ASME B30.32-2021

Unmanned Aircraft Systems (UAS) Used in Inspection, Testing, Maintenance, and Load-Handling Operations

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: May 9, 2022

The next edition of this Standard is scheduled for publication in 2026. This Standard will become effective 1 year after the Date of Issuance.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Interpretations are published on the ASME website under the Committee Pages at http://cstools.asme.org/ as they are issued.

Errata to codes and standards may be posted on the ASME website under the Committee Pages to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in codes and standards. Such errata shall be used on the date posted.

The Committee Pages can be found at http://cstools.asme.org/. There is an option available to automatically receive an e-mail notification when errata are posted to a particular code or standard. This option can be found on the appropriate Committee Page after selecting "Errata" in the "Publication Information" section.

The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

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FOREWORD

This American National Standard, Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings, has been developed under the procedures accredited by the American National Standards Institute (ANSI). This Standard had its beginning in December 1916, when an eight-page Code of Safety Standards for Cranes, prepared by the American Society of Mechanical Engineers (ASME) Committee on the Protection of Industrial Workers, was presented at the annual meeting of ASME.

Meetings and discussions regarding safety on cranes, derricks, and hoists were held from 1920 to 1925 involving the ASME Safety Code Correlating Committee, the Association of Iron and Steel Electrical Engineers, the American Museum of Safety, the American Engineering Standards Committee (AESC) [later changed to American Standards Association (ASA), then to the United States of America Standards Institute (USASI), and finally to ANSI], Department of Labor — State of New Jersey, Department of Labor and Industry — State of Pennsylvania, and the Locomotive Crane Manufacturers Association. On June 11, 1925, the AESC approved the ASME Safety Code Correlating Committee's recommendation and authorized the project with the U.S. Department of the Navy, Bureau of Yards and Docks, and ASME as sponsors.

In March 1926, invitations were issued to 50 organizations to appoint representatives to a Sectional Committee. The call for organization of this Sectional Committee was sent out October 2, 1926, and the Committee was organized on November 4, 1926, with 57 members representing 29 national organizations.

Commencing June 1, 1927, and using the eight-page Code published by ASME in 1916 as a basis, the Sectional Committee developed the Safety Code for Cranes, Derricks, and Hoists. The early drafts of this safety code included requirements for jacks, but, due to inputs and comments on those drafts, the Sectional Committee decided in 1938 to make the requirements for jacks a separate code. In January 1943, ASA B30.2-1943 was published addressing a multitude of equipment types, and in August 1943, ASA B30.1-1943 was published addressing only jacks. Both documents were reaffirmed in 1952 and widely accepted as safety standards.

Due to changes in design, advancement in techniques, and general interest of labor and industry in safety, the Sectional Committee, under the joint sponsorship of ASME and the Bureau of Yards and Docks (now the Naval Facilities Engineering Command), was reorganized on January 31, 1962, with 39 members representing 27 national organizations. The new Committee changed the format of ASA B30.2-1943 so that the multitude of equipment types it addressed could be published in separate volumes that could completely cover the construction, installation, inspection, testing, maintenance, and operation of each type of equipment that was included in the scope of ASA B30.2. This format change resulted in B30.3, B30.5, B30.6, B30.11, and B30.16 being designated as revisions of B30.2 with the remainder of the B30 volumes being published as totally new volumes. ASA changed its name to USASI in 1966 and to ANSI in 1969, which resulted in B30 volumes from 1943 to 1968 being designated as either ASA B30, USAS B30, or ANSI B30, depending on their date of publication.

In 1982, the Committee was reorganized as an Accredited Organization Committee operating under procedures developed by ASME and accredited by ANSI. This Standard presents a coordinated set of rules that may serve as a guide to government and other regulatory bodies and municipal authorities responsible for the guarding and inspection of the equipment falling within its scope. The suggestions leading to accident prevention are given both as mandatory and advisory provisions; compliance with both types may be required by employers of their employees.

In case of practical difficulties, new developments, or unnecessary hardship, the administrative or regulatory authority may grant variances from the literal requirements or permit the use of other devices or methods but only when it is clearly evident that an equivalent degree of protection is thereby secured. To secure uniform application and interpretation of this Standard, administrative or regulatory authorities are urged to consult the B30 Committee, in accordance with the format described in Section IX of the Introduction, before rendering decisions on disputed points.

Safety codes and standards are intended to enhance public safety. Revisions result from committee consideration of factors such as technological advances, new data, and changing environmental and industry needs. Revisions do not imply that previous editions were inadequate.

This first edition of ASME B30.32 was approved by ASME and the ASME B30 Committee. It was approved by ANSI and designated an American National Standard on October 21, 2021.

ASME B30 COMMITTEE
Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings

(The following is the roster of the Committee at the time of approval of this Standard.)

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B30 STANDARD INTRODUCTION

SECTION I: SCOPE

The ASME B30 Standard contains provisions that apply to the construction, installation, operation, inspection, testing, maintenance, and use of cranes and other lifting and material-movement-related equipment. For the convenience of the reader, the Standard has been divided into separate volumes. Each volume has been written under the direction of the ASME B30 Standards Committee and has successfully completed a consensus approval process under the general auspices of the American National Standards Institute (ANSI).

