

Drone Tests and Scorable Scenarios for Evaluating System Capabilities and Remote Pilot Proficiency in Open, Obstructed, and Confined Environments (Levels 1-5)



Test Director

Adam Jacoff

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

Sponsor

Science and Technology Directorate
U.S. Department of Homeland Security

Website

RobotTestMethods.nist.gov


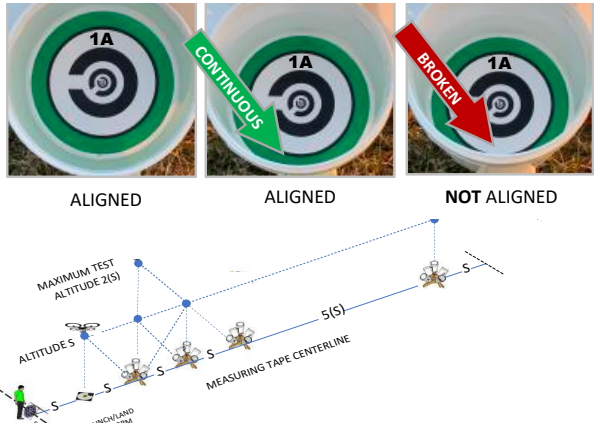

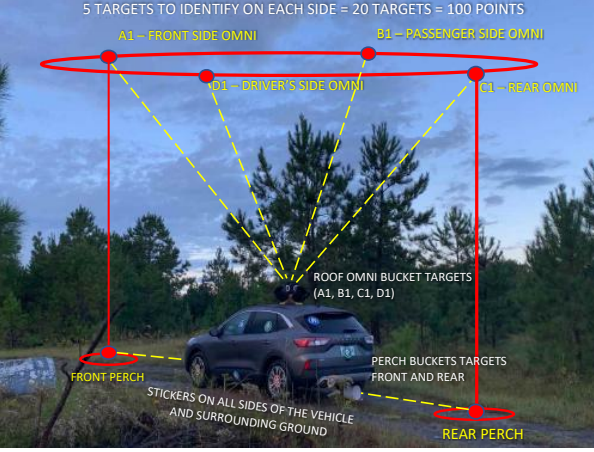

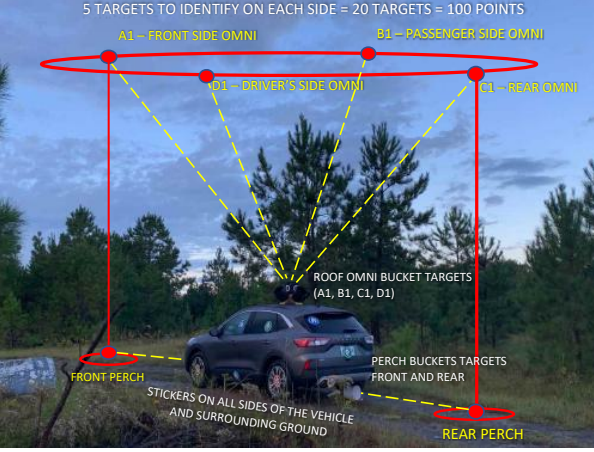

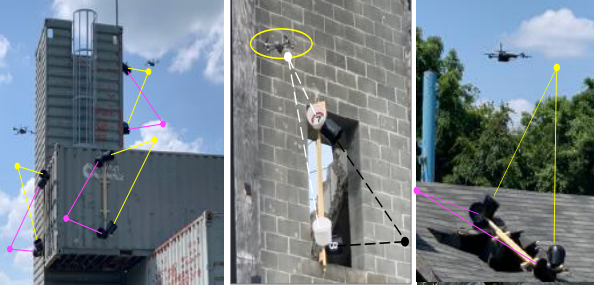




Email

RobotTestMethods@nist.gov



Levels of Proficiency For Different Missions



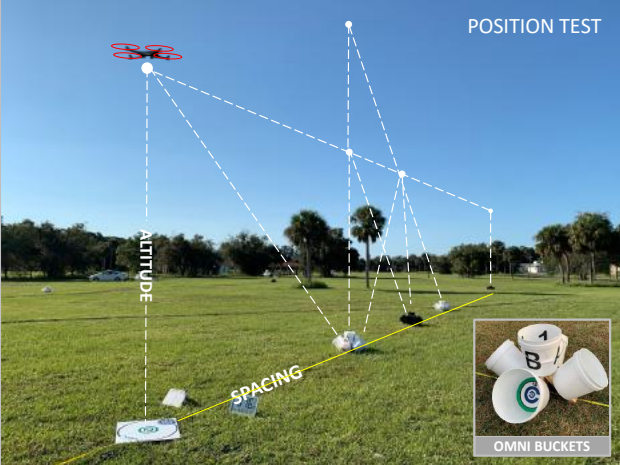
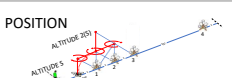
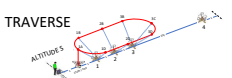
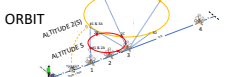
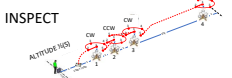
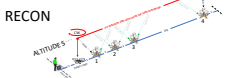




<p>LEVEL 1</p> 	<p>OPEN Test Lane Basic Proficiency/Safety Checkride Evaluate positive aircraft control in quick trials for novices and recreational pilots using the first 2 of 5 flight paths.</p> <ul style="list-style-type: none"> • 10 minutes (5 minutes each) • 40 Alignment Points 	
<p>LEVEL 2</p> 	<p>OPEN Test Lane Maneuvering Trials Evaluate open area maneuvering around ground objects using all 5 flight paths with no additional pilot workload.</p> <ul style="list-style-type: none"> • 25 minutes (5 minutes each) • 100 Alignment Points 	
<p>LEVEL 3</p> 	<p>OPEN Test Lane Payload Functionality Trials Evaluate open area maneuvering while controlling zoom and exposure to identify ground objects using all 5 flight paths.</p> <ul style="list-style-type: none"> • 25 minutes (5 minutes each) • 100 Alignment & 100 Acuity Points 	
<p>LEVEL 4</p> 	<p>OBSTRUCTED Test Lane Payload Functionality Trials Evaluate maneuvering in close proximity to objects while controlling zoom and exposure.</p> <ul style="list-style-type: none"> • 25 minutes (5 minutes each) • 50 Alignment & 50 Acuity Points 	
<p>LEVEL 5</p> 	<p>CONFINED Test Lane Payload Functionality Trials Evaluate maneuvering in tight spaces, dealing with the drone's own turbulent air, while controlling zoom and exposure.</p> <ul style="list-style-type: none"> • 25 minutes (5 minutes each) • 50 Alignment & 50 Acuity Points 	



INTRODUCTION

Users of aerial drones weighing less than 25 kg (55 lbs) at takeoff, also known as small unmanned aircraft systems (sUAS) or remotely piloted aircraft systems (RPAS), need ways to measure whether a particular drone can perform specific missions in unstructured, complex, and often hazardous environments. These missions require various combinations of elemental capabilities. Each capability can be represented as a test method with an associated apparatus and procedure enabling repeatable and reproducible measures of performance with objective results.

