



Aerial Drone Tests and Scorable Scenarios for Evaluating System Capabilities and Remote Pilot Proficiency in Level 3 Open, Level 4 Obstructed, and Level 5 Confined Environments

Developed by the National Institute of Standards and Technology



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Test Director

Intelligent Systems Division National Institute of Standards and Technology U.S. Department of Commerce



Sponsor:

Systems Engineering & Standards Division
Science and Technology Directorate
U.S. Department of Homeland Security





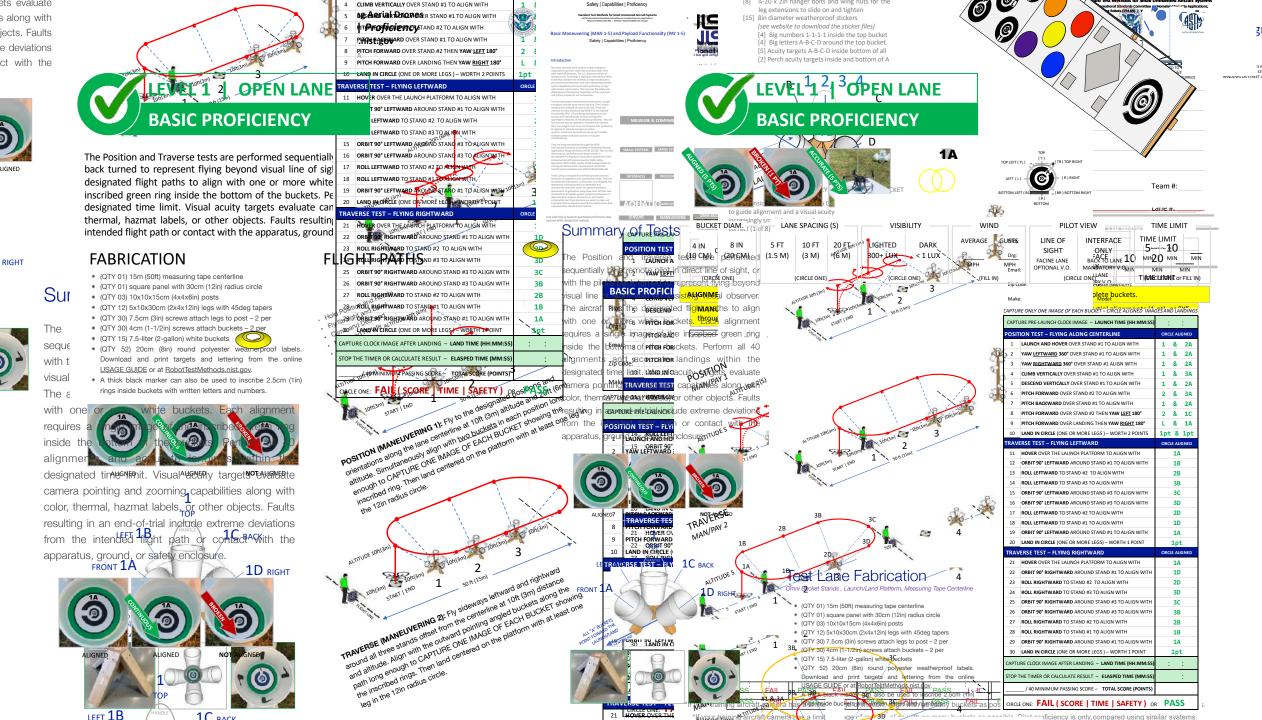


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Level 4 Obstructed Environments



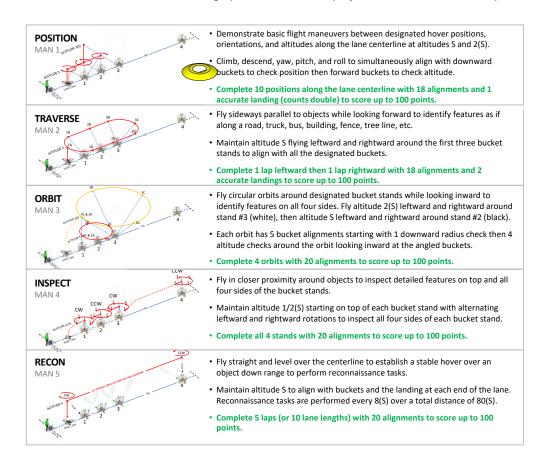
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VERSION 2023A



Perform 5 different flight paths around the omni bucket stands. Each flight path includes as sequence of a with one or more buckets. Capture a SINGLE IMAGE of the inscribed ring inside each bucket and land accu

- Score ALIGNMENT POINTS after trial from images with UNBROKEN RINGS (5 pts) or BROKEN RINGS (1 r
- Land CENTERED (5 pts) with the aircraft center inside the designated 60 cm (24 inch) diameter circle, (1 pt) with at least one propeller motor inside the circle.
- Start timer at launch and end after the last task is completed. Trial time limits are typically 5 minutes حمد المحادثة المحا minutes to complete all 5 tests) although organizations may set their own trial time limits and passing cop
- · Extreme deviations from the intended flight path, or contact with any object, ends the trial to ensure safety.



- leg extensions to slide on and tighten [15] 8in diameter weatherproof stickers
- [4] Big numbers 1-1-1-1 inside the top bucket
- [4] Big letters A-B-C-D around the top bucket





Team #:

nm

BUCKET DIAM. LANE SPACING (S) PILOT VIEW TIME LIMIT TIME LIMIT AVERAGE GUSTS LINE OF INTERFACE 10 FT 20 FT LIGHTED DARK 4 IN 5 ----10 SIGHT ONLY (10 CM) (20 CM) (3 M) 300+ LUX (1.5 M) (6 M) < 1 LUX BACK CELANE 1.0 MIN 20 MIN MIN FACINE LANE MPH MPH MANDÁTORY V.O.NII V OPTIONAL V.O. (CIRCLE ONE) ANE (CIRCLIONE) (CIRCLE ONE) (CIRCLE ONE) (FILL IN) T(CVAELEICALETOR FILL IN)

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Time Elapsed Time	PASS FEAT	PASS FAIle c	PASS FAIL	PASS CC F		PASS FAI	DACE P	ASS	FAII	DAGG FAII	Ĭ.
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*If your training aircraft camera has a limited range of motion, align with as many buckets as possible. Pilot proficiency is only compared using similar sy

NATIONAL INSTITUTE OBIN diameter weatherproof stickers
STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE Website to download the stickers files. leg extensions to shae on and tighten

[4] Big numbers 1-1-1-1 inside the top bucket

- [4] Big letters A-B-C-D around the top bucket
- [5] Acuity targets A-B-C-D inside bottom of all

[2] Perch acuity targets inside and bottom of A

Capture in

Scoring

1, 2, 3, 4

ALIGN WITH BUCKETS AND LAND ACURATELY

20 ALIGNMENTS TOTAL UP TO 100 POINTS



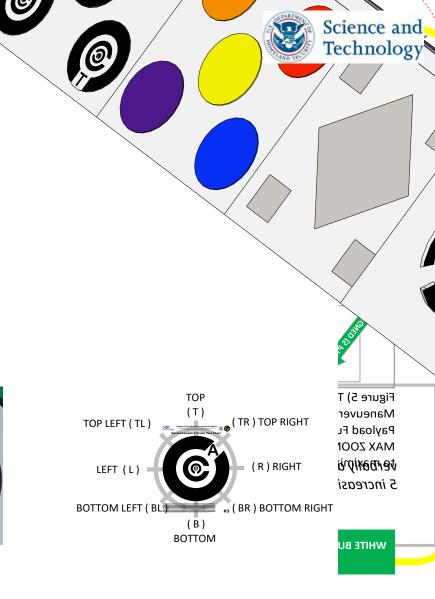
to guide alignment and a visual acuity target with increasingly small Concentric Cs gaps to identify the correct (1 of 8) orientations.