As of the date of issuance of this Volume, the B30 Standard comprises the following volumes:

B30.1 Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries

B30.2 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)

B30.3 Tower Cranes

B30.4 Portal and Pedestal Cranes

B30.5 Mobile and Locomotive Cranes

B30.6 Derricks

B30.7 Winches

B30.8 Floating Cranes and Floating Derricks

B30.9 Slings

B30.10 Hooks

B30.11 Monorails and Underhung Cranes (withdrawn 2018 — requirements found in latest revision of B30.17)

B30.12 Handling Loads Suspended From Rotorcraft

B30.13 Storage/Retrieval (S/R) Machines and Associated Equipment

B30.14 Side Boom Tractors

B30.15 Mobile Hydraulic Cranes (withdrawn 1982 — requirements found in latest revision of B30.5)

B30.16 Overhead Underhung and Stationary Hoists

B30.17 Cranes and Monorails (With Underhung Trolley or Bridge)

B30.18 Stacker Cranes (Top or Under Running Bridge, Multiple Girder With Top or Under Running Trolley Hoist)

B30.19 Cableways

B30.20 Below-the-Hook Lifting Devices

B30.21 Lever Hoists

B30.22 Articulating Boom Cranes

B30.23 Personnel Lifting Systems

B30.24 Container Cranes

B30.25 Scrap and Material Handlers

B30.26 Rigging Hardware

B30.27 Material Placement Systems

B30.28 Balance Lifting Units

B30.29 Self-Erecting Tower Cranes

B30.30 Ropes

B30.31 Self-Propelled, Towed, or Remote-Controlled Hydraulic Platform Transporters[1]

B30.32 Unmanned Aircraft Systems (UAS) Used in Inspection, Testing, Maintenance, and Lifting Operations

SECTION II: SCOPE EXCLUSIONS

Any exclusion of, or limitations applicable to, the equipment, requirements, recommendations, or operations contained in this Standard are established in the affected volume's scope.

SECTION III: PURPOSE

The B30 Standard is intended to

(a) prevent or minimize injury to workers, and otherwise provide for the protection of life, limb, and property by prescribing safety requirements

(b) provide direction to manufacturers, owners, employers, users, and others concerned with, or responsible for, its application

(c) guide governments and other regulatory bodies in the development, promulgation, and enforcement of appropriate safety directives

SECTION IV: USE BY REGULATORY AGENCIES

These volumes may be adopted in whole or in part for governmental or regulatory use. If adopted for governmental use, the references to other national codes and standards in the specific volumes may be changed to refer to the corresponding regulations of the governmental authorities.

[1] This volume is currently in the development process.

SECTION V: EFFECTIVE DATE

(a) Effective Date. The effective date of this Volume of the B30 Standard shall be 1 yr after its date of issuance. Construction, installation, inspection, testing, maintenance, and operation of equipment manufactured and facilities constructed after the effective date of this Volume shall conform to the mandatory requirements of this Volume.

(b) Existing Installations. Equipment manufactured and facilities constructed prior to the effective date of this Volume of the B30 Standard shall be subject to the inspection, testing, maintenance, and operation requirements of this Standard after the effective date.

It is not the intent of this Volume of the B30 Standard to require retrofitting of existing equipment. However, when an item is being modified, its performance requirements shall be reviewed relative to the requirements within the current volume. The need to meet the current requirements shall be evaluated by a qualified person selected by the owner (user). Recommended changes shall be made by the owner (user) within 1 yr.

SECTION VI: REQUIREMENTS AND RECOMMENDATIONS

Requirements of this Standard are characterized by use of the word *shall*. Recommendations of this Standard are characterized by the word *should*.

SECTION VII: USE OF MEASUREMENT UNITS

This Standard contains SI (metric) units as well as U.S. Customary units. The values stated in U.S. Customary units are to be regarded as the standard. The SI units are a direct (soft) conversion from the U.S. Customary units.

SECTION VIII: REQUESTS FOR REVISION

The B30 Standards Committee will consider requests for revision of any of the volumes within the B30 Standard. Such requests should be directed to

Secretary, B30 Standards Committee
ASME Standards and Certification
Two Park Avenue
New York, NY 10016-5990

Requests should be in the following format:

Volume:	Cite the designation and title of the volume.
Edition:	Cite the applicable edition of the volume.
Subject:	Cite the applicable paragraph number(s) and the relevant heading(s).
Request:	Indicate the suggested revision.
Rationale:	State the rationale for the suggested revision.

Upon receipt by the Secretary, the request will be forwarded to the relevant B30 Subcommittee for consideration and action. Correspondence will be provided to the requester defining the actions undertaken by the B30 Standards Committee.

SECTION IX: REQUESTS FOR INTERPRETATION

The B30 Standards Committee will render an interpretation of the provisions of the B30 Standard. An Interpretation Submittal Form is available on ASME's website at http://cstools.asme.org/Interpretation/InterpretationForm.cfm.