These test methods can be conducted individually or in operationally relevant sequences and combinations to evaluate drone capabilities and remote pilot proficiency. The results measure the reliability of the drone and remote pilot to perform the essential mission tasks. A series of complementary test lanes enable users to evaluate a wide spectrum of intended missions.

MEASURE & COMPARE		SCALABLE (ALTITUDE = SPACING)	5 FLIGHT PATHS
 SMALL DRONES	 LARGE DRONES		    
 INTERFACES	 PROCEDURES		
 SENSORS	 MANEUVERING		

The Open Test Lane uses designated altitudes, positions, and orientations in 5 different flight paths to evaluate Basic Maneuvering and Payload Functionality. All flights are conducted in open environments with no obstacles.

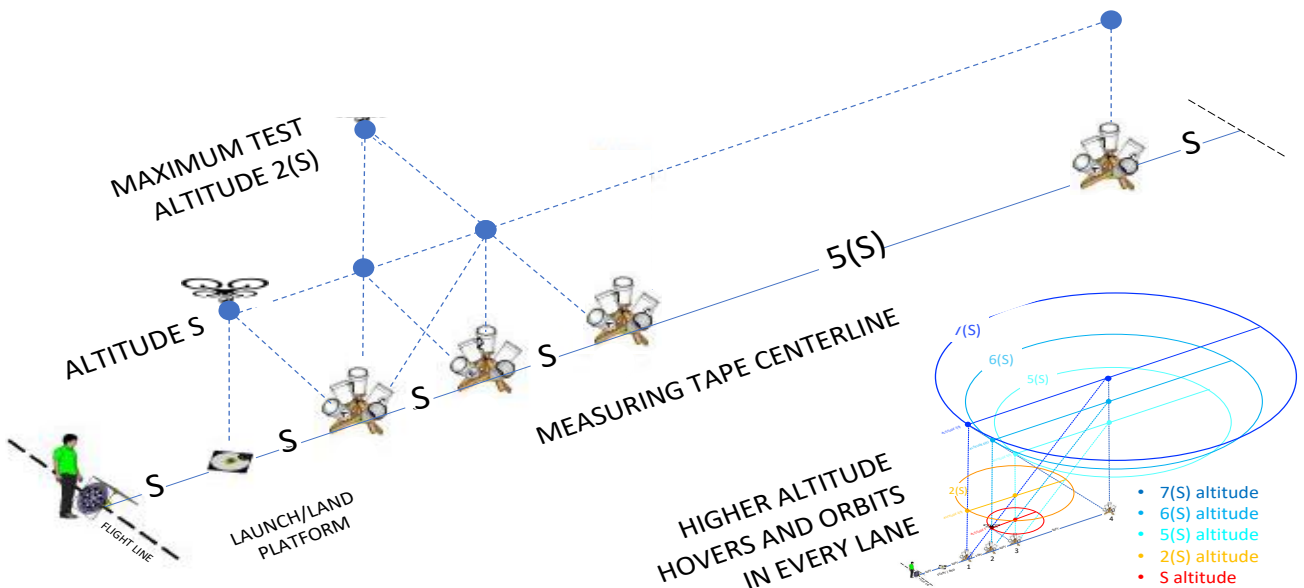
The National Institute of Standards and Technology developed these tests, with sponsorship from the U.S. Department of Homeland Security Science and Technology Directorate, to facilitate objective comparisons across different testing locations using drones of various sizes and capabilities within the designated weight class. These tests are being standardized through the ASTM International Standards Committee on Homeland Security Applications (E54.09)

These test are inexpensive, easy to fabricate, and simple to use so they can be replicated widely by organizations or individuals to measure their own drones and pilots. Resulting trial scores are comparable no matter where or when the testing occurs.



These tests support drone researchers, manufacturers, and other organizations in different ways. Researchers use these tests to understand mission requirements, encourage innovation, and demonstrate break-through capabilities. Manufacturers use these tests to evaluate design decisions, integrate emerging technologies, and harden systems. Various other organizations use these tests to guide purchasing, make deployment decisions, and measure remote pilot proficiency for credentialing. Examples include emergency response operations, critical infrastructure inspection, industrial and commercial applications, and even recreational pilots.

These tests can be used to objectively evaluate aerial drones with an onboard camera and remote pilot display that can be flown under 120 m (400 ft) altitude in open environments to identify objects on or near the ground. A remote pilot is in control of all drone functionality, although assistive features and autonomous behaviors may be used to improve effectiveness or efficiency.



OMNI STAND SPACING = S MAX TEST ALTITUDE = 2(S) LANE LENGTH = 10(S)

3 m (10 ft)	6 m (20 ft)	30 m (100 ft)
6 m (20 ft)	12 m (40 ft)	60 m (200 ft)
9 m (30 ft)	18 m (60 ft)	90 m (300 ft)

The Open Test Lanes are scalable to be used at various altitudes both indoors on a basketball court and outdoors on a football field or parking lot.

Test trials result in objective measures of drone capabilities and remote pilot proficiency that can be compared and tracked over time. Organizations using these test methods set their own level of acceptable performance to align with their air space, environment, and mission complexities. Organizations can also adopt pass/fail performance thresholds set by others within their user community.