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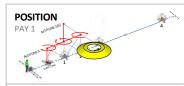


Perform 5 different flight pa alignments with one or more capture a SINGLE IMAGE of the

- Score ALIGNMENT POINTS
- Score ACUITY POINTS by canning out the 3 mercusingly small viscore recent introductions of 2 percusing

landings are not included. **RECON** (MAN/PAY 5)

- Land CENTERED (5 pts) with the aircraft center inside the designated 60 cm (24 inch) diameter cir OFFSET (1 pt) with at least one propeller motor inside the circle.
- Start timer at launch and end after the last task is completed. Trial time limit pically 5 minutes each (25 minutes to complete all 5 tests) although organizations may set their own trial time limits and passing scores.
- Extreme deviations from the intended flight path, or contact with any object, ends the trial to ensure safety.



 Demonstrate basic flight maneuvers between designated hover positions, orientations, and altitudes along the lane centerline at altitudes S and 2(S).

detailed features on the top and all sides. The drone flies at altitude

1/2(S) all around each omni bucket stand to align with the designated

buckets. Inspection tasks start on top then rotate around the objects in alternating clockwise and counter clockwise directions. Accurate

Evaluate drones flying straight and level down range to establish stable

hovers over objects in open space to perform reconnaissance tasks. The

drone flies at altitude (S) at a sustainable speed directly over the lane

centerline to align with designated buckets and the landing at each end

of the lane. The down range reconnaissance tasks include looking

straight down on the objects in different orientations and at an angle. A

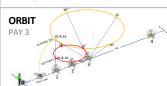
complete trial covers a total distance of 80(S) with moving (non-stop) alignments over the angled buckets along the centerline helping to

identify deviations from the intended path and encourage consistency.

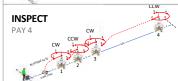
- Climb, descend, yaw, pitch, and roll to simultaneously align with downward buckets to check position then forward buckets to check altitude.
- Complete 10 positions along the lane centerline with 18 alignments and 1 accurate landing (counts double) to score up to 100 points.



- Fly sideways parallel to objects while looking forward to identify features as if along a road, truck, bus, building, fence, tree line, etc.
- Maintain altitude S flying leftward and rightward around the first three bucket stands to align with all the designated buckets.
- Complete 1 lap leftward then 1 lap rightward with 18 alignments and 2 accurate landings to score up to 100 points.



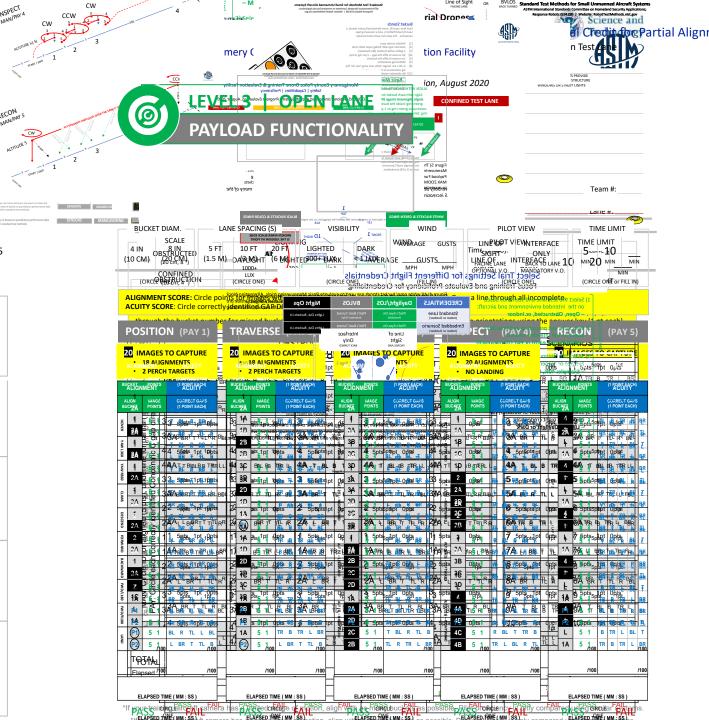
- Fly circular orbits around designated bucket stands while looking inward to identify features on all four sides. Fly altitude 2(S) leftward and rightward around stand #3 (white), then altitude S leftward and rightward around stand #2 (black).
- Each orbit has 5 bucket alignments starting with 1 downward radius check then 4 altitude checks around the orbit looking inward at the angled buckets.
- Complete 4 orbits with 20 alignments to score up to 100 points.



- Fly in closer proximity around objects to inspect detailed features on top and all four sides of the bucket stands.
- Maintain altitude 1/2(S) starting on top of each bucket stand with alternating leftward and rightward rotations to inspect all four sides of each bucket stand.
- Complete all 4 stands with 20 alignments to score up to 100 points.



- Fly straight and level over the centerline to establish a stable hover over an object down range to perform reconnaissance tasks.
- Maintain altitude S to align with buckets and the landing at each end of the lane. Reconnaissance tasks are performed every 8(S) over a total distance of 80(S).
- Complete 5 laps (or 10 lane lengths) with 20 alignments to score up to 100 points.



ALIGN WITH BULLIKIE Has get NA Scoring 1 Align with each bucket lor Capture in single alignment image (N green ring inside the buck continuous green ring or 1 poi **ALIGN W** scoring for accur **20 ALIGNMENTS TOTAL UP** to guide alignment and a visu-Align Version 202 increasingly small Concentric correct (1 of 8) orientations.

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OPEN TEST LANE

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August 2020

CONFINED TEST LANE

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> ct the test procedure a ed on the intended mis AN (5 min. each) or PA

ct the test lane and scr

he intended environm

en, Obstructed, or Inc

Select

Focus

ct the minimum profic age or "expert" scores ample: 40%, 60%, 80%

ct pilot view:

The bucket stands are adjusted to vertical using the slotted leg extensions so the angled buckets are at 45 degrees.

11/9/21

- OFFSET (1; motor inside

– UNBROKEN

- BROKEN RI

- NO RINGS (

- CENTERED

point inside t

Score accurate

Verification of captured alignment images can be during the trial when obvious or after the trial to eliminate discussions during the trial. Images can also be stored for documentation.

Safety | Canabilities | Proficiency

C gap directions as possible to score 1 point each. Use

Align with each bucket long enough to verify the

video or zoomed in images after the trial to score

yourself, although scores may differ from live trials.

MARIONAL reguntrols.

OS).

or BVLOS

TEST OR

SCENARIO



LEVEL 4

PAYLO/

detailed features on the top and all sides. The drone flies at altitude 1/2(S) all around each omni bucket stand to align with the designated buckets. Inspection tasks start on top then rotate around the objects in alternating clockwise and counter clockwise directions. Accurate landings are not included.

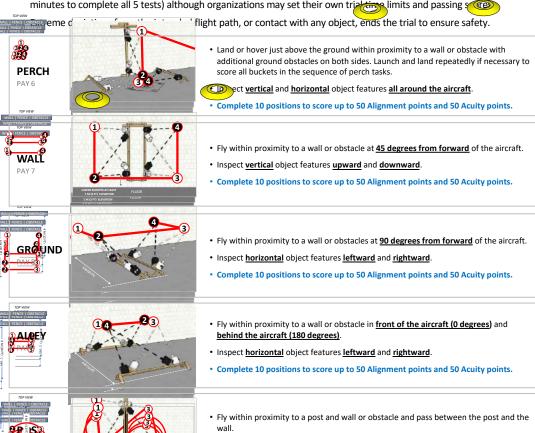
RECON (MAN/PAY 5)

Evaluate drones flying straight and level down range to establish stable hovers over objects in open space to perform reconnaissance tasks. The drone flies at altitude (S) at a sustainable speed directly over the lane centerline to align with designated buckets and the landing at each end of the lane. The down range reconnaissance tasks include looking straight down on the objects in different orientations and at an angle. A complete trial covers a total distance of 80(S) with moving (non-stop) alignments over the angled buckets along the centerline helping to identify deviations from the intended path and encourage consistency.