Phrase the question as a request for an interpretation of a specific provision suitable for general understanding and use, not as a request for approval of a proprietary design or situation. Plans or drawings that explain the question may be submitted to clarify the question. However, they should not contain any proprietary names or information. Read carefully the note addressing the types of requests that the B30 Standards Committee can and cannot consider.

Upon submittal, the request will be forwarded to the relevant B30 Subcommittee for a draft response, which will then be subject to approval by the B30 Standards Committee prior to its formal issuance. The B30 Standards Committee may rewrite the question for the sake of clarity.

Interpretations to the B30 Standard will be available online at https://cstools.asme.org/Interpretation/SearchInterpretation.cfm.

SECTION X: ADDITIONAL GUIDANCE

The equipment covered by the B30 Standard is subject to hazards that cannot be abated by mechanical means, but only by the exercise of intelligence, care, and common sense. It is therefore essential to have personnel involved in the use and operation of equipment who are competent, careful, physically and mentally qualified, and trained in the proper operation of the equipment and the handling of loads. Serious hazards include, but are not limited to, improper or inadequate maintenance, overloading, dropping or slipping of the load, obstructing the free passage of the load, and using equipment for a purpose for which it was not intended or designed.

The B30 Standards Committee fully realizes the importance of proper design factors, minimum or maximum dimensions, and other limiting criteria of wire rope or chain and their fastenings, sheaves, sprockets, drums, and similar equipment covered by the Standard, all of which are closely connected with safety. Sizes, strengths, and similar criteria are dependent on many different factors, often varying with the installation and uses. These factors depend on

(a) the condition of the equipment or material
(b) the loads

(c) the acceleration or speed of the ropes, chains, sheaves, sprockets, or drums

(d) the type of attachments

(e) the number, size, and arrangement of sheaves or other parts

(f) environmental conditions causing corrosion or wear

(g) many variables that must be considered in each individual case

The requirements and recommendations provided in the volumes must be interpreted accordingly, and judgment used in determining their application.

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Chapter 32-0
Scope, Definitions, Personnel Competence, and Documentation

SECTION 32-0.1: SCOPE OF B30.32

Volume B30.32 includes provisions that apply to the use of unmanned aircraft systems (UAS) to support the inspection, testing, maintenance, and load-handling operations of equipment addressed in other volumes of the ASME B30 Standard, except ASME B30.12.

SECTION 32-0.2: DEFINITIONS

aircraft: a device that is used or intended to be used for flight in the air.

first-person view (FPV): a mode of UAS operation in which the remote pilot in command (RPIC) monitors the unmanned aircraft vehicle (UAV) position through a camera installed on the UAV.

impact tolerance: a UAV design characteristic that allows any part of the UAV structure to be impacted during planned normal flight operations and not adversely affect the UAV's capability to continue flight operations (see Figure 32-0.2-1).

inertial measurement unit (IMU): an electronic device that measures and reports the specific force, angular rate, and, sometimes, orientation of the body, using a combination of accelerometers and gyroscopes.

lift director: a person that directly oversees the work being performed by equipment and personnel covered by other volumes of the ASME B30 Standard and is the person responsible for all non-UAS equipment operations.

load-handling operation: the activities that support equipment covered by other volumes in the ASME B30 Standard in the performance of their operations.

low-altitude authorization and notification capability (LAANC): the collaboration between the Federal Aviation Administration (FAA) and the public that directly supports UAS integration into the airspace by providing UAV pilots with access to controlled airspace at or below 400 ft (122 m) and the awareness of where UAVs can and cannot fly and provides air traffic professionals with visibility into where and when UAVs are operating.

normal flight operation: the flight of a UAV that is properly performing within the UAS manufacturer's flight guidance that addresses environment and performance.

payload: any weight lifted by a UAV that is attached to the UAV at locations authorized by the UAV manufacturer, does not violate the UAV manufacturer's established weight and balance limits, and uses attachment means provided or authorized for use by the UAV manufacturer or a qualified person.

qualified person: a person who, by possession of a recognized degree in an applicable field or certificate of professional standing, or who, by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work and has the requisite information and skills necessary to evaluate the suitability of a device, a component, or information for use with a UAS.

remote pilot in command (RPIC): a competent and appropriately licensed person with the combination of skills and knowledge required to perform the tasks defined in this Volume who is responsible for all aspects of the UAS operation.

shall: a word indicating a requirement.

should: a word indicating a recommendation.

site owner: a person with the authority to speak for the entity controlling the site over which flight operations will take place.

support personnel: the person or persons designated to assist in the preparation and/or accomplishment of a UAS flight operation and operation of equipment covered by other volumes of the ASME B30 Standard.

testing: the operations that provide information regarding an operational characteristic.

UAS manufacturer: the entity that integrates the UAV with its control systems and accessories.

UAS operator: a competent person who is appropriately licensed and directly inputs the commands that manipulate the movement of a UAV.