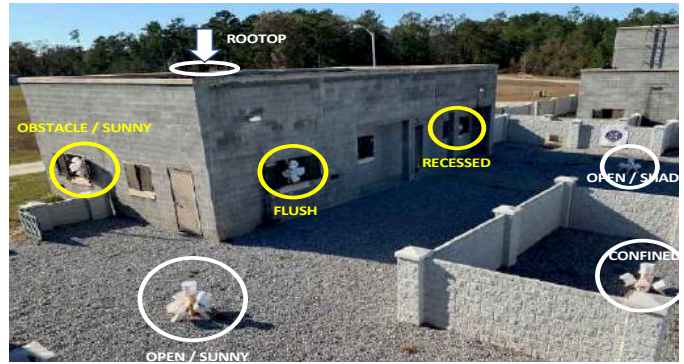


LEVEL 1-3 | OPEN LANES AND SCORABLE SCENARIOS

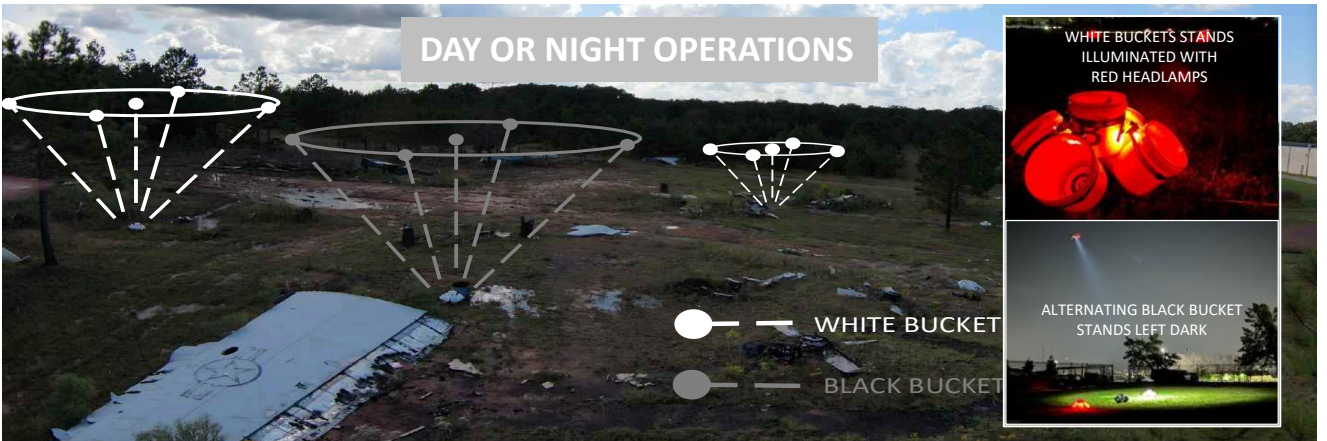
WIDE AREA SEARCH



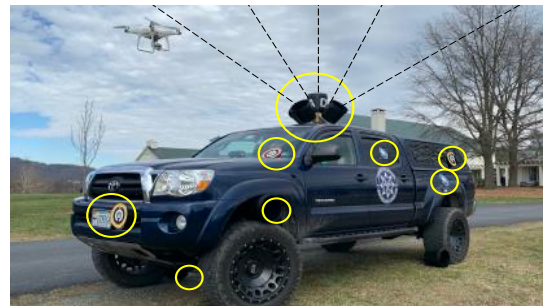
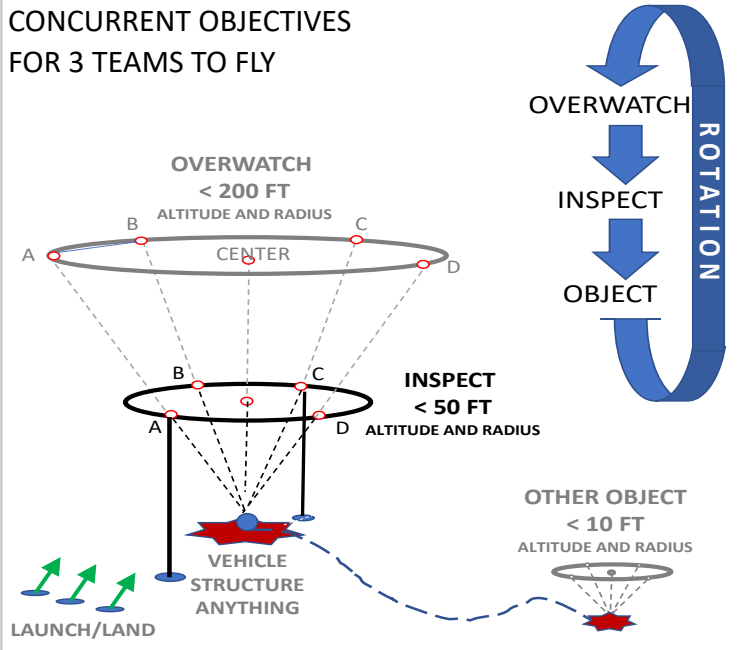
URBAN AREA SEARCH



