions for take-off, landing and major steps during flight (mission devise manipulation, action for ATC instructions, contingency procedures, etc...) should be kept.

(b) If an active qualified pilot is on-board during take-off, landing and other major flight steps, breakaway from the pre-designated positions is possible.

- Moving away from the cockpit is necessary for physiological reasons.
- Handing over a seat to a qualified pilot due to change in duty.

(c) In the case night flights, the pilot and visual observer should be in their spots 1 hour prior to the flight, due to night visual adjustment.

(4) Seat Time (Rest) for Unmanned Aircraft Operators and Flight Mission Limitation.

(a) The flight mission rest time for unmanned aircraft operators should be ensured to at least 12 hours.

(b) If an operator is found in a physical state which is seen as unsatisfactory for mission accomplishment, he / she is no longer able to accomplish the mission.

(c) If an unexpected situation occurs, the responsibilities for the command pilot are as follows.

- If the mission is unaccomplished due to injury or disease, fatigue, alcohol or drug use of operator, the flight should be restricted from further continuation.
- If the operator's mission accomplishment capabilities are markedly deteriorated due to fatigue or disease, he/she should be shifted with another pilot.

(5) Necessary Inventory for Unmanned Aircraft Flights.

The necessary inventory for unmanned aircraft flights is as follows.

(a) The operator should keep in hand a checklist which includes contingency procedures for all flight areas.

(b) An air route map which includes the planned route and estimated routes according to changes in destinations is necessary.

(c) If an operator is during a mission wearing glasses, measures should be provided as to ensure comfortable use of them.

(6) Unmanned Aircraft System Purchase Costs.

Unmanned aircraft system purchase remarks and costs are as follows.

(a) Compulsory instrument for flight such as airspeed indicator, precision altimeters, vertical velocity indicator, turn and slip indicator, attitude and heading indicator, secondary attitude indicator should be installed.

(b) Radio navigation instruments for navigational signal-aided flight under visual flight meteorological conditions and night usage should be installed.

(c) Two usable individual radio communication devises (including contingency frequencies) operating on two-way systems, and second surveillance radar transponder should be installed.

(d) On-board cameras and sensors for distinguishing other flight paths and collision prevention should be installed.

(e) Navigational lighting, anti-collision lighting, position lighting, flight instrument / equipment lighting and lighting equipment inside ground-based control center, individual flashlights for each aircrew's duty position should be installed.

(f) Flight recording equipment loading and operational status (point of time) conformation matters are as follows.

- Flight recording equipment and remote control station recording equipments : from start of take-off until end of landing.
- Sound recording equipments: from start of checklist procedures until all engines are turned off after end of flight, and end of checklist procedures.

(7) Drug and Alcoholic Drink Standards for Unmanned Aircraft Operators.

(a) Mission accomplishment (including flight practice) under the use of drugs and/or alcoholic drinks is not permitted under the following circumstances.

- Less than 8 hours after the use of drugs and/or alcoholic drinks.
- If under the influence of alcoholic at the moment.
- If under the use of drugs which negatively affect the accomplishment of duties and flight safety (marijuana, morphine, phencyclidine, amphetamine, cocaine, etc...)
- If physical status is seen or concluded as being harmful to flight safety.

(8) General flight rules for unmanned aircraft.

The general flight rules for unmanned aircraft are as follows.

(a) General rules.

- The unmanned aircraft pilot should, in any case, make his flight possible for sense and avoid.
- For collision avoidance with other aircraft, a distance of at least 500 feet should be maintained.
- The priority passing flight rules of the Military Aircraft Operation should be followed.
- Radio contact with ATC or other related military agencies should be always kept, and calls within the contingency should be carefully listened to at all times.

(b) Day/Night Flight Rules.

- Unmanned aircraft which lack the necessary equipment for sense and avoid abilities can fly only during daytime.
- Night flights should be only undertaken when necessary Sense and Avoid equipment are installed, and night collision caution-related measures should be prepared.

(c) Full Auto-Flight Rules.

- Unmanned aircraft designed to fly freely without any outer control of human pilots cannot fly inside controlled airspace.
- If a pre-programmed unmanned aircraft is flying under auto-pilot mode inside controlled airspace, it should always be ready to be controlled manually by a pilot by stopping auto-pilot mode.

(d) Falling and Hazardous Materials.

- Unmanned aircraft are prohibited from dropping or scattering, spraying any objects during flight. However, approved military operations and training such as scattering leaflets are excused.

(e) Tracking / Pursuit Aircraft Operations.