UAV manufacturer: the entity that manufactures the UAV.

unmanned aircraft system (UAS): a system consisting of a powered unmanned aerial vehicle and equipment, apparatus, appurtenance, software, and accessories that are operated, or designed to be operated, without a person on board and that uses aerodynamic forces to provide aerial vehicle lift.

unmanned aircraft vehicle (UAV): the aerial vehicle that is flown as part of a UAS; sometimes identified as a UAV, a drone, or a quadcopter (see Figures 32-0.2-1 and 32-0.2-2).

visual line of sight (VLOS): a type of operation in which the UAS operator, with or without the assistance of a visual observer, can maintain continuous unobstructed and mechanically unaided visual contact with the UAV in the performance of the planned operations of the UAS.

visual observer: a designated person who, by visual observation of the UAV, assists the UAS operator in conducting the flight.

SECTION 32-0.3: PERSONNEL COMPETENCE

Persons performing the tasks or functions identified in this Volume shall meet the qualifying criteria stated in the applicable volumes of the ASME B30 Standard and shall, through education, training, experience, skill, and physical fitness, be competent and capable to perform the tasks and functions associated with UAS operations, as presented in this Volume, and required by their employer or employer's representative.

SECTION 32-0.4: DOCUMENTATION

32-0.4.1 General Information

(a) The UAS manufacturer or UAS component manufacturer shall furnish with each UAS or component documentation that includes information applicable to the operation, inspection, testing, maintenance, components, and wiring diagram of the UAS.

(b) The UAS manufacturer's documentation shall at least provide the following:

(1) definition of the inspection, testing, and maintenance criteria of the UAS and requirements, including frequency

(2) definition of the required and recommended preflight requirements regarding the accomplishment of inspections of the UAS, UAV, batteries, and supplied sensors

(3) recommendations that include how to

(-a) validate that the expected weather is suitable for UAV flight

(-b) assign and indoctrinate UAS support personnel

(-c) verify that the UAS registration is valid

(-d) determine what documentation is provided by the UAS manufacturer

(c) The UAS manufacturer's documentation shall be provided in a language specified by the UAS purchaser at the time of the initial sale by the manufacturer.

(d) Pictograms used to identify controls shall be described in the instructions. The pictograms should comply with applicable industry-recognized sources.

32-0.4.2 Translation of Technical and Safety-Related Instructions and Manuals

(a) The entities responsible for the operation, use, inspection, testing, maintenance, assembly, and disassembly of the UAS shall have the technical and safety-related information available in a language that their employees can read and understand. If the information is not available in a language understood by their employees, the entities shall obtain a translation of the original UAS manufacturer's technical and safety-related information from the UAS manufacturer or from a translation service provider.

(b) Translations of the original-language instructions shall meet professional translation industry standards, which include, but are not limited to, the following:

(1) translating the complete paragraph message, instead of word by word

(2) ensuring grammatical accuracy

(3) preserving the source document content without omitting or expanding the text

(4) translating the terminology accurately

(5) reflecting the level of sophistication of the original document

NOTE: If the UAS manufacturer no longer exists or if the required language is not available from the manufacturer, translation of the instructions with the machine is acceptable.

(c) The finished translation shall be verified for compliance with (b) by a qualified person who understands the technical content of the subject matter.