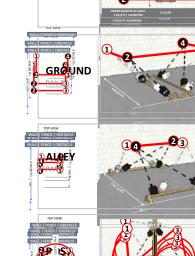
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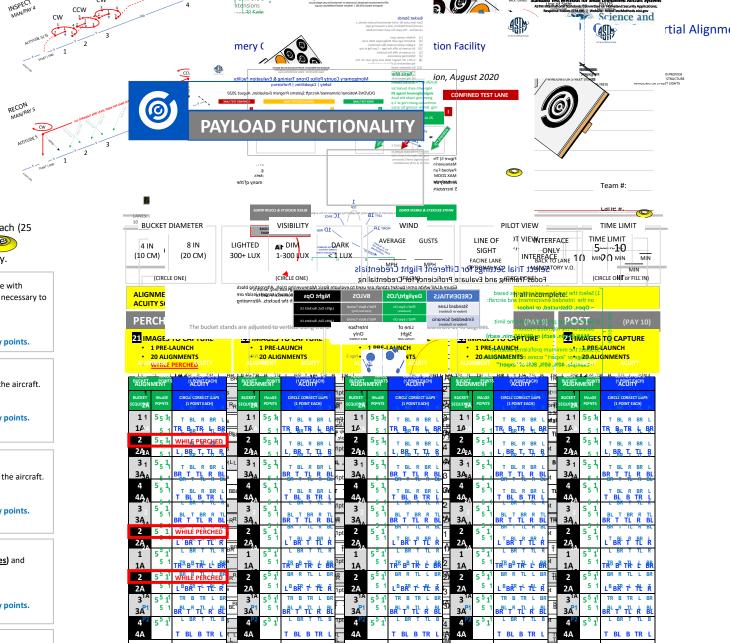
- Score ALIGNMENT POINTS the trial: UNBROKEN RING
- Score ACUITY POINTS by calling out the 5 increasingly small VISUAL ACUITY TARGET GAPS (1 pt each).
- Start timer at launch and end after the last task is completed. Trial time limits are typically 5 minutes each (25 minutes to complete all 5 tests) although organizations may set their own trial times limits and passing s



· Inspect vertical object features upward and downward all around the post.

Complete 10 positions to score up to 50 Alignment points and 50 Acuity points.





ELAPSED TIME (MM:SS)

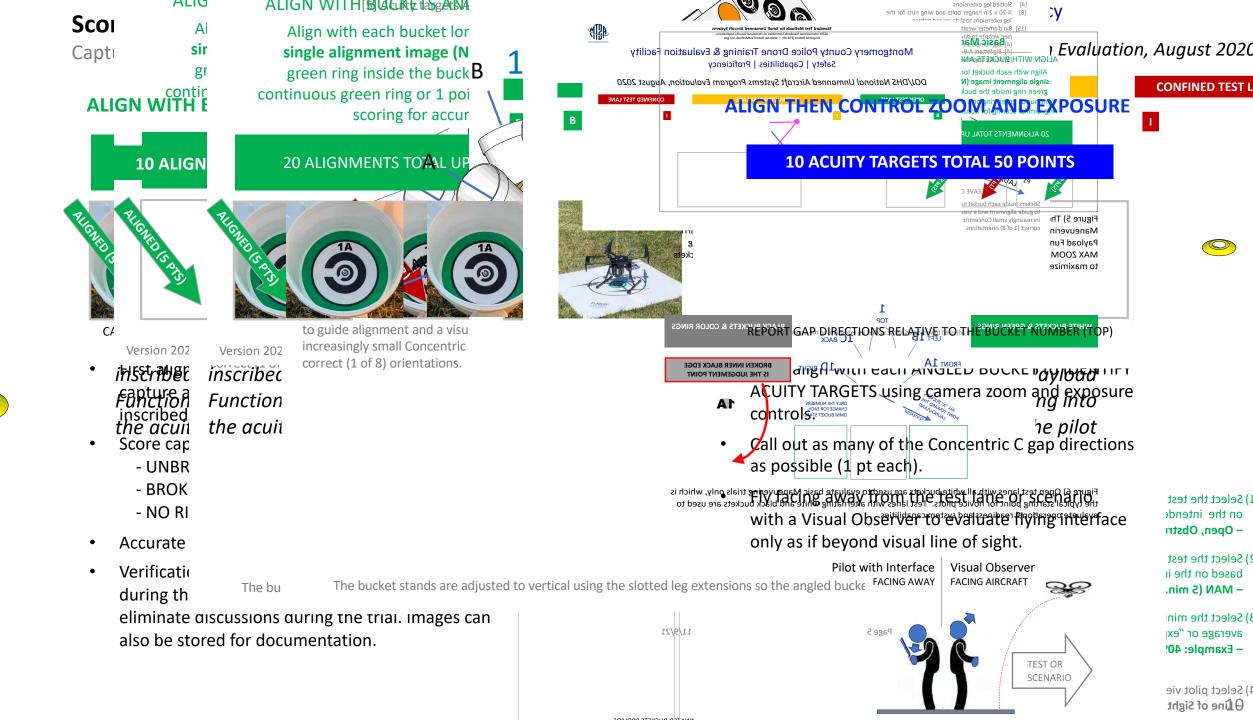
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ELAPSED TIME (MM : SS)

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s centered on the platform with the chassis or any ground **Test Methods for Evaluating Aerial Drones** ithin 0 chill and rainds chargonal institute of Standards and Technology Science and Safety Capabilities | Proficiency Technology RobotTestMethods.nist.gov (MAN/PAY 3) drones flying circular flight paths at different altitudes around hile looking inward to identify features on all four sides. The Select Trial Settings for Different Flight Credentials pits at altitude 2(S) in both directions then altitude (S) in both to align with the designated buckets. Each orbit starts with an Focus Training and Evaluate Proficiency for Credentialing ownward bucket alignment to check the radius before **CREDENTIALS** Daylight/LOS **BVLOS Night Ops** ng leftward and rightward. Accurate landings are not included. Lights Out. Buckets Lit CCW **Embedded Scenario T** (MAN/PAY 4) drones flying in closer proximity around objects to inspect eatures on the top and all sides. The drone flies at altitude around each omni bucket stand to align with the designated Science and nspection tasks start on top then rotate around the objects in g clockwise and counter clockwise directions. Accurate tion Facility mery (are not included. (MAN/PAY 5) ion, August 2020 drones flying straight and level down range to establish stable **CONFINED TEST LANE** er objects in open space to perform reconnaissance tasks. The 0 es at altitude (S) at a sustainable speed directly over the lane e to align with designated buckets and the landing at each end PAYLOAD FUNCTIONALITY ine. The down range reconnaissance tasks include looking own on the objects in different orientations and at an angle. A trial covers a total distance of 80(S) with moving (non-stop) ts over the angled buckets along the centerline helping to MAX ZOOM eviations from the intended path and encourage consistency. Team #: **BUCKET DIAMETER** TIME LIMI 1D RIGH Wind TIME LIMIT AVERAGE GUSTS LINE OF LIGHTED DARK 4 IN 8 IN 5----10 (20 CM) 300+ LUX 1-300 UX <1LUX (10 CM) MIN O CNIM FACINE LANE O.V YNOTS EVERY Trial SEVERY BY BY TO Iffer ENT Flight Credentials (CIRCLE ONE) (CIRCLE ONE) Fod@9774919 and Evaluate Proficienc/VIF6P7Credentialing (CIRCLE ONE or FILL IN Pilot view alæcwity สอบดูอประจารide are Night Ops Daylight/LOS **CREDENTIALS** Standard Lane MAN perfor partial atignments (1 pt), or "X The bucket stands are adjusted to vert Line of Time limit Sight Allev 6, Perch 77 (X/a) **ALIGNMENT** ALIGNMENT





ONLY FOR SCORING Science and TRIALS ON DAY 3. Technology DECLARE EACH CONCENTRIC C FOR YOUR PROCTOR TO SCORE DURING

NIST OF LAND REPORT APPRICATIONS RELATIVE CONTRACTIONS RELATIVE CO iteland ' Jocuses on Payloaa

Hude (S) the lug mout starting over the color lity Trials

Capture a single image inside each bucket and the

Brief reminders and the trial.

Accurate landings are not included in this test.

A complete trial totals a distance of 80(S)

bucket alignments to score up to 100 alignment points.

Payload Functionality Trials (PAY): Same as Basic

Maneuvering (MAN) then ident

ilot with Interface | Visual Observer extensions so the angled buck Verify your score afte the trial using captured video, although scores

as if

ach).