- The airborne position of the tracking / pursuit aircraft should be always kept enough as to ensure safety of collision with the unmanned aircraft due to unexpected disorders, and should be in a distance as to be acknowledgeable in the unmanned aircraft visual flight path searchable distance.
- Tracking / pursuit aircraft are prohibited from operating inside class A airspace restricted · prohibited · warning areas.
- Tracking / pursuit aircraft are only permitted to operate during daytime, and when air visibility is 3 SM.
- The tracking/pursuit aircraft pilot are prohibited from attempting other operations (visual observation, unmanned aircraft piloting, etc...) simultaneously while undertaking the tracking mission.

(9) Visual Flight Rules (VFR) for Unmanned Aircraft.

Visual flight rules for unmanned aircraft are as follows.

(a) Flight should be attempted at, or above the VFR meteorological minimum as state in the military aircraft operations directive.

(b) When flying by VFR, an airborne or ground-based visual observer is needed.

(c) Visual observers for collision avoidance should follow the rules stated below.

- Operation should take place inside the visual limit range (1 NM left / right, 3,000 feet above / below).
- Even if using binoculars, field battle glasses or telephoto lens, the approved visual limit distance should be kept.
- The visual limit distance is the maximum approved distance, and can be reviewed for expanses in distance.

(10) Instrument Flight Rules (IFR) for unmanned aircraft.

(a) The following instrument and navigation devices for flight inside a particular airspace are required.

- Two communication two-way independent remote communication device.
- Secondary Surveillance Radar (SSR) Transponder

(b) IFR should follow the following minimum flight altitude.

- In a mountainous or high-altitude area, 2,000 feet above the highest obstacle inside a 5 NM range from the unmanned aircraft estimated position.
- In other area 1,000 feet above the highest obstacle inside a 5 NM range from the unmanned aircraft estimated position.

(c) When changing from IFR to VFR, the change in the flight plan should be notified to the controlling ATC.

(d) For unmanned aircraft controlled by a remote control device, IFR is prohibited if communication by 1 pilot is uneasy.

(11) Inner calls, ATC and communication unmanned aircraft.

(a) When unmanned aircraft is airborne, immediate and constant inner calls between the flight participants (pilot, visual observer, etc...) should be made possible.

(b) Radio communication between unmanned aircraft and ATC agency should be limited to the command pilot or co-pilot.

(c) The mutual communication needs between the unmanned aircraft and the ATC agency is as follows.

- Participants who hold responsibility in unmanned aircraft collision avoidance such as the visual observer and other participants are also able to have immediate communication with the unmanned aircraft pilot.
- Vocal transmission using radio communication devices equipped inside unmanned aircraft is possible.

(d) Continuous communication is required between the pilot and ATC in the following situations.

- When unmanned aircraft is flying under IFR.
- When unmanned aircraft is flying class A, D or in some instances, E airspace.
- When communication with ATC is required in related rules such as flight regulations.

(e) When flying class A airspace, radar monitoring by ATC should be possible.

(f) Flight should be attempted while equipped with necessary remote communication device (including communication devices used for obtaining meteorological information during flight) for differing type of unmanned aircraft operations.

(12) Airspace and area flight unmanned aircraft.

(a) Flight criteria for controlled airspace and uncontrolled airspace, divided by grades, are shown on Table 6.

Table 6. Flight Approval and Applicable Flight Rules

Category		Flight Approval and Applicable Flight Rules
controlled airspace	A	Should only be flown IFR.
controlled airspace	B	unmanned aircraft flight is prohibited.
controlled airspace	C	Flight should be undertaken after submitting, and receiving approval of flight plan including hazard diminution measures. Default flight rules is IFR, but VFR is possible in controlled airspace
controlled airspace	D	Flight should be undertaken after submitting, and receiving approval of flight plan including hazard diminution measures. Default flight rules is IFR, but VFR is possible in controlled airspace
controlled airspace	E	Default flight rules is IFR, but VFR is possible in controlled airspace
uncontrolled airspace (G)		Should be flown in visually acknowledgeable VFR
Comment		All IFR and VFR inside all separated airspace except class A airspace should be undertaken under VMC, and flight visibility of 3SM is always required.

(b) Airspace such as military controlled areas which are separated from civil controlled airspace should be flown with conditions and procedures which are sufficient for flight safety.

(c) Even when in airspace that is separated from civil airspace, unmanned aircraft flight requisites for intrusion of other aircraft is as follows.

- ATC instruction regarding flight monitoring, separated airspace boundary and other aircraft acknowledgment, and actions should be followed.
- Contingency recovery procedures, link suspension procedures, aircraft collision avoidance procedures, and more should be arranged.
- Standard aircraft collision prevention light should be equipped, and should be operable at all stages of flight.