Figure 32-0.2-1
Typical Impact-Tolerant UAV Configurations

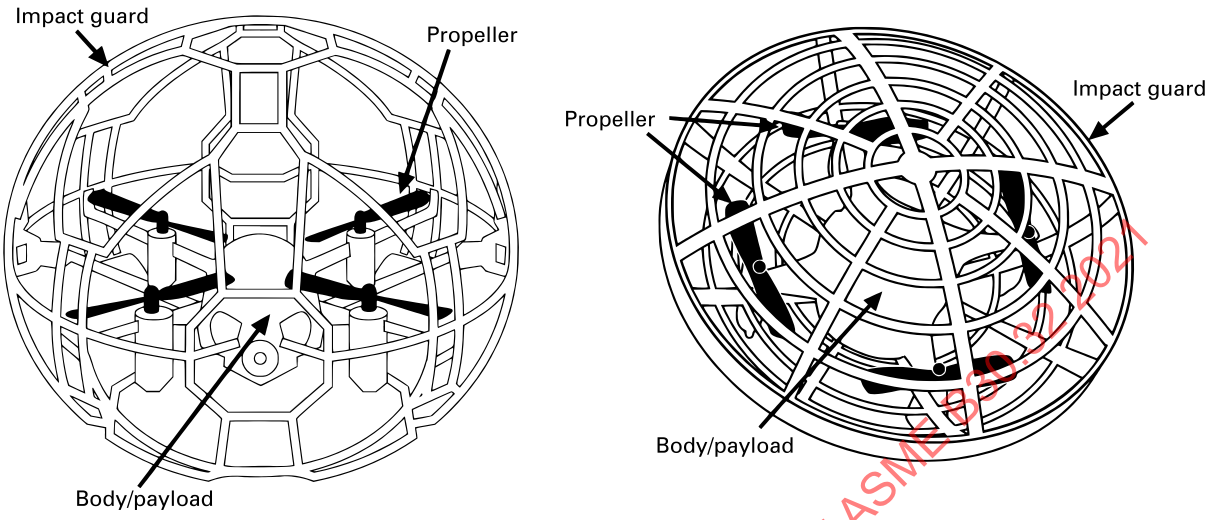
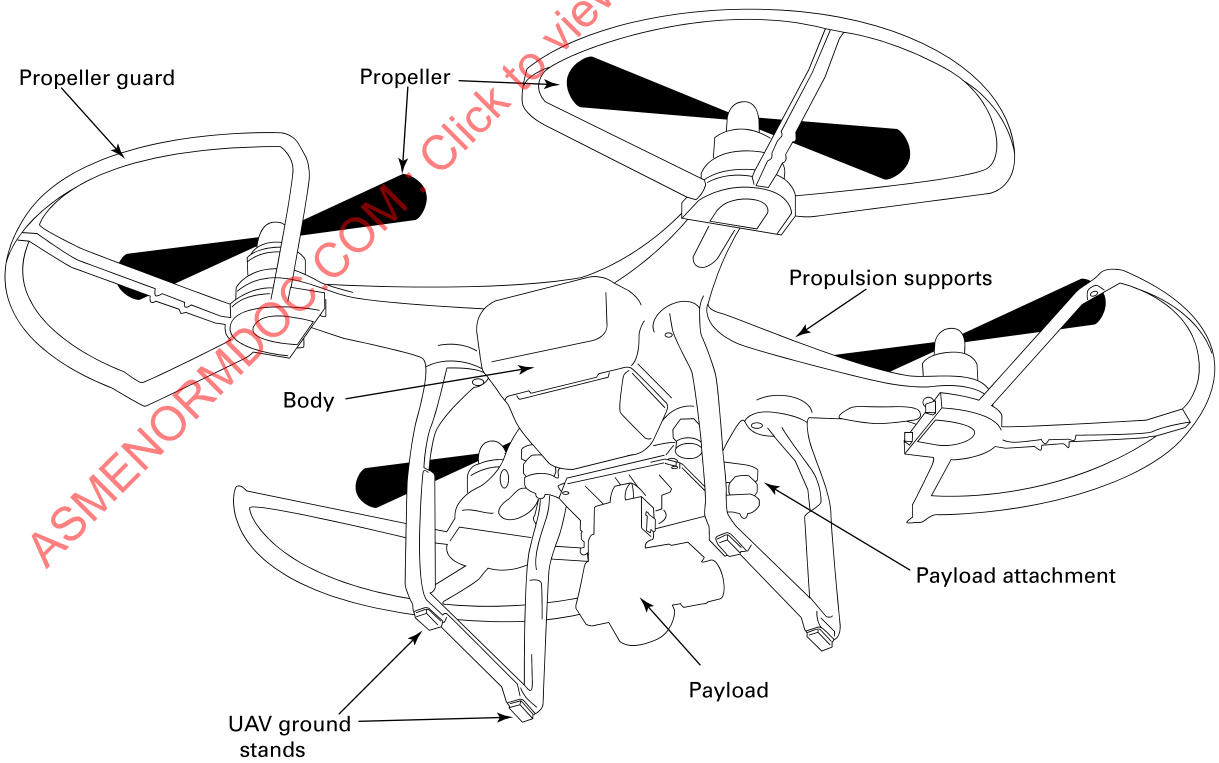


Figure 32-0.2-2
Typical UAV Components



Chapter 32-1
UAS Characteristics

SECTION 32-1.1: POWERED FLIGHT CONFIGURATION

(a) The UAS characteristics shall meet or exceed the criteria established by the applicable regulatory bodies.

(b) The UAS manufacturer shall designate the UAV's maximum rated speed for each powered flight configuration authorized for the UAS. When carrying a payload, the UAV maximum rated speed shall be no more than 100 mph (161 km/h).

(c) The UAV shall maintain a neutral-pitch attitude when all flight controls are in their neutral position.

(d) The UAV shall have the capability to send video images to the UAS controls.

(e) A global positioning system (GPS) shall be installed on UAVs designed to be operated outside of enclosed spaces.

SECTION 32-1.2: UAV BODY

32-1.2.1 Configuration

(a) The UAV body shall be suitable to operate in the environments specified by the UAS manufacturer.

(b) The UAV manufacturer shall have at least considered the issues of water, dust, and adverse weather in establishing the allowable operating conditions and configurations.

(c) The UAV manufacturer should provide lighting that will allow the UAV to be visually followed during flight.

(d) UAV propellers shall be protected as defined in para. 32-1.2.2.

(e) The UAV body shall have visual indicators that allow its front, rear, sides, and orientation to be visually identified during flights in the UAS manufacturer's specified flight environments.

(f) The UAV shall have installed, or be capable of being retrofitted with, an in-flight identification system that meets the requirements of the applicable regulatory bodies.