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21 IMAGES TO CAPTURE

USE INTERFACE

THE TRIAL

raw a line through all incomplete.

ng into ment by zooming into

targets, all features. The pilot

ALLEY

1 PRE-LAUNCH

20 ALIGNMENTS

21 IMAGES TO CAPTURE

POST

1 PRE-LAUNCH

(PAY 10)

20 ALIGNMENTS

White and black bucket shading spossible to score up

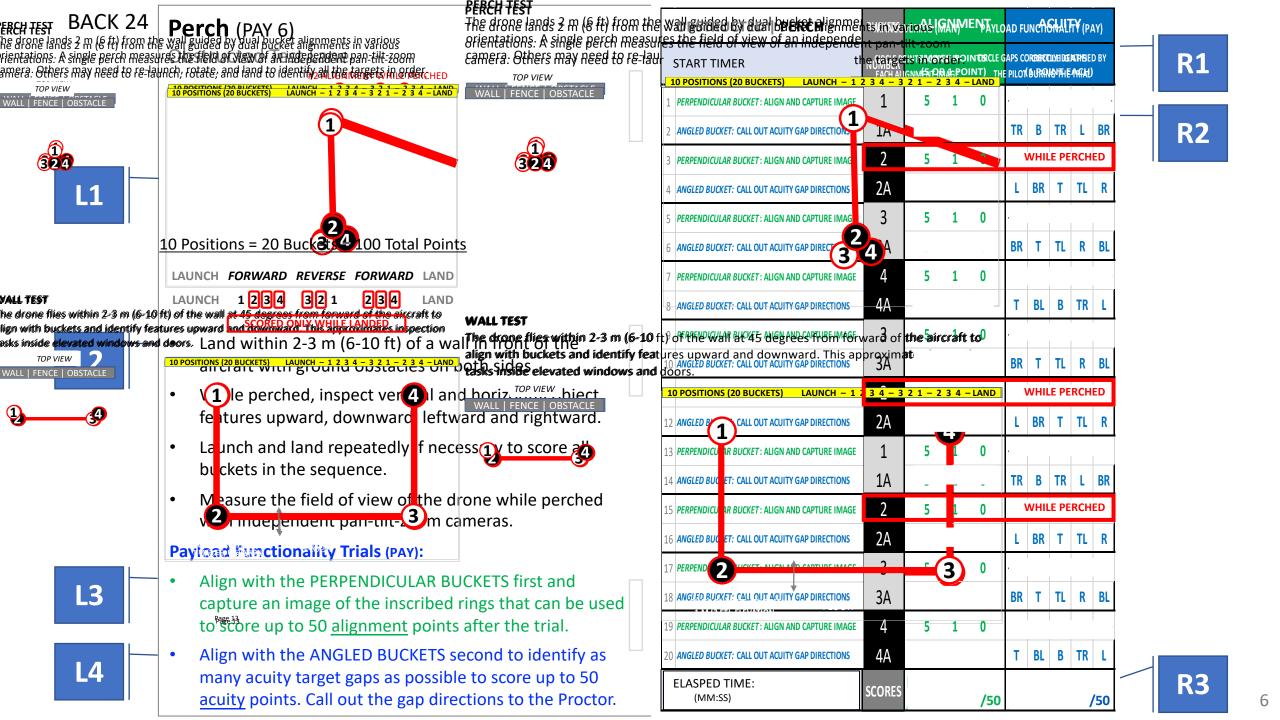
SCORE WHILE PERCHED.

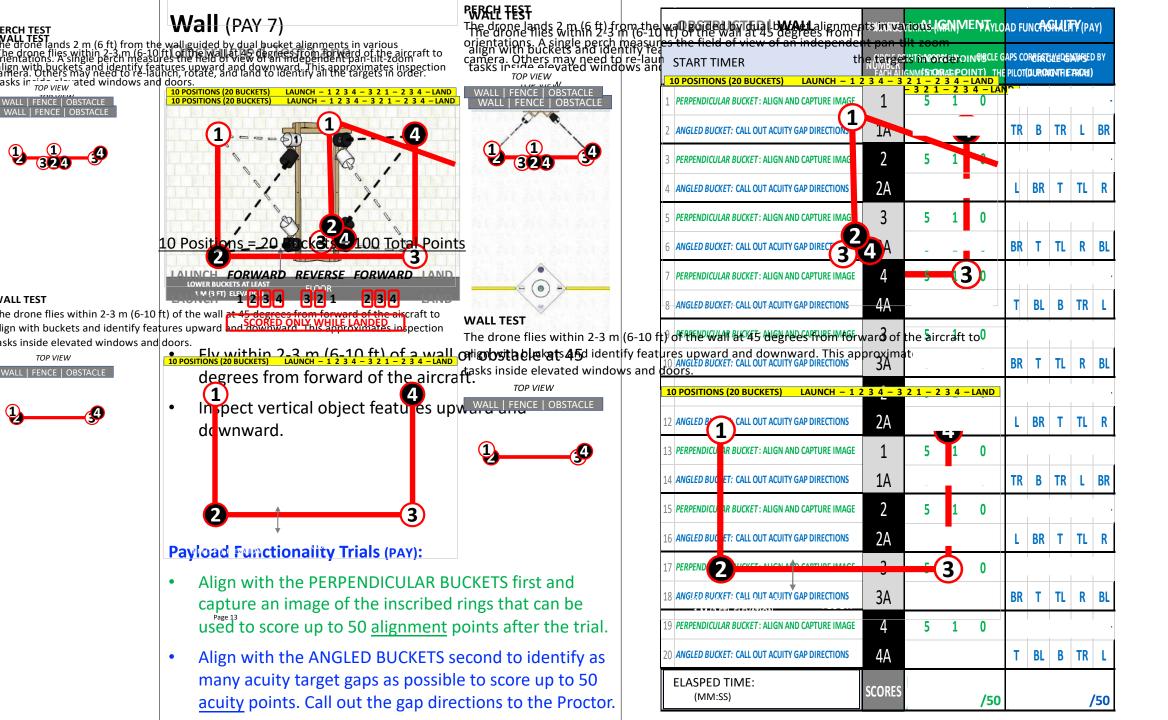
Circle alignment points when declared by the pilot with verification of images during or after the trial.

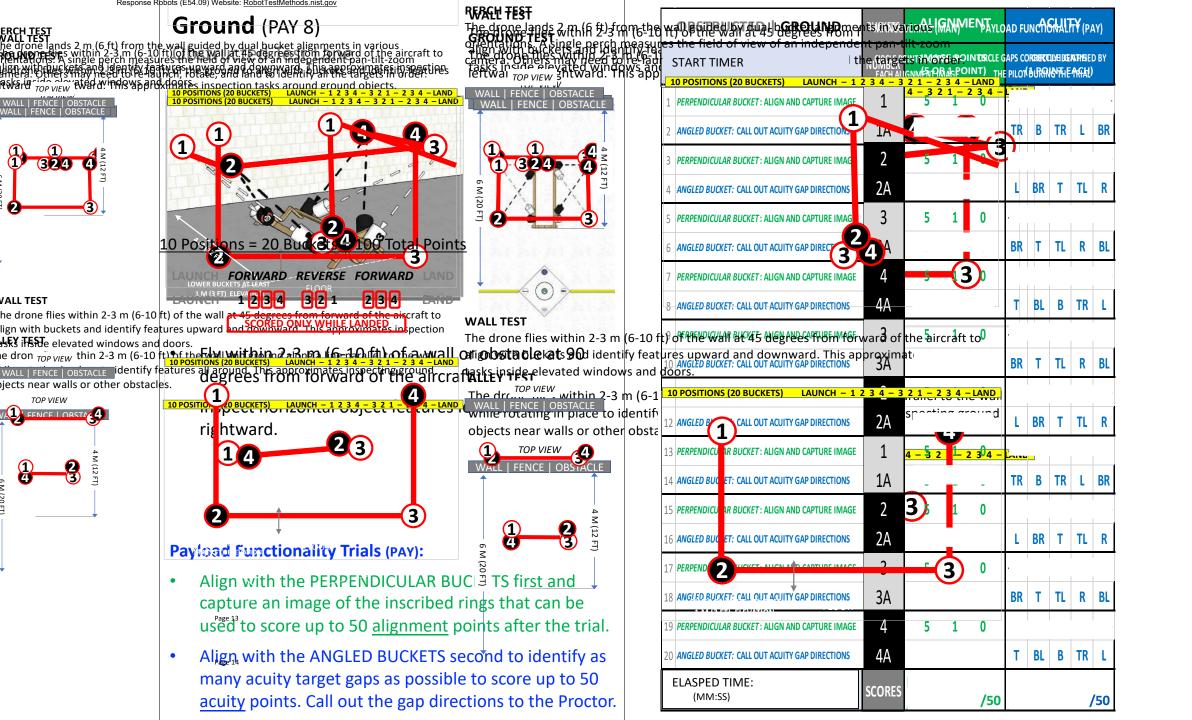
Separate totals for ALIGNMENT and ACUITY points (50 points each).