- Secondary Surveillance Radar (SSR) transponder should be equipped and operable.

(d) Flight requirement for unmanned aircraft flying in civil controlled airspace is as follows.

- Flight should be undertaken with equipment necessary for each airspace type (TCAS, transponder, etc...) equipped.
- The pilot should always monitor flight status and ATC transmission, and should be able to immediately accept of unmanned aircraft flight. However, in the case of flight such as URA flight that are related to security, NOTAMs should be given only to air path separation essential actors.

(e) Flight criteria for flight above cities, populous areas and dwellings are as follows.

- Flight above cities or populous areas, dwellings is restricted. However, for instances such as contingencies and rescue flight are allowed, after a hazard diminution plan has been set.
- Even if not a populous areas, flight above areas with heavy car traffic or where populations gather densely is restricted.

(f) Flight per line of sight in class G airspace is as follows.

- Area should not be a densely populated areas, and flight is only permitted for daytime.
- Operation should always take place in less than 1 NM horizontal, less than 400 feet AGL from the pilot.
- Operation should take place at least 5 NM away from any military base, aerodrome or helipad.

Ⅲ. Conclusion and Proposal

This study proposed a military aircraft flight operation standard which takes into account higher laws and directives, and recent international standards. Firstly, It proposed flight principles and flight standards applicable to airspace operated by unmanned aircraft. Secondly, It proposed operational standards such as operator position, duty operation limitation, and procurement. Thirdly, it proposed flight rules applicable to actual flight such as general flight rules, visual flight rules, and instrument flight rules. Fourthly, it proposed calls between operators, ATC and communication matters, airspace and flight rules per airspace.

This study can be seen as a preliminary study for the introduction of MUAV. Hence it focused widely on the required standards and matters regarding flight safety as indicated by the MOLIT of the Republic of Korea. However unconditioned introduction of all related systems causes operational efficiency problems. Hence it is recommended that an in-depth study be undertaken in the future, that takes into account efficiency as well as safety issues.

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Abstract

A Study on the Legal and Institutional Military UAV Rules in Korea

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The MOLIT is also establishing the flight safety standards for UAV within the current Aviation Law. Accordingly the required flight criteria includes operator location, mission operation limit, equipment, etc. which are the principle and standard applied based on the airspace use for UAV. Also, general flight rules, visual flight rules, instrument flight rules are required to be applied to the actual flight. Besides, an appliance regulation needs to be arranged regarding two-way communication, ATC and communication issue, airspace and area in-flight between UAS(Unmanned Aircraft System) users. An operation of the UAV in the air significantly requires the guarantee of the aircraft's capacity, and also the standardized flight criteria. A safe and smooth use is ensured only if this criteria is applied and understood by the entire airspace users. For the purpose, a standardized military UAV flight operations criteria and a law complementary scheme.

Key Words : UAV(Unmanned Aerial Vehicle), UAS(Unmanned Aircraft System), ATC(Air Traffic Control), SSR(Secondary Surveillance Radar), IFR(Instrument Flight Rules), VFR(Visual Flight Rules), SUA(Special Use Airspace)

초 록

한국의 군용 무인항공기 비행규칙에 관한 법적·제도적 운용 연구

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국토교통부는 현행 항공법 체계 내에서 무인항공기급 비행안전기준 마련을 추진중에 있다. 이에 부응하여 군용항공기 운용 등에 관한 법률에 무인항공기 관련 내용의 보완 검토도 필요하다고 판단된다. 무인항공기 비행규칙은 무인항공기를 운용해야할 공역을 기준으로 적용할 비행원칙과 운용자 위치, 임무운용한계, 구비물품 등을 들 수 있다. 또한 실제 비행에 적용해야 할 규칙으로는 일반비행규칙, 시계비행규칙, 계기비행규칙 등이 요구된다. 그리고 무인항공기체계 운용자 간에 이루어지는 통화, 관제 및 통신사항, 공역 및 구역별 비행 등에 대한 적용규칙 마련도 필요하다고 할 수 있다. 공역에서의 무인항공기 운용은 항공기 성능에 대한 능력을 보장받는 것이 중요하지만 그에 못지않게 필수적으로 요구되어지는 것은 표준화된 비행기준이라고 할 수 있다. 이러한 비행규칙과 공역에 대한 관리기준을 공역사용자가 모두 숙지하고 비행에 적합하게 적용하여야만 안전하고 원활한 비행운용이 가능하다. 본 논문은 표준화된 비행규칙과 법률의 보완을 위해 연구하였다.

주제어 : 무인항공기, 무인항공기시스템, 항공교통관제, 2차감시레이다, 계기비행방식, 시계비행방식, 특별사용공역

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