32-1.2.2 Structure

(a) UAVs designated as impact tolerant do not require propeller guards but shall be able to withstand in-flight impacts to their structure or payload by a fixed object, without loss of controlled flight, when flying at a speed that is not less than 20% of the UAV manufacturer's designated maximum rated speed.

(b) UAVs not designated as impact tolerant shall have propeller guards installed that are

(1) designed for use on the UAV

(2) able to withstand in-flight impacts with a fixed object, without loss of controlled flight, when flying at a speed that is not less than 20% of the UAV manufacturer's designated maximum rated speed

SECTION 32-1.3: CONTROLS

32-1.3.1 General

(a) Modifications to the UAS manufacturer's control system shall not be made without the written approval of the UAS manufacturer or a qualified person. The controls shall have the capability to be attached to the UAS operator's person by harness, clips, or other methods.

(b) The controls shall use the radio frequencies allowed by the regulatory body that controls the communication frequencies allowed at the flight location.

(c) Programmable UAV flight characteristics shall be provided for flight operations that

(1) automatically activate upon loss of signal and/or insufficient UAS or UAV power

(2) have the capability of returning to a designated landing location using a programmed flight altitude

(3) have the capability to adjust the video frequency used between the controls and the UAV (e.g., to reduce interference from local transmission sources)

(4) have the capability of automatically landing the UAV upon the loss of control signal or insufficient UAS flight power

(d) Programmable flight characteristics should be provided for flight operations that have the capability to adjust control frequency of the UAS (e.g., to reduce interference from local transmission sources).

(e) A GPS shall be installed on UAS systems designed to be operated outside of enclosed spaces.

(1) When a GPS is enabled, it shall have the capability to locate the UAV in a radius of less than 20 ft (6 m) in any direction.

(2) When a GPS is enabled, it should provide input to the UAS control software to enable the UAV to maintain its attitude and position in both vertical and horizontal planes.

(f) The controls shall be capable of controlling flight operations to within the height and distance limitations established by the UAS manufacturer.

(g) Anticollision and proximity location control systems should be installed and should be capable of

(1) providing visual or audible warnings when specified parameters are met

(2) being turned off

(3) being tested for satisfactory operation prior to flight operations

32-1.3.2 Software

Control software shall

(a) provide the capability to present information on aircraft flight proximity

(b) provide warnings regarding controlled airspace

(c) have the capability to be programmed for an allowable flight distance from the UAS operator

(d) have the capability, when GPS is enabled and the UAS controls are released, to maintain the attitude, altitude, and horizontal position of the UAV

32-1.3.3 Flight Information Displays

Flight information displays shall be provided and

(a) shall indicate when the control signal for the UAV is lost

(b) shall indicate the UAV operating altitude

(c) shall have a visual and/or audible indicator that displays the status of the UAS batteries in terms of remaining UAV flight time

(d) should provide the following:

(1) legible indication as to the status of the operating parameters and settings of the UAS, as defined by the UAS manufacturer

(2) a legible display through FPV or through installed sensors

(3) compatibility with third-party software applications used by the UAS

(4) the capability to display aircraft warnings relevant to the UAS operating area

(5) the capability to display airspace warnings relevant to the UAS operating area

(6) the calibration status of installed flight control sensors

(7) the calibration status of the IMU

Chapter 32-2
UAS Used in Inspection, Testing, Maintenance, and Load-Handling Operations

SECTION 32-2.1: SUITABLE INSPECTING, TESTING, MAINTENANCE, AND LOAD-HANDLING OPERATIONS

32-2.1.1 Inspection

(a) Thermal and acoustic emissions (e.g., brakes, clutches, motors, engines, wiring)

(b) Mechanical conditions (e.g., wear, damage, attachment, ropes, sheaves, slings)

(c) Component configurations (e.g., rigging position, clearances)

(d) Structural conditions (e.g., oxidation, cracking, coating failure, deformation)

(e) Noncontact measurements (e.g., ultrasonic, infrared)

32-2.1.2 Testing

Function operation monitoring (e.g., sheaves, guides, drums, ropes, switches, rods, linkages)

32-2.1.3 Maintenance

(a) Lubrication application verification (e.g., pins, bearings, reservoirs, gears)

(b) Fluid reservoir content verification (e.g., brakes, antifreeze)

32-2.1.4 Load Handling Operations

(a) Clearance monitoring (e.g., designated signal person aid)

(b) Other ASME B30 Standard equipment load location verification

(c) Other ASME B30 Standard equipment movement, loading, rigging, assembling, disassembling, and setting up

(d) Emergency rescue and incident investigation

Chapter 32-3
UAS Operation Personnel, Preparations, and Practices

SECTION 32-3.1: FLIGHT OPERATION PERSONNEL

32-3.1.1 General

(a) Personnel shall be competent to perform their assigned tasks as required by the applicable codes, standards, and site requirements, as well as this Volume.