Any organization can select their own passing score.

o tlo	ALIGI	IMENT	ACUITY		ALIGNI	MENT	ACUITY		ALIGNI	MENT		ACUIT	Y	/	ALIGN	MENT		ACU	ITY	ALIG	NMENT	ACUITY
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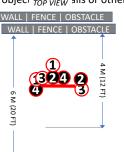




ERCH TEST

Alley (PAY 9)

h<mark>e ldFynEFan</mark>ds 2 m (6 ft) from the wall guided by dual bucket alignments in various rTencefrone.flesingtbiperch mહિલ્હીય દેશ કોર્ન માના પ્રાથમિક ઉપયોગ સિક્ક ના પ્રાથમિક ભાગાના કોર્માણી દેશ કોર્ય awhila rotating in ayacecto idaetifulfaat,uresadl, axaunda Thio amaraxinaatas in Sagetin assouch object TOP VIEW alls or other obstacles.



WALL | FENCE | OBSTACLE WALL | FENCE | OBSTACLE 10 Positions = 20 Buckets 4 100 Total Points FORWARD REVERSE FORWARD

VALL TEST

he drone flies within 2-3 m (6-10 ft) of the wall

lign with buckets and identify features up property with 1223 This confidentify of period asks inside elevated windows and doors.

WALL | FENCE | OBSTACLE

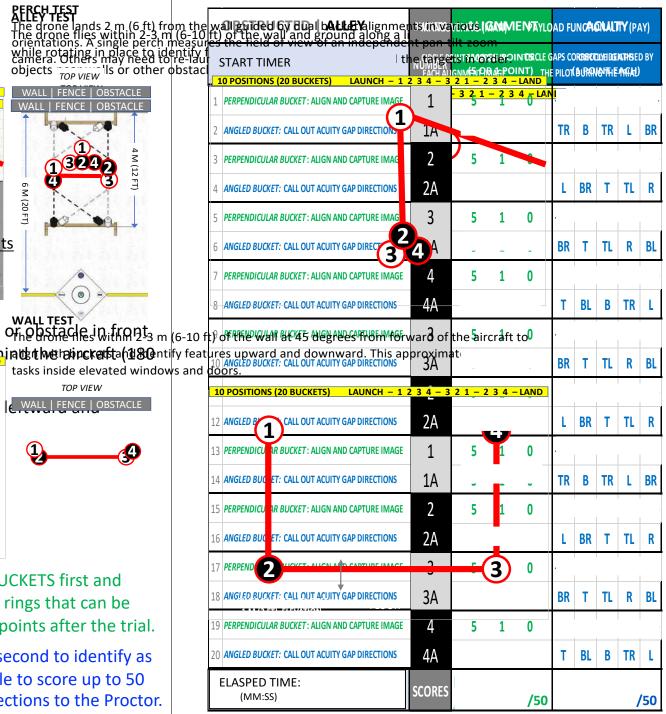


Of the aircraft (O degrees) and hehialbut wetheincketsta (1880 ntify features upward and downward. This approximate 10 positions (20 Buckets) Launch - 1 2 3 4 - 3 2 1 - 2 3 4 - LAND tasks inside elevated windows and doors. degrees). TOP VIEW

In pect horizontal object features | WALL | FENCE | OBSTACLE rightward.

Payload Functionality Trials (PAY):

- Align with the PERPENDICULAR BUCKETS first and capture an image of the inscribed rings that can be used to score up to 50 alignment points after the trial.
- Align with the ANGLED BUCKETS second to identify as many acuity target gaps as possible to score up to 50 acuity points. Call out the gap directions to the Proctor.



POST CHISTEST **Post** (PAY 10) The artife of the property of ERCH TEST POST TEST the drone lands 2 m (6 ft) from the wall guided by dual bucket alignments in various rientations. As single per a measures the new or a different elevations the research objects ations of airple which are as Hiles the field of view of an independent objects upward and downward. This approved the rest to leave the rest of the rest and the rest walls or other rest and need to re-launch, potate, and land to leentry and the targets in older. other postal ers may need to re-laur START TIMER TOP VIEW WALL | FENCE | OBSTACLE TR B TR L BR INGLED BUCKET: CALL OUT ACUITY GAP DIRECTIONS 324 PERPENDICULAR BUCKET: ALIGN AND CAPTURE IM L BR T TL R ANGLED BUCKET: CALL OUT ACUITY GAP DIRECTION PERPENDICULAR BUCKET: ALIGN AND CAPTURE IM 1 10 Positions = 20 Buckets 4 100 Total Points BR T TL R BL T-FORWARD REVERSE FORWARD 1 LAND VALL TEST T BL B TR L he drone flies within 2-3 m (6-10 ft) of the w **WALL TEST** lign with buckets and identify features upward and rownward. This approximates in pection The drone flies within 2-3 m (6-10 ft) of the wall at 45 degrees first who was a second and downward. This approximates in section design Top VIEW that at are performed in a second of the large transfer of the aircraft to the second of the BR T TL R BL . The sequence incures forme packtracking tasks inside elevated windows and doors conducted in forward then reverse then forw. 1 der. The sequence is 1234-321-21 typed underlined numbers indicating the back acking parties requested. Procedure TOP VIEW ocedure is the san Upy Walle FENCE | OBSTACLE Conformed Conformation of the san designation of LAUNCH - 1 2 3 4 - 3 2 1 - 2 3 4 - LAND alionments with L BR T TL R Maneuvering Trials: A complete trial totals up 1 990 between it he post and the wall 4 m busketalignments. The sequ Points are scored using a single no zoom image of each bucket showing either a full alignmen ring (5 performed in various directions relat of positions is 0 3 2 1 – 2 3 4 with points), a partial alignment ring (1 point), or no lignment ring (0 point). condiced in forward en reverse the the red underlined numbers indicatir ANGLED BUG TR B TR L BR Payload Functionality Trials: Perpendicular buctets are scored for alignments (up to 5 points each). Angled buckets are scored for acuity points (up 🔥 5 points each). Payload Functionality trials 🕍 dd an Maneuvering Trials: A complete trial ket **5**lig<mark>li</mark>ment**8**. operational workload to identify acuity target plus visual/thermal detail the system can discense sults in the total score. Each acuity target as 5 Points are scored using a single no zo increasingly small gap orientations to identify correctly. The smallest features are 1 mm (0.04 in) L BR T TL R points), a partial alignment ring (1 po needed to read small text on shipping labels (SCHX): Fight identifiable gap orientation is): to 5 3 s each Align with the PERPENDICULAR BUCKETS and Angled buckets are scored for acuity 3A an BR T TL R BL capture an image of the inscribed of the thorn of the identify acuitant of the identification of the ide used to score up to 50 alignment plus in issuel/the mial detail the system cuity target has 5 1 mm (0 0/1 in) increasingly small gap orientations to T BL B TR L Align with the ANGLED BUCKETS seeded dote ad small fexton shipping many acuity target gaps as possible to score up to 50 **ELASPED TIME: SCORES** (MM:SS) /50 /50

acuity points. Call out the gap directions to the Proctor.



or Evaluating Aerial Drones Safety [Capabilities | Proficiency RobotTestMethods.nis.gov 4th SHIFT (15-20 minutes) **ALL ARE OFF**



Teams Rotate Through Each Role

Each Pilot flies a 5-minute trial with help from othe A 3-4 person team completes all 5 tests in 2 hours.

TEAM ROTATIONS





Four person teams always have one person getting their aircraft ready to launch right after the previous lands.