DAY OR NIGHT OPERATIONS

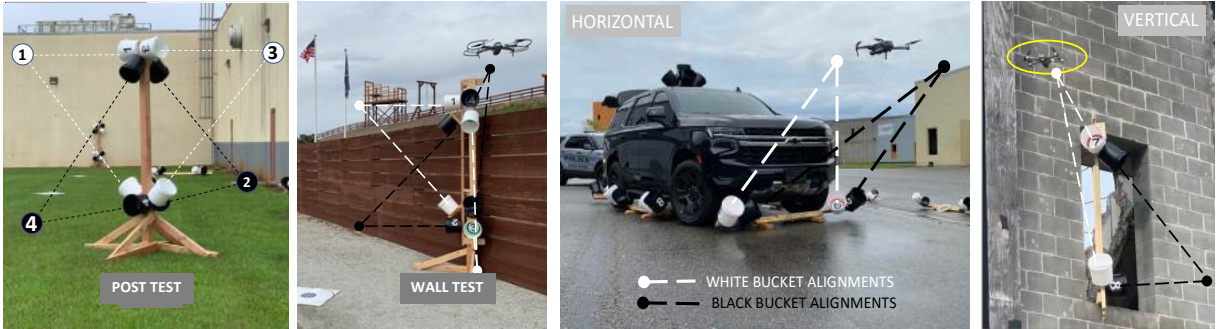


CONCURRENT OBJECTIVES FOR 3 TEAMS TO FLY





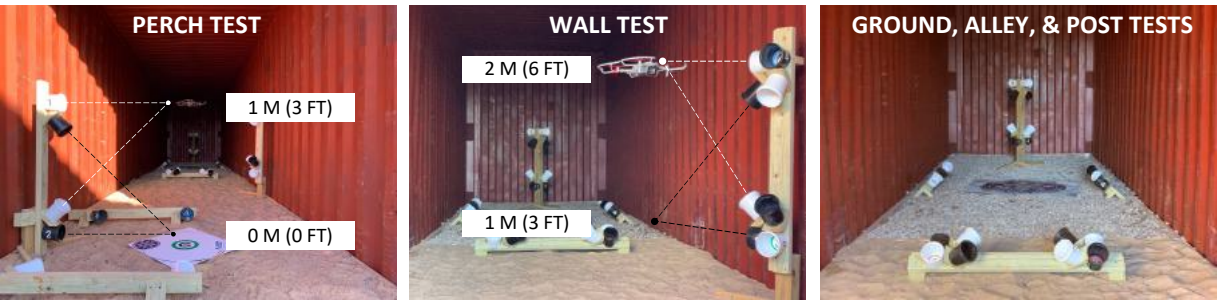
LEVEL 4 | OBSTRUCTED LANES AND SCORABLE SCENARIOS



Dual Bucket Alignments Guide Remote Pilots to Safe Positions in Proximity to Objects



LEVEL 5 | CONFINED LANES AND SCORABLE SCENARIOS





Levels 1-2: Maneuvering Only

ALIGN WITH BUCKETS AND LAND ACCURATELY



PURPOSE

- For novice and recreational remote pilots to demonstrate positive aircraft control.
- Use ALL WHITE BUCKETS to emphasize precise maneuvering skills while focusing on the flight paths and alignments.

PROCEDURE

- Align with each bucket and pause long enough to capture a SINGLE NO-ZOOM IMAGE showing the entire alignment ring. Only the first image is scored.
- Score ALIGNMENT POINTS using the CAPTURED ALIGNMENT IMAGES after the trial to eliminate discussions during the trial:
 - UNBROKEN RING (5 points)
 - BROKEN RING (1 point)
 - NO RING (0 points)
- Score ALIGNMENT POINTS for ACCURATE LANDINGS during the trial:
 - CENTERED (5 points) with the aircraft center inside the designated 60 cm (24 inch) diameter circle.
 - OFFSET (1 point) with at least one propeller motor inside the circle.

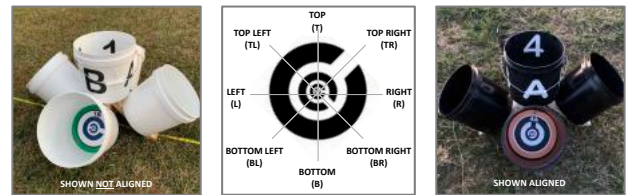
SCORING

- Set a pass/fail minimum score for ALIGNMENT POINTS based on a chosen trial time.
- Example pass/fail minimum score requiring 80 of 100 (80%) of available points across all 20 alignments:
 - 5-minute trial time limit
 - 16 alignments or more (20 seconds each)
 - 80+ ALIGNMENT POINTS (16 perfect or more)

NOTE: Drones with less stability need to be quicker to align with more buckets within the time limit.

Levels 3-5: Payload Functionality

ADD ZOOM AND EXPOSURE TO IDENTIFY TARGETS



PURPOSE

- For professional remote pilots to demonstrate operational tasks in lighted, dark, and BVLOS trials.
- Use WHITE & BLACK BUCKETS to include a task workload at each alignment by requiring both zoom and exposure control to identify visual acuity targets.

PROCEDURE

- Align with each bucket and pause long enough to capture a SINGLE FULL-ZOOM IMAGE showing the entire alignment ring with clear contrast for scoring.
- Score ALIGNMENT POINTS using both the CAPTURED ALIGNMENT IMAGES and ACCURATE LANDINGS similar to the Basic Maneuvering Trials. The zoomed in images of the alignment rings are typically obvious so can be verified during or after the trial and stored. The accurate landings need to be scored during the trial.
- Score ACUITY POINTS separately while aligned and zoomed in on the acuity targets to identify up to 5 increasingly small gap directions through the pilot interface (1 point each). Use the answer key on the form to verify. Maximum zoom images of the acuity targets may be optionally captured and stored.

SCORING

- Set SEPARATE pass/fail minimum scores for both ALIGNMENTS and ACUITY based on a chosen trial time.
- Example pass/fail minimum score requiring 80% of available points across 10-20 alignments:
 - 5-minute trial time limit
 - 10 alignments or more (30 seconds each)
 - 50+ ALIGNMENT POINTS (10 perfect or more)
 - 30+ ACUITY POINTS (3 of 5 gaps per alignment)

NOTE: Drones with less stability or less zoom need to be quicker to align with more buckets within the time limit.