(b) Personnel responsible for the supervision, operation, inspection, or maintenance of the UAS shall be familiar with the applicable contents of the manuals furnished by the UAS manufacturer as well as how to

(1) determine the need for waivers, LAANC notification/approval, and notice to airports or heliports

(2) validate the expected weather during flight operations

(3) assign and train UAS support personnel

(4) verify that the UAS operator certificate and UAS registration are valid

(5) verify that all required UAS manufacturer documentation is present

(c) Personnel trained on equipment covered by other volumes of the ASME B30 Standard who are involved with UAS operations shall be competent to perform their assigned tasks as specified in those volumes of the ASME B30 Standard and as required by any applicable codes, standards, and site requirements.

(d) Personnel assigned tasks associated with the UAS flight operation or with equipment covered by other volumes of the ASME B30 Standard shall receive briefings specified in this Volume.

(e) As a minimum, UAS flight operation briefings shall identify the following:

(1) the RPIC

(2) the UAS operator

(3) the visual observer and other support personnel, as applicable

(4) the lift director, as applicable

(5) personnel trained on equipment covered by other volumes of the ASME B30 Standard, as applicable

(6) the site owner, as applicable

(7) the specific tasks and responsibilities of the persons identified in (1) through (6)

(8) a description of the UAS that will be used, capabilities of the UAV, purpose of the flight, and the plan for the flight including the following:

(-a) takeoff and landing locations, primary and alternate

(-b) planned flight path

(-c) potential distance from the flight area that could cause loss of communication

(-d) expected battery life for the flight operation

(-e) any identified airspace prohibitions

(9) the communication method, equipment, and practices that will be used, as well as any backup methods

(10) the potential physical hazards and conditions that could arise during the flight operation, including the following:

(-a) unanticipated people or equipment entering the flight area

(-b) unanticipated and anticipated aircraft entering the flight area

(-c) physical features around the site, such as power lines, structures, or communication devices, that could disrupt communication with the UAS or be a hazard to the flight operation

(-d) situations or conditions that would require stopping UAS flight operations

(11) the environmental hazards that could arise during the UAS flight operation that are not acceptable and unanticipated and would cause the halting of flight operations

(12) potential UAS malfunction hazards, including, but not limited to emergency procedures related to the following:

(-a) loss of control

(-b) loss of communication with the UAV

(-c) failure or low battery power of the UAS and controller

(-d) physical failure of a UAV, including a payload drop

(-e) zones and locations of emergency landings, if necessary

(-f) unsafe/safe locations around the UAS flight area

32-3.1.2 Responsibilities

(a) General

(1) A single individual may perform the tasks of more than one of the positions listed in (b) through (f); however, there shall be at least one RPIC and at least one visual observer designated for a flight operation.

(2) All of the responsibilities listed in this paragraph shall be assigned to personnel supporting the flight operation.

(b) *RPIC.* At a minimum, the RPIC shall be responsible for the following:

(1) determining that the UAV is of a size, weight, and characteristics to be able to adequately perform its required tasks

(2) determining what the applicable regulations are at the flight location and ensuring that these requirements are followed

(3) ensuring that regulations applicable to the flight are reviewed by the UAS operation personnel and that steps have been taken to ensure compliance, including getting any required waivers or clearances

(4) determining the competency requirements for the personnel supporting the flight operations

(5) determining that the personnel competency and proficiency requirements established by the applicable regulations have been met prior to the commencement of any flight operations

(6) verifying that all required flight operation documents are available and that any required inspections, maintenance, or tests of the UAS have been completed before the start of flight operations

(7) verifying that competent persons have been assigned to perform the UAS support functions

(8) supervising the flight operations

(9) accomplishing other tasks that are needed to enhance the safety of the flight operations

(10) conducting flight operations only when the RPIC feels physically and mentally fit to perform the operation

(11) designating the appropriate number of support personnel for performing the flight operation

(12) preparing a flight plan and ensuring that the plan is retained as part of the jobsite records

(13) holding a preflight operation briefing attended by personnel involved in the flight operation, and if individuals are changed during a series of flights, briefing each new person appropriately

(14) ensuring that the preflight briefing addresses the following, at a minimum:

(-a) the operational requirements of this Volume

(-b) the assignment and responsibilities of each person involved in the flight operation

(-c) the procedures to be followed during flight operations

(-d) guidance on general and specific safety-enhancing precautions

(-e) communication methods and/or signals for the flight operation

(-f) any unique considerations of the flight operation

(-g) tasks to be accomplished during the flight operations

(-h) emergency procedures for the loss of control signal, loss of communication, or UAS malfunction

(-i) identification of the recognized hazards identified during the planning for the flight

(-j) identification of the anticipated weather conditions during the flight and the variances that would necessitate the flight's termination

(15) terminating flight operations if hazardous conditions develop

(16) developing a description of the purpose of the flight, including a list of the desired results at the completion of the flight operations

(17) coordinating the UAS operations with the lift director

(18) verifying that the UAS programing and control system software is correct and appropriately updated

(19) wearing the personal protective equipment (PPE) required and appropriate for the site and flight operation

(c) *UAS Operator.* At a minimum, the UAS operator shall be responsible for the following:

(1) flying the UAS only when the requirements of this Volume have been met

(2) flying the UAS in a careful and safe manner

(3) flying the UAS only into a location where such operation is permitted

(4) conducting flight operations only if the UAS operator feels physically and mentally fit to perform the operation

(5) not engaging in any practice that will divert their attention while controlling the UAS

(6) responding to commands only from the RPIC or another designated person

(7) stopping UAS operations whenever they have any doubt as to the safety of the operation and consulting with the RPIC and lift director before reinitiating or commencing operations

(8) understanding and applying the UAS manufacturer's documentation for specific safety instructions and limitations on the UAS operation

(9) inspecting the UAS setup and flight area before the flight operations and reporting their observations to the RPIC; these inspections shall, at a minimum, include inspecting the area for potential hazards, such as

(-a) physical obstructions and electrical transmission and distribution lines

(-b) potentially hazardous geographic locations

(-c) wind, weather, or unacceptable flight or task conditions

(10) not wearing clothing or body accessories that inhibit their ability to correctly use the controls or sense any indications provided by the controls

(11) not allowing the UAS to be used as a dedicated spotter when assisting operations in proximity to electrical conductors

(12) not flying the UAS to a position within 50 ft (15 m) of an electrical transmission or distribution line

(13) not operating the UAS while under the influence of alcohol or while using any drug that could adversely affect their ability to control the UAS

(14) notifying the operator of equipment covered by other volumes of the ASME B30 Standard prior to the UAS entering the airspace that extends to 23 ft (7 m) above the highest extension of the equipment structure and 23 ft (7 m) horizontally from any portion of the equipment structure

(15) operating only one UAS at a time

(16) ensuring that any object attached to or carried by the UAV is secure and does not adversely affect the flight characteristics or controllability of the UAV

(17) enabling the GPS when flying outside of enclosed spaces

(18) wearing the PPE required and appropriate for the site and flight operation

(d) Visual Observers. At a minimum, one or more visual observers shall be responsible for the following:

(1) accomplishing the tasks assigned by the RPIC, including notifying the RPIC of any of the following:

(-a) changes in weather conditions that could impact safe operation

(-b) the presence of natural and man-made hazards (e.g., ground traffic, aircraft intrusion, worker distraction)

(-c) intrusion into UAS operation airspace by other aircraft

(-d) movement of equipment covered by other volumes of the ASME B30 Standard

(2) not engaging in any practice or having any other duties that will reduce the safety of the flight operation

(3) wearing the PPE required and appropriate for the site and flight operation

(4) not acting as a visual observer while under the influence of alcohol or while using any drug that could adversely affect their ability to perform assigned tasks

(e) Support Personnel. At a minimum, support personnel shall be responsible for the following:

(1) accomplishing the tasks assigned by the RPIC

(2) not engaging in any practice or having any other duties that will reduce the safety of the flight operation

(3) wearing the PPE required and appropriate for the site and flight operation

(4) not acting as a support personnel while under the influence of alcohol or while using any drug that could adversely affect their ability to perform assigned tasks

(f) Lift Director. At a minimum, the lift director shall be responsible for the following:

(1) coordinating the UAS tasks, as requested by the RPIC

(2) not engaging in or authorizing any practice or other duties that will reduce the safety of the flight operation

(3) wearing the PPE required and appropriate for the site and flight operation

(4) not acting as a lift director while under the influence of alcohol or while using any drug that could adversely affect their ability to perform their assigned tasks

(5) coordinating with the site controller and/or site owner and discussing the following:

(-a) clearance requirements from the UAV operations for the safety of site personnel and the public

(-b) potential hazards and controls for personnel involved in the UAS activities

(-c) the boundaries of the work zone and how to keep personnel out of the area

(-d) informing personnel to stay out of the UAV's operating area

(-e) schedule of the UAS operations

(6) being the liaison between UAS activity and other activities at the site

SECTION 32-3.2: FLIGHT OPERATION PREPARATION

Flight operation preparation activities take place at many locations and in many different time frames and require many different skills, which precludes the establishment of any precise personnel responsibilities or accomplishment timing; however, all the preparation activities listed in this Section shall be accomplished, as generally indicated.

Prior to flight operations, a description of the purpose of the flight, including the desired results at the completion of the operation, shall be developed, along with the designation of a RPIC for each UAS in operation. If there is a potential for conflicts during simultaneous UAS flight operations, a RPIC shall be designated to coordinate the operations.

Prior to the start of flight operations, the following actions shall be accomplished:

(a) a physical visual survey of the flight operation site that identifies

(1) physical hazards or conditions that could impact flight operations

(2) physical flight support requirements

(b) gathering of documentation that establishes

(1) the regulatory bodies and other authorization entities responsible for the authorization and/or approval of the UAS flight operation

(2) that required authorizations from the applicable entities have been accomplished and

(-a) required flight authorizations have been or will be received

(-b) site approval or coordination requirements have been or will be met

(c) defining the UAS flight operation personnel requirements and the communication methods to be used with those personnel