Three person teams work too, but require some time between each rotation to prepare the next after which produced distances and marks

- Maintain control of the aircraft.
- Call out each intention of movement before doing so
- Call out each bucket alignment and acuity target gap.

PROCTOR

- Fill in the form header.
- Read the test procedures to the Pilot.
- Confirm, record, and attest to scoring after the trial.

VISUÄL OBSERVER (VO)

- Maintain sight with the aircraft and surroundings.
- Repeat the Pilot's intention of movement to confirm.
- Call out corrections and warnings as necessary.





PILOTS





BENEFIT AND ATOMS all 5 tests in 2 hours. **PILOT PROCTOR** CING AWAY FROM .

Person 2 Person 3

Person 3 Person 1 Person 2

3rd SHIFT (10-15 minute Person 2 Person 3

4th SHIFT (15-20 minutes ALL ARE OFF

WITH EVERY bucket in the sequence

and land accurately according to the procedure. The Four person teams always have one person getting their object ixea is searing ALL points possible for your air grafts. withoutenaking mistakes work too, but require some time between each rotation to prepare the next aircraft.

Score! For complete trials, track your scores over time.

Maintain control of the aircraft.

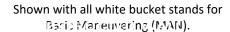
The average of your last five trials is an excellent measure call out each intention of movement before doing so. of your proficiency on the aircraft and interface used gap.

PROCTOR

Efficiency: (Optional): Faccomplete trials with maximum identify the most efficient systems and techniques. Time al. limited trais can be used across multiple tests to maintain Maintain sight with the aircraft and surroundings. a schedule and similarly satisfied novices and emerits confirm.

Call out corrections and warnings as necessary.





CENTERLINE



Trave

Orbit

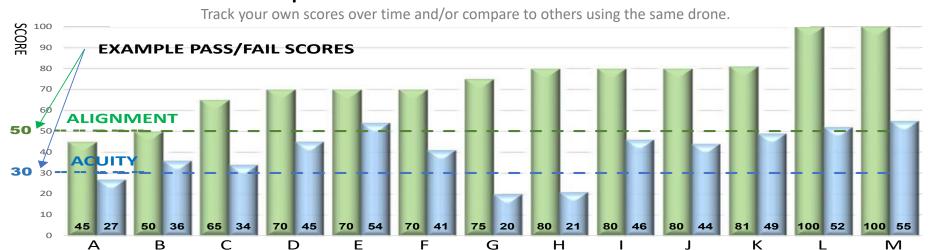
Spiral

20

S altitude

Alternating black and white buckets stands for Payload Functionality (PAY).

Separate Scores for ALIGNMENT and ACUITY



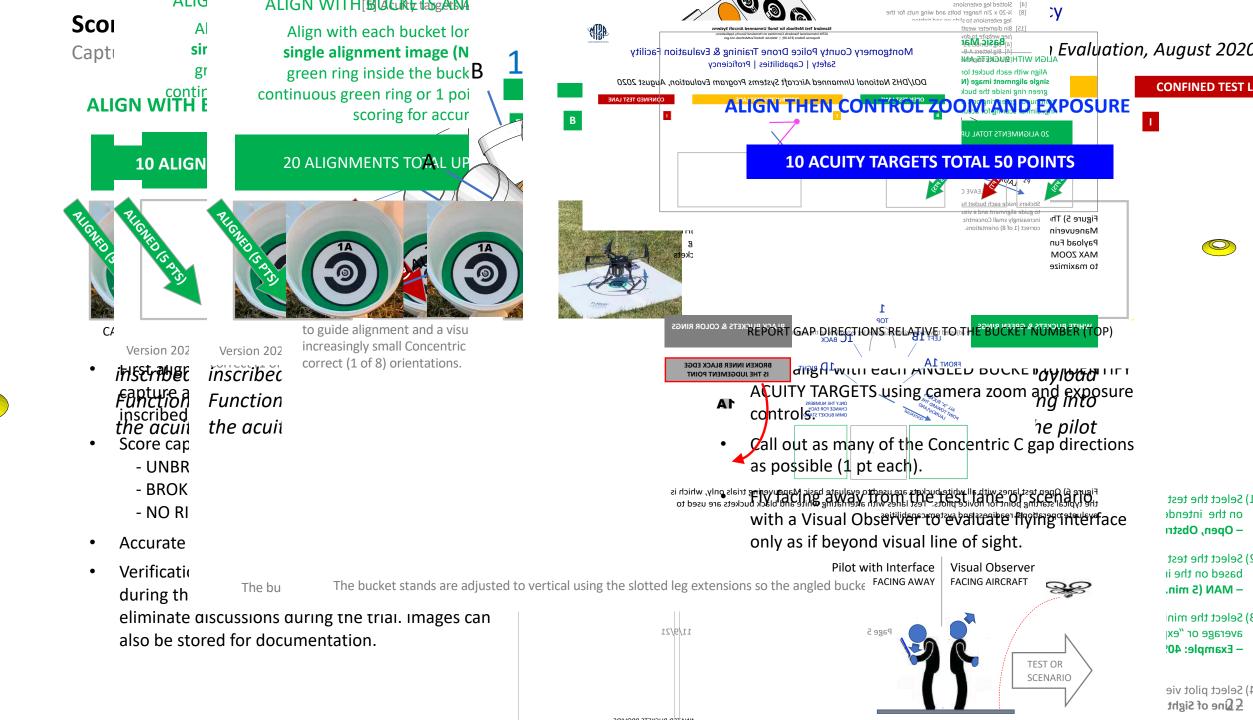


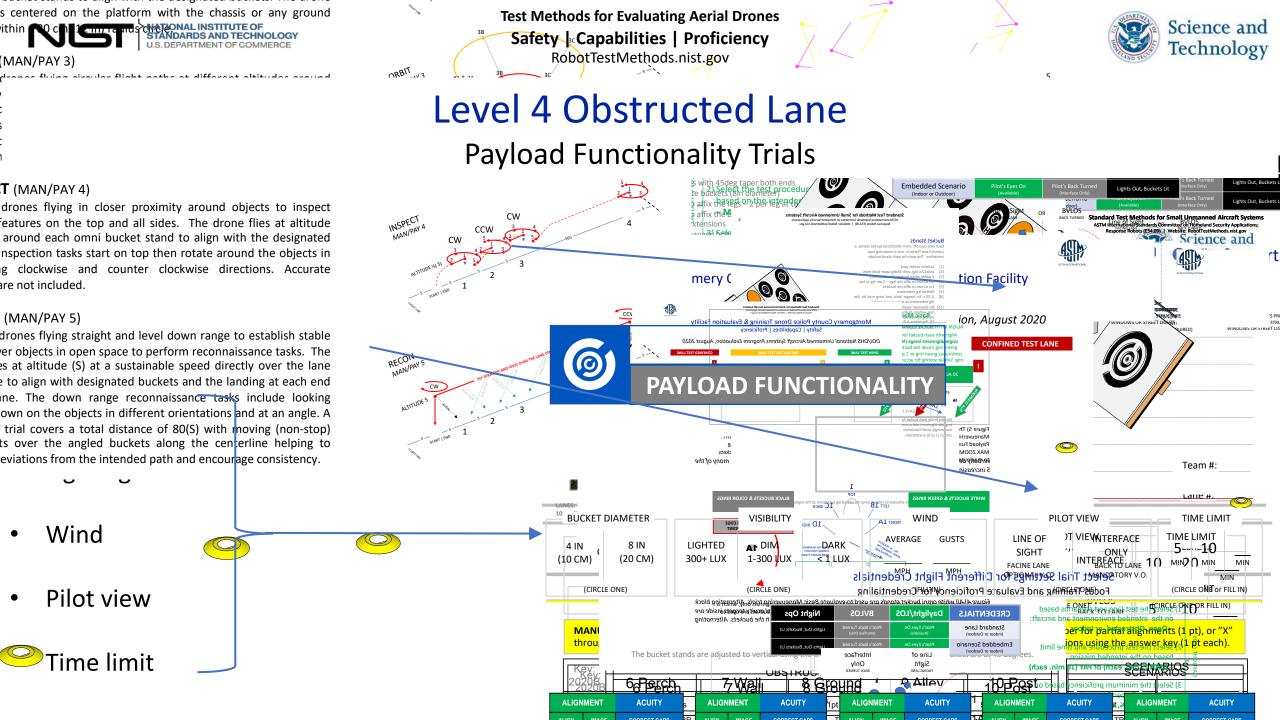
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Level 4 Obstructed Lane Proctoring









ONLY FOR SCORING TRIALS ON DAY 3. DECLARE EACH CONCENTRIC C FOR YOUR PROCTOR TO



NIST OF LAND REPORT APPRICATIONS RELATIVE CONTRACTIONS RELATIVE CO iteland ' Jocuses on Payloaa

Hude (S) the lug mout starting over the color lity Trials

Capture a single image inside each bucket and the

Brief reminders and the trial.