LEVEL 1 | OPEN AREA

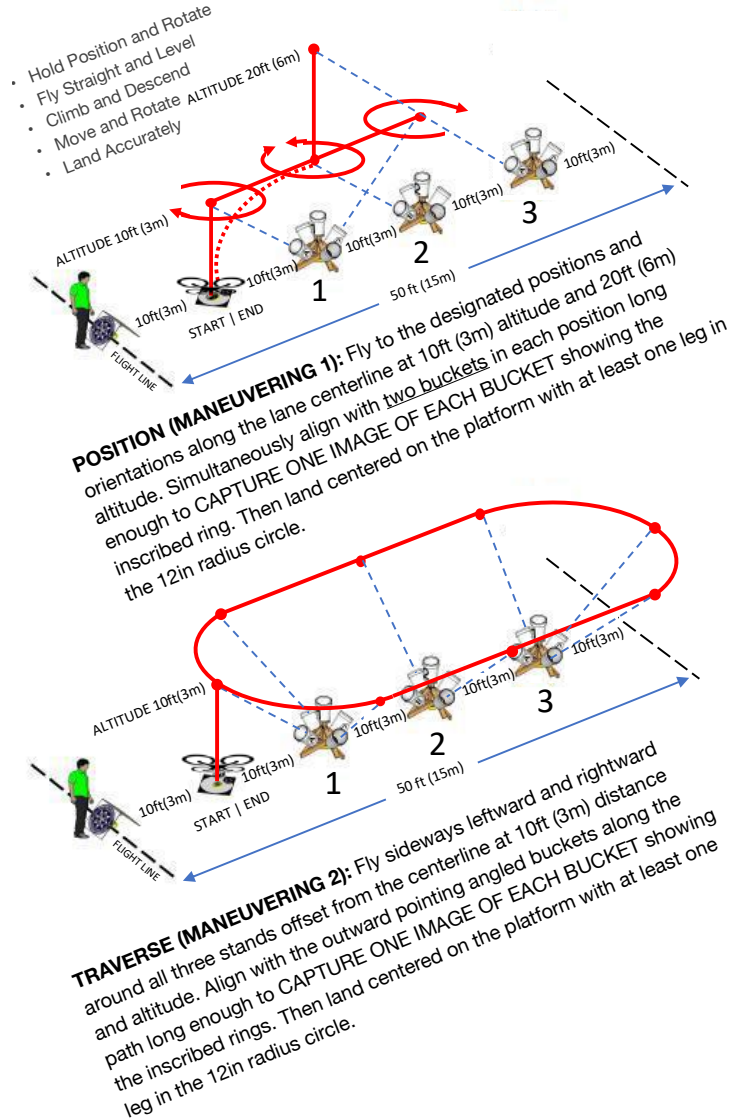
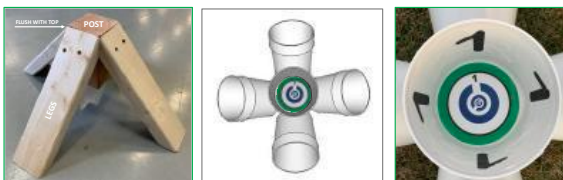
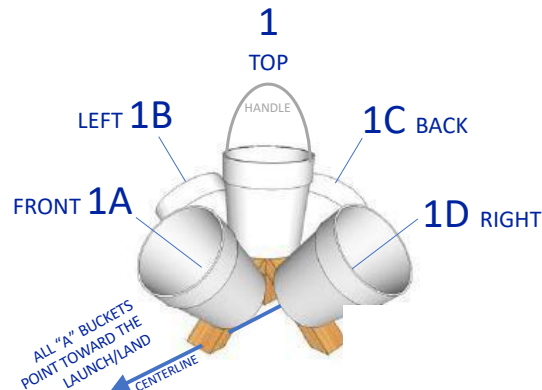
BASIC SAFETY CHECKRIDE

The Position and Traverse tests are performed sequentially by a remote pilot in direct line of sight, or with the pilot's back turned to represent flying beyond visual line of sight with an assisting visual observer. The aircraft flies the designated flight paths to align with one or more white buckets. Each alignment requires a single image of the inscribed green ring inside the bottom of the buckets. Perform all 40 alignments and accurate landings within the designated time limit. Visual acuity targets evaluate camera pointing and zooming capabilities along with color, thermal, hazmat labels, or other objects. Faults resulting in an end-of-trial include extreme deviations from the intended flight path or contact with the apparatus, ground, or safety enclosure.

FABRICATION

- (QTY 01) 15m (50ft) measuring tape centerline
- (QTY 01) square panel with 30cm (12in) radius circle
- (QTY 03) 10x10x15cm (4x4x6in) posts
- (QTY 12) 5x10x30cm (2x4x12in) legs with 45deg tapers
- (QTY 30) 7.5cm (3in) screws attach legs to post - 2 per
- (QTY 30) 4cm (1-1/2in) screws attach buckets - 2 per
- (QTY 15) 7.5-liter (2-gallon) white buckets
- (QTY 52) 20cm (8in) round polyester weatherproof labels. Download and print targets and lettering from the online [USAGE GUIDE](#) or at [RobotTestMethods.nist.gov](#).
- A thick black marker can also be used to inscribe 2.5cm (1in) rings inside buckets with written letters and numbers.

FLIGHT PATHS





M LEVEL 2 | OPEN AREA MANEUVERING ONLY

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

- Score ALIGNMENT POINTS after trial from images with UNBROKEN RINGS (5 pts) or BROKEN RINGS (1 pt).
- Land CENTERED (5 pts) with the aircraft center inside the designated 60 cm (24 inch) diameter circle, or 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 limits are typically 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.

POSITION
MAN 1

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

TRAVERSE
MAN 2

- 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.**

ORBIT
MAN 3

- 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.**

INSPECT
MAN 4

- 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.**

RECON
MAN 5

- 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.**

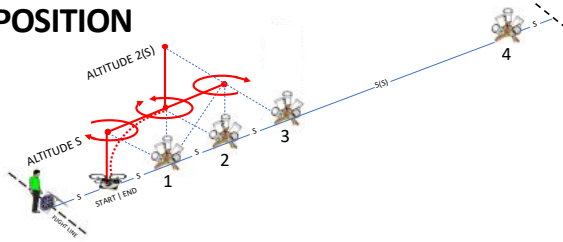


LEVEL 3 | OPEN AREA

PAYLOAD FUNCTIONALITY

Perform 5 different flight paths around the omni bucket stands. Each flight path includes a sequence of alignments with one or more buckets. While aligned with each bucket, control camera zoom and exposure to capture a SINGLE IMAGE of the inscribed ALIGNMENT RING and IDENTIFY VISUAL ACUITY TARGETS inside each bucket.

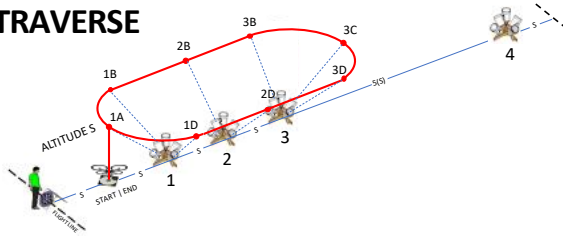
POSITION



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

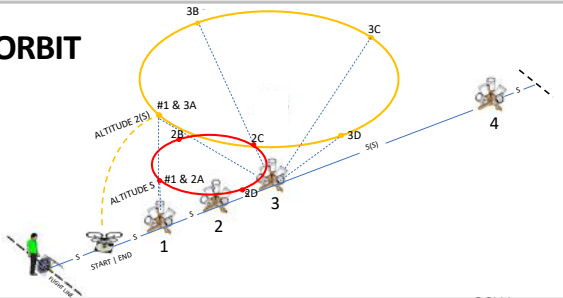
TRAVERSE



- 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.**

ORBIT

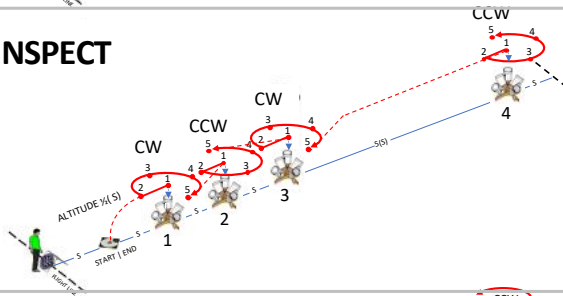


- Fly circular orbits around designated bucket stands while looking inward to identify features on all four sides. Fly altitude 2(S) leftward and rightward around stand #3 (white), then altitude S leftward and rightward around stand #2 (black).