Accurate landings are not included in this test.

A complete trial totals a distance of 80(S)

bucket alignments to score up to 100 alignment points.

Payload Functionality Trials (PAY): Same as Basic

Maneuvering (MAN) then ident

ilot with Interface | Visual Observer extensions so the angled buck Verify your score afte the trial using captured video, although scores

ach).

(with a as if

> 21 IMAGES TO CAPTURE 1 PRE-LAUNCH 20 ALIGNMENTS

raw a line through all incomplete.

USE INTERFACE

SCORE DURING

THE TRIAL

ng into ment by zooming into

targets, all features. The pilot

ALLEY

POST (PAY 10)

21 IMAGES TO CAPTURE 1 PRE-LAUNCH

20 ALIGNMENTS

White and black bucket shading spossible to score up

SCORE WHILE PERCHED.

Circle alignment points when declared by the pilot with verification of images during or after the trial.

Separate totals for ALIGNMENT and ACUITY points (50 points each).

Any organization can select their own passing score.

o tlo	ALIGI	IMENT	ACUITY		ALIGNI	MENT	ACUITY		ALIGNI	MENT		ACUIT	Y	/	ALIGN	MENT		ACU	ITY	ALIG	NMENT	ACUITY
	BUCKET	IMAGE POINTS	CIRCLE CORRECT GAPS (1 POINT EACH)	7	BUCKET SEQUENCE	IMAGE POINTS	CIRCLE CORRECT GAPS (1 POINT EACH)		BUCKET SEQUENCE	IMAGE POINTS		CIRCLE CORREC			BUCKET SEQUENCE	IMAGE POINTS	d	RCLE CORF		BUCKET SEQUENC	IMAGE POINTS	CIRCLE CORRECT GAPS (1 POINT EACH)
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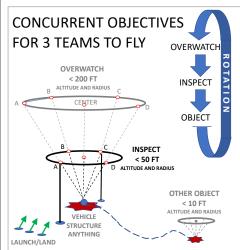
Level 4 Obstructed Scenarios

Obstructed Vehicle Inspection Scenarios

Day and Night Trials

USE SETS OF 5 "INLINE" DUAL BUCKET RAILS

DISTRIBUTED THROUGHOUT THE SCENARIO













Obstructed Search Scenarios

Day and Night Trials

START TIMER (CAPTURE CLOC

PERPENDICULAR BUCKET

ANGLED BUCKET: CALL OL

ANGLED BUCKET: CALL OL

PERPENDICULAR BUCKET

10 ANGLED BUCKET: CALL OL

11 PERPENDICULAR BUCKET

2 ANGLED BUCKET: CALL OL

13 PERPENDICULAR BUCKET

4 ANGLED BUCKET: CALL OU

5 PERPENDICULAR BUCKET

16 ANGLED BUCKET: CALL OU

17 PERPENDICULAR BUCKET:

18 ANGLED BUCKET: CALL OU

19 PERPENDICULAR BUCKET

20 ANGLED BUCKET: CALL OU

STOP TIMER (CAPTURE CLOCK

USE SETS OF 5 "OFFSET" DUAL BUCKET RAILS

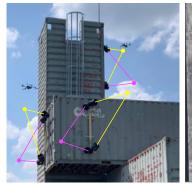
HORIZONTALS DISTRIBUTED WITH OBJECTS OF INTEREST







VERTICALS IN ELEVATED WINDOWS AND ON STRUCTURES







- Teams concurrently fly separate objectives set up at safe distances and/or altitudes apart (with a clearly designated and safe return path).
- Each pilot flies for 15 minutes across 3 different objectives for 5 minutes each. Teams move as necessary to maintain sight lines and communication.
- Scenarios restart with a different rotation of Pilot, Proctor, and VO.

START TIMER (CAPTO

1 PERPENDICULAR

2 ANGLED BUCKET

PERPENDICULAR

4 ANGLED BUCKET

5 **PERPENDICULAR**

6 ANGLED BUCKET

7 PERPENDICULAR

8 ANGLED BUCKET

9 **PERPENDICULAR**

ANGLED BUCKET

PERPENDICULAR

12 ANGLED BUCKET

13 PERPENDICULAR

L4 ANGLED BUCKET

15 PERPENDICULAR

L6 ANGLED BUCKET

17 PERPENDICULAR

18 ANGLED BUCKET

19 PERPENDICULAR

ANGLED BUCKET

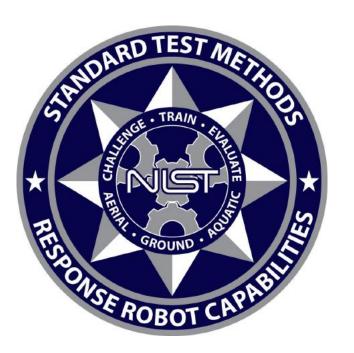
STOP TIMER (CAPTU



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Robot Test Methods. nist. gov





Level 1-4 Quiz Review

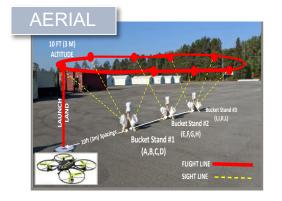
Standards Enable Credentialing of Proctors and Remote Pilots

Safety | Capabilities | Proffice are extended to accommodate the orbit radius of forward flying systems.

NIST Develops and Validates Test Methods

- Apparatus that can be reproducible by others.
- **Procedures** that are repeatable to conduct test trials.
- **Performance Metrics** that are quantitative and can be compared over time, across locations and internationally
- Evaluate Systems using expert pilots conducting complete trials
- *Operator proficiency* is compared with similar systems on the same lane spacing in similar environmental conditions with either complete or time limited trials

Compare time limited trials that are incomplete by total surfaces ensure the top bucket is points for similar elapsed times or calculate and compare the scoring rate as points per minute for different elapsed times







These test methods are primarily intended for vertical takeoff and landing systems with an

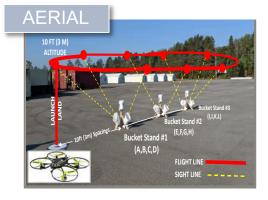
Standards Enable Credentialing of Proctors and Remote Pilots

Safety | Capabilities | Profice per extended to accommodate the orbit radius of forward flying systems.

When conducting evaluations with these Test Methods the results should only be compared to similar environmental conditions.

Night or dark trials can be conducted with white or red headlamps illuminating the white buckets or only using the lights and sensors onboard the drone.

Bucket stands on a level surfaces ensure the top bucket is vertical and the angled buckets are 45 degrees.







These test methods are primarily intended for vertical takeoff and landing systems with an

vertical and the angled buckets are 45 degrees.

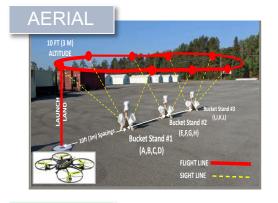
Standards Enable Credentialing of Proctors and Remote Pilots

Safety | Capabilities | Profice per extended to accommodate the orbit radius of forward flying systems.