- 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.**

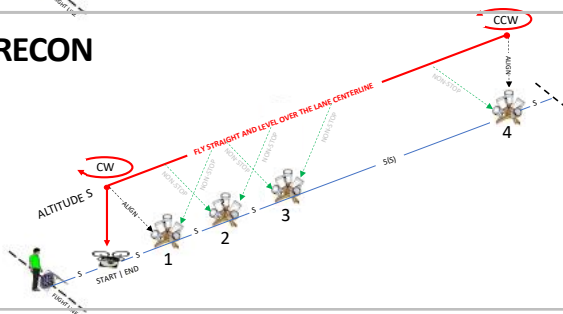
INSPECT



- 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.**

RECON



- 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.**



LEVEL 3 | OPEN AREA

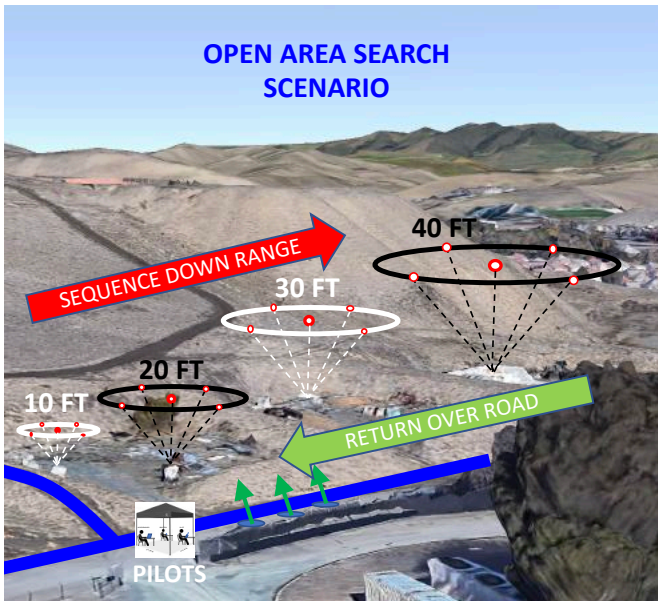
SCORABLE SCENARIOS

Perform the designated flight paths around objects with omni bucket stands. Each flight path includes a sequence of alignments with one or more buckets. While aligned with each bucket, control camera zoom and exposure to capture a SINGLE IMAGE of the inscribed ring and IDENTIFY TARGETS inside each bucket or in view nearby. Identify other objects of interest within the scenario at the same time.

- Score ALIGNMENT POINTS after the trial from images with UNBROKEN RINGS (5 pts) or BROKEN RINGS (1 pt).
- Score ACUITY POINTS by calling out the 5 increasingly small VISUAL ACUITY TARGET GAPS (1 pt each).
- Land CENTERED (5 pts) with the aircraft center inside the designated 60 cm (24 inch) diameter circle, or 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 limits are typically 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.

Open Area Search Scenarios

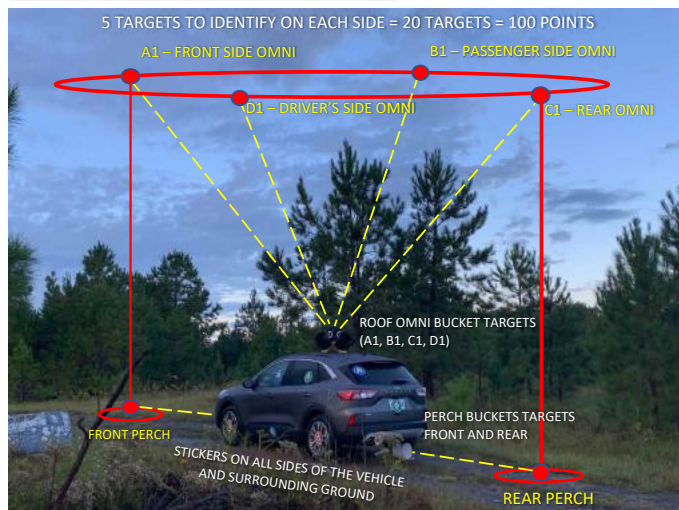
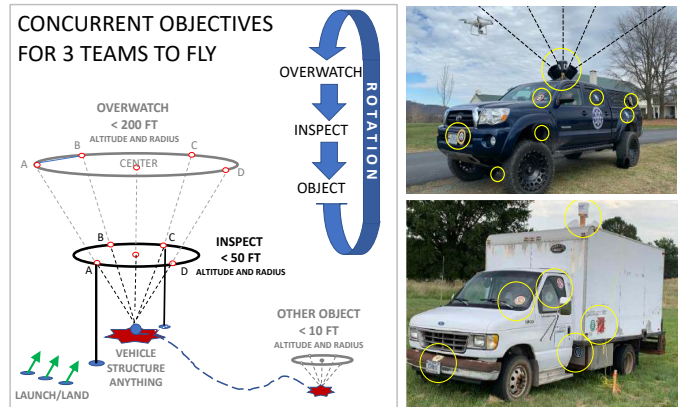
Day and Night Trials



- 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.

Open Vehicle Identification Scenarios

Day and Night Trials





LEVEL 4 | OBSTRUCTED

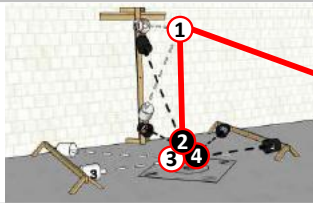
PAYLOAD FUNCTIONALITY

Perform 5 different flight paths around the dual bucket rails in either scale of test lane. Each flight path includes alignments with perpendicular buckets then angled buckets using zoom and exposure control to identify recessed targets.

- All sequences have 10 positions with 20 buckets to score: **1 2 3 4 – 3 2 1 – 2 3 4** (*forward–reverse–forward*)
- Score **ALIGNMENT POINTS** by capturing a **SINGLE IMAGE** of the inscribed rings to verify alignments during or after the trial: **UNBROKEN RINGS** (5 pts), **BROKEN RINGS** (1 pt).
- Score **ACUITY POINTS** by identifying and calling out the 5 increasingly small **VISUAL ACUITY TARGET GAPS** (1 pt each).
- Faults for extreme deviations from the intended flight path or contact with any object ends the trial to ensure safety.
- Timer starts at launch and ends after the last task is completed. Trial time limits are typically set to 5 minutes each (25 minutes to complete all 5 tests) although organizations may set their own trial time limits and passing scores.

PERCH

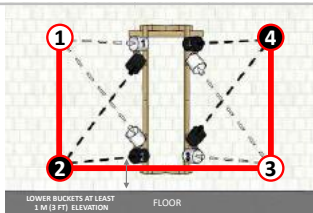
PAY 6



- Land or hover just above the ground within proximity to a wall or obstacle with additional ground obstacles on both sides. Launch and land repeatedly if necessary to score all buckets in the sequence of perch tasks.
- Inspect **vertical** and **horizontal** object features **all around the aircraft**.
- **Complete 10 positions to score up to 50 Alignment points and 50 Acuity points.**

WALL

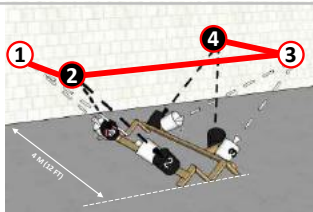
PAY 7



- Fly within proximity to a wall or obstacle at **45 degrees from forward** of the aircraft.
- Inspect **vertical** object features **upward** and **downward**.
- **Complete 10 positions to score up to 50 Alignment points and 50 Acuity points.**

GROUND

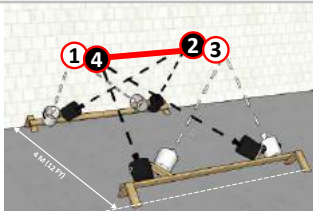
PAY 8



- Fly within proximity to a wall or obstacles at **90 degrees from forward** of the aircraft.
- Inspect **horizontal** object features **leftward** and **rightward**.
- **Complete 10 positions to score up to 50 Alignment points and 50 Acuity points.**

ALLEY

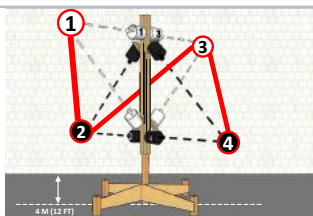
PAY 9



- Fly within proximity to a wall or obstacle in **front of the aircraft (0 degrees)** and **behind the aircraft (180 degrees)**.
- Inspect **horizontal** object features **leftward** and **rightward**.
- **Complete 10 positions to score up to 50 Alignment points and 50 Acuity points.**

POST

PAY 10



- Fly within proximity to a post and wall or obstacle and pass between the post and the wall.
- 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.**



LEVEL 4 | OBSTRUCTED SCORABLE SCENARIOS

Perform the designated flight paths to triangulate around dual bucket rails in various orientations. Align with perpendicular buckets then angled buckets. Use zoom and exposure to identify targets inside the buckets.

- All sequences have 5 apparatuses defining 10 positions with 20 alternating white and black buckets to score.
- Score ALIGNMENT POINTS by capturing a SINGLE IMAGE of the inscribed rings to verify alignments during or after the trial: UNBROKEN RINGS (5 pts), BROKEN RINGS (1 pt).
- Score ACUITY POINTS by identifying the 5 increasingly small VISUAL ACUITY TARGET GAPS (1 pt each).
- Faults for extreme deviations from the intended flight path or contact with any object ends the trial for safety.
- Timer starts at launch and ends after the last task is completed. Trial time limits are typically set to 15-20 minutes, although organizations may set their own trial time limits and passing scores.

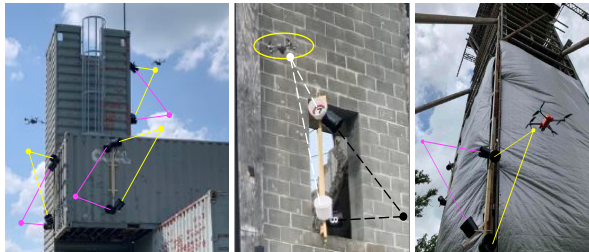
Obstructed Search Scenarios

Day and Night Trials

USE SETS OF 5 "INLINE" DUAL BUCKET RAILS
DISTRIBUTED THROUGHOUT THE SCENARIO



VERTICALS IN ELEVATED WINDOWS AND ON STRUCTURES

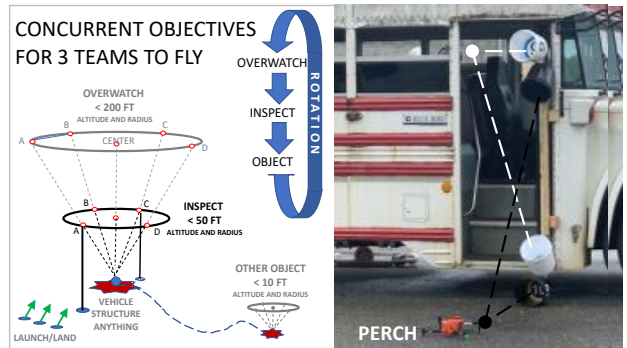


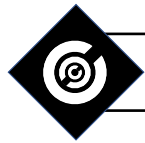
- Teams concurrently fly separate objectives set up at safe distances and/or altitudes apart (with a clearly designated and safe return path).
- Each pilot flies for 15 minutes across 3 different objectives for 5 minutes each. Teams move as necessary to maintain sight lines and communication.
- Scenarios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

Obstructed Vehicle Inspection Scenarios

Day and Night Trials

USE SETS OF 5 "INLINE" DUAL BUCKET RAILS
DISTRIBUTED THROUGHOUT THE SCENARIO





LEVEL 5 | CONFINED

PAYLOAD FUNCTIONALITY

Perform 5 different flight paths around the dual bucket rails in either scale of test lane. Each flight path includes alignments with perpendicular buckets then angled buckets using zoom and exposure control to identify recessed targets.