When Credentialing operators an organization can;

- Set their own pass/fail scoring threshold
- Adopt a pass/fail scoring threshold set by a regional or national association with which the organization collaborates
- Adopt a pass/fail scoring threshold set by a similar organization

 Bucket stands on a level surfaces ensure the top bucket is







Choose Appropriate Lang Spacing Based on Optics and Safety

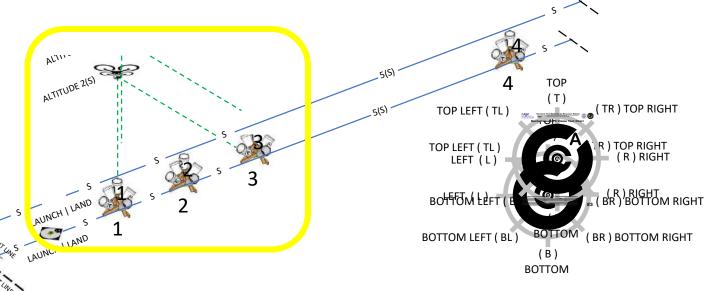
ASTM International Etandricks Gormaittee on Homeland Security Applications;
Response Robots (E54.09) | Website: RobotTestMethods.nist.gov

ALWAYS:

 Acuity from 2(S) so the targets must be visible

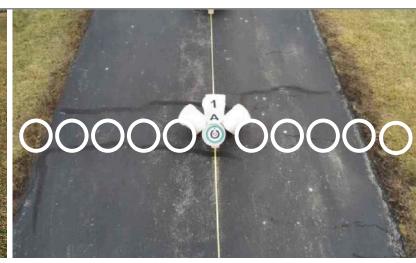
INDOORS:

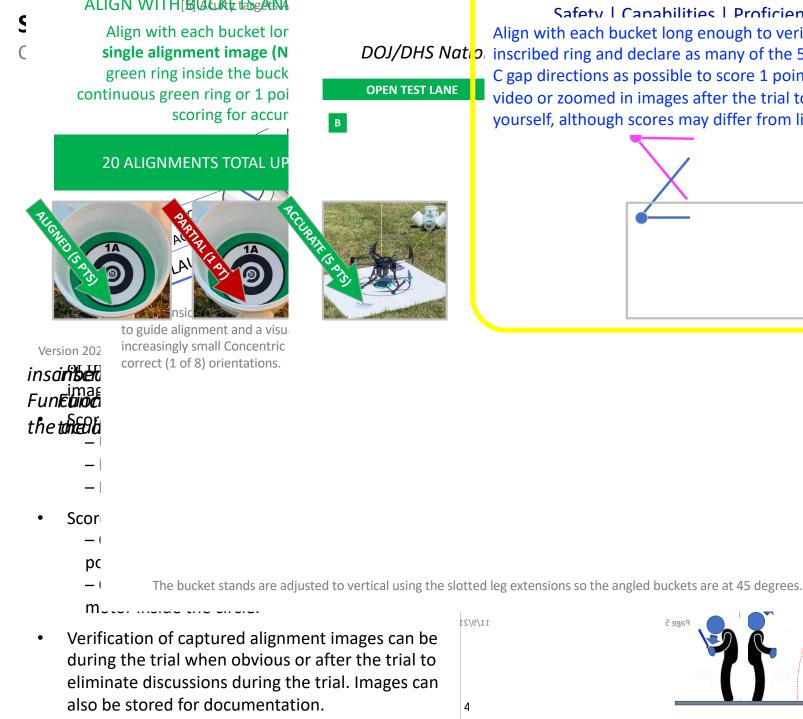
- Lane Length = 10(S)
- Lane Width = 6(S)
- Elevation = 2(S)PLUS SAFETY MARGIN





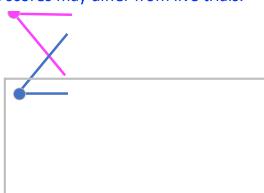






Safety | Canabilities | Proficiency

Align with each bucket long enough to verify the DOJ/DHS Nation inscribed ring and declare as many of the 5 Concentric C gap directions as possible to score 1 point each. Use video or zoomed in images after the trial to score yourself, although scores may differ from live trials.



August 2020

CONFINED TEST LANE

MARIORAN

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²roctor.

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OS).

38

TEST OR

SCENARIO

regcontrols.

ginterface

Select Trial Setti

Focus Training an

est lane and scenarios based nded environment and aircraft structed, or Indoor

est procedure and time limit e intended mission:

iin. each) or PAY (10 min. each

ninimum proficiency based on 'expert' scores in the same tria

40%, 60%, 80% of "expert"

11/9/21



LEVEL 4

PAYLO/

detailed features on the top and all sides. The drone flies at altitude 1/2(S) all around each omni bucket stand to align with the designated buckets. Inspection tasks start on top then rotate around the objects in alternating clockwise and counter clockwise directions. Accurate landings are not included.

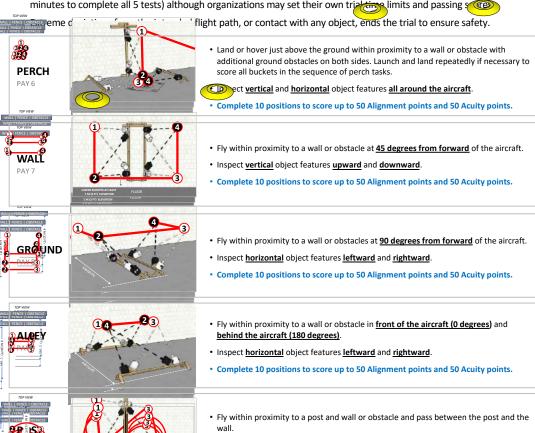
RECON (MAN/PAY 5)

Evaluate drones flying straight and level down range to establish stable hovers over objects in open space to perform reconnaissance tasks. The drone flies at altitude (S) at a sustainable speed directly over the lane centerline to align with designated buckets and the landing at each end of the lane. The down range reconnaissance tasks include looking straight down on the objects in different orientations and at an angle. A complete trial covers a total distance of 80(S) with moving (non-stop) alignments over the angled buckets along the centerline helping to identify deviations from the intended path and encourage consistency.



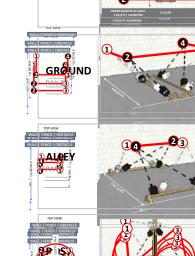
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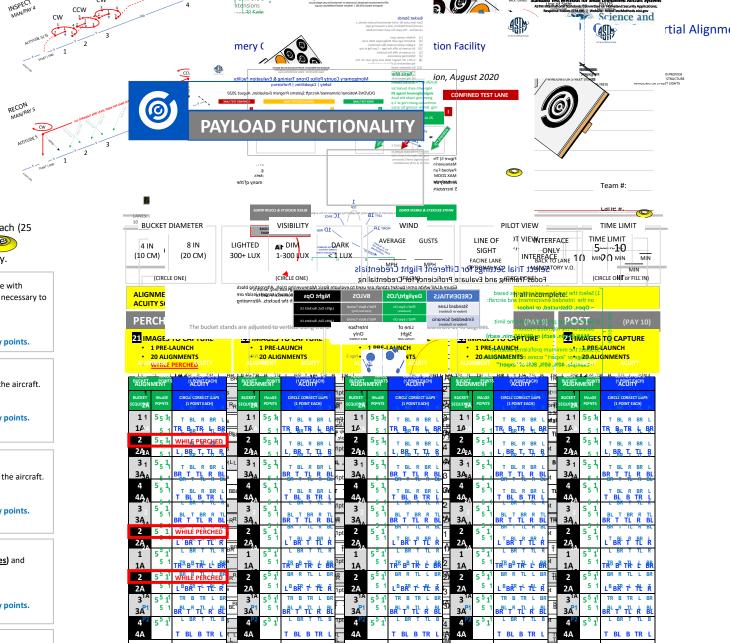
- Score ALIGNMENT POINTS the trial: UNBROKEN RING
- Score ACUITY POINTS by calling out the 5 increasingly small VISUAL ACUITY TARGET GAPS (1 pt each).
- Start timer at launch and end after the last task is completed. Trial time limits are typically 5 minutes each (25 minutes to complete all 5 tests) although organizations may set their own trial times limits and passing s



· Inspect vertical object features upward and downward all around the post.

Complete 10 positions to score up to 50 Alignment points and 50 Acuity points.





ELAPSED TIME (MM:SS)

on, alight the many buckstones possible

ELAPSED TIME (MM : SS)

Por Rice Profection La Trinity company Lucide Chronical Starterns

Helapsed

If pour training the particular of A in the control of A in the control of A in the control of t