- All sequences have 10 positions with 20 buckets to score: **1 2 3 4 – 3 2 1 – 2 3 4** (*forward–reverse–forward*)
- Score ALIGNMENT POINTS by capturing a SINGLE IMAGE of the inscribed rings to verify alignments during or after the trial: UNBROKEN RINGS (5 pts), BROKEN RINGS (1 pt).
- Score ACUITY POINTS by identifying and calling out the 5 increasingly small VISUAL ACUITY TARGET GAPS (1 pt each).
- Faults for extreme deviations from the intended flight path or contact with any object ends the trial to ensure safety.
- Timer starts at launch and ends after the last task is completed. Trial time limits are typically set to 5 minutes each (25 minutes to complete all 5 tests) although organizations may set their own trial time limits and passing scores.

<p>PERCH PAY 6</p>		<ul style="list-style-type: none"> • Land or hover just above the ground within proximity to a wall or obstacle with additional ground obstacles on both sides. Launch and land repeatedly if necessary to score all buckets in the sequence of perch tasks. • Inspect <u>vertical</u> and <u>horizontal</u> object features <u>all around the aircraft</u>. • Complete 10 positions to score up to 50 Alignment points and 50 Acuity points.
<p>WALL PAY 7</p>		<ul style="list-style-type: none"> • Fly within proximity to a wall or obstacle at <u>45 degrees from forward</u> of the aircraft. • Inspect <u>vertical</u> object features <u>upward</u> and <u>downward</u>. • Complete 10 positions to score up to 50 Alignment points and 50 Acuity points.
<p>GROUND PAY 8</p>		<ul style="list-style-type: none"> • Fly within proximity to a wall or obstacles at <u>90 degrees from forward</u> of the aircraft. • Inspect <u>horizontal</u> object features <u>leftward</u> and <u>rightward</u>. • Complete 10 positions to score up to 50 Alignment points and 50 Acuity points.
<p>ALLEY PAY 9</p>		<ul style="list-style-type: none"> • Fly within proximity to a wall or obstacle in <u>front of the aircraft (0 degrees)</u> and <u>behind the aircraft (180 degrees)</u>. • Inspect <u>horizontal</u> object features <u>leftward</u> and <u>rightward</u>. • Complete 10 positions to score up to 50 Alignment points and 50 Acuity points.
<p>POST PAY 10</p>		<ul style="list-style-type: none"> • Fly within proximity to a post and wall or obstacle and pass between the post and the wall. • Inspect <u>vertical</u> object features <u>upward</u> and <u>downward</u> all around the post. • Complete 10 positions to score up to 50 Alignment points and 50 Acuity points.



LEVEL 5 | CONFINED

SCORABLE SCENARIOS

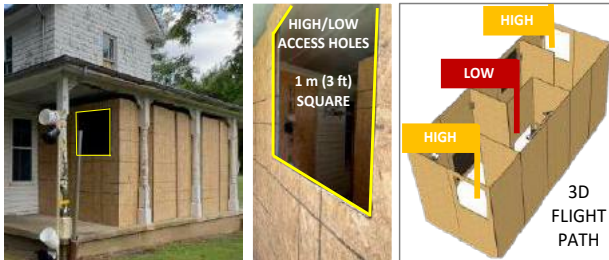
Perform the designated flight paths to triangulate around dual bucket rails in various orientations. Align with perpendicular buckets then angled buckets. Use zoom and exposure to identify targets inside the buckets.

- All sequences have 5 apparatuses defining 10 positions with 20 alternating white and black buckets to score.
- Score ALIGNMENT POINTS by capturing a SINGLE IMAGE of the inscribed rings to verify alignments during or after the trial: UNBROKEN RINGS (5 pts), BROKEN RINGS (1 pt).
- Score ACUITY POINTS by identifying the 5 increasingly small VISUAL ACUITY TARGET GAPS (1 pt each).
- Faults for extreme deviations from the intended flight path or contact with any object ends the trial for safety.
- Timer starts at launch and ends after the last task is completed. Trial time limits are typically set to 15-20 minutes, although organizations may set their own trial time limits and passing scores.

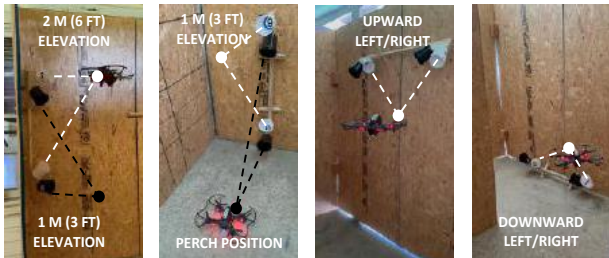
Confined Room-to-Room Labyrinth

Search tasks with 1 m (3ft) minimum clearances

USE SETS OF 5 "INLINE" DUAL BUCKET RAILS
HORIZONTALS FOR LEFTWARD/RIGHTWARD INSPECTIONS



VERTICALS FOR UPWARD/DOWNWARD INSPECTIONS



- Fabricated room-to-room search scenario with inspect tasks that can be replicated to track and compare scores.
- Self-standing plywood corner walls define 1.2m (4 ft) switchback hallways with a blackout tarp ceiling over top at 2.4m (8ft). Fits inside a 6m (20ft) shipping container.
- Square access "windows" measuring 1m (3ft) square provide entry/exit and interior high/low pass throughs.

Confined Vehicle Inspection Scenarios

Day and Night Trials

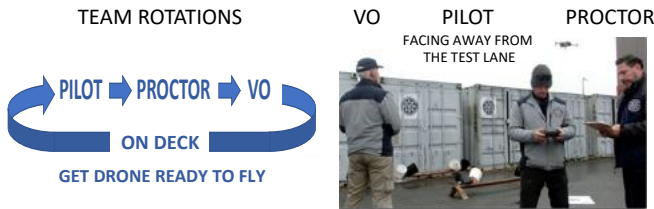
USE SETS OF 5 "INLINE" DUAL BUCKET RAILS
DISTRIBUTED THROUGHOUT THE SCENARIO





Teams Rotate Through Each Role

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



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 aircraft.

PILOT

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

PROCTOR

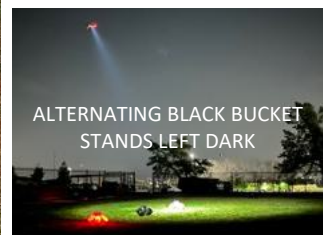
- Fill in the form header.
- Read the test procedures to the Pilot.
- Confirm, record, and attest to scoring after the trial.

VISUAL 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.

Day and Night Operations

Evaluate using repeatable hovers and orbits



Separate Scores for ALIGNMENT and ACUITY

Track your own scores over time and/or compare to others using the same drone.

