ASTM E54.09 Homeland Security Applications; Response Robots Open Test Lane and Related Scenarios

Version 2022A

STARTS AT 10:00 AM EST
WASHINGTON, DC TIME

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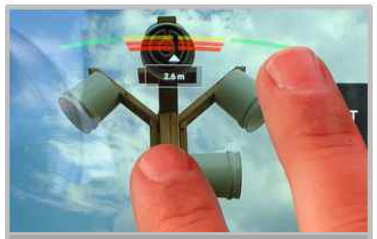
Reproducible Tests for Maneuvering and Payload Functionality

Open Test Lane

MEASURE & COMPARE


SMALL SYSTEMS


LARGE SYSTEMS

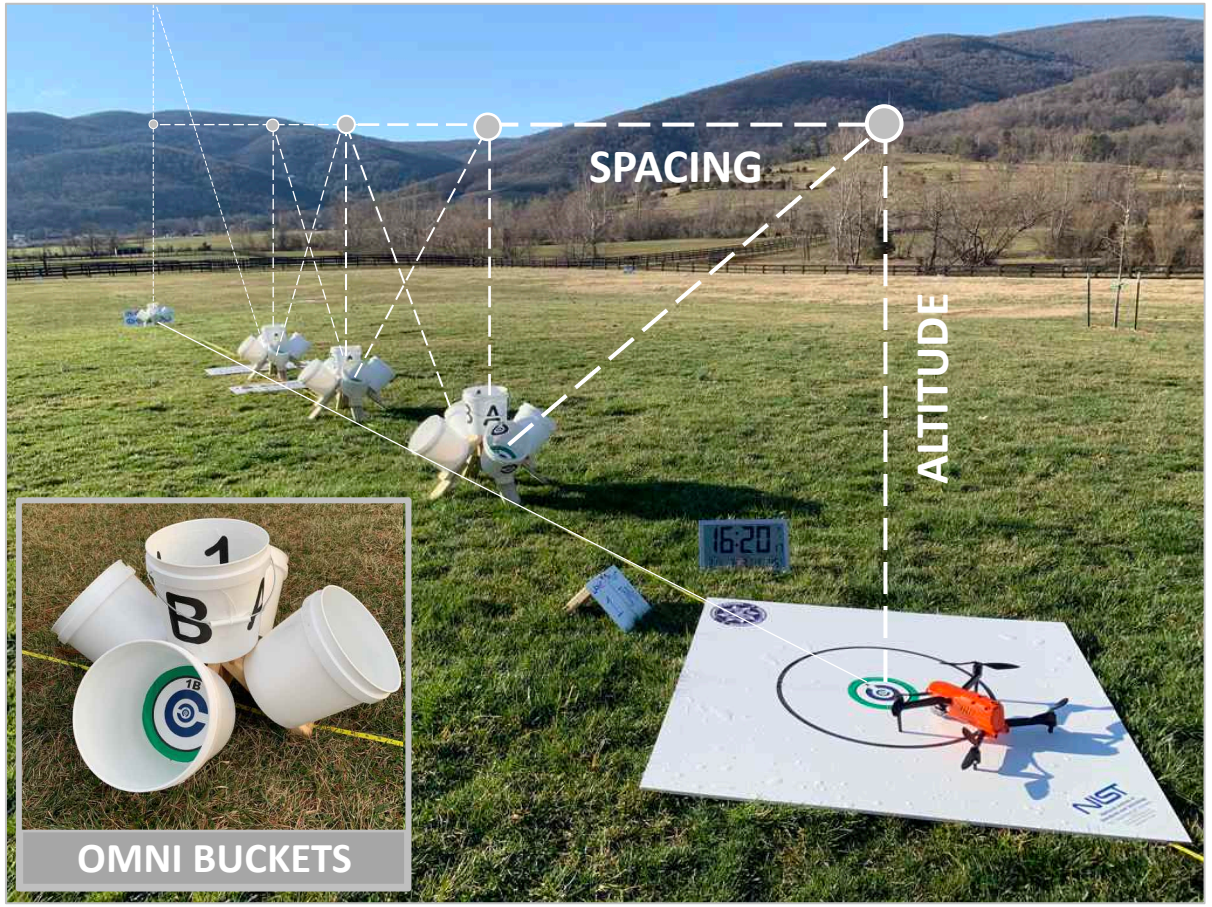

INTERFACES


PROCEDURES


SENSORS


MANEUVERING

SCALABLE TEST LANES (ALTITUDE = SPACING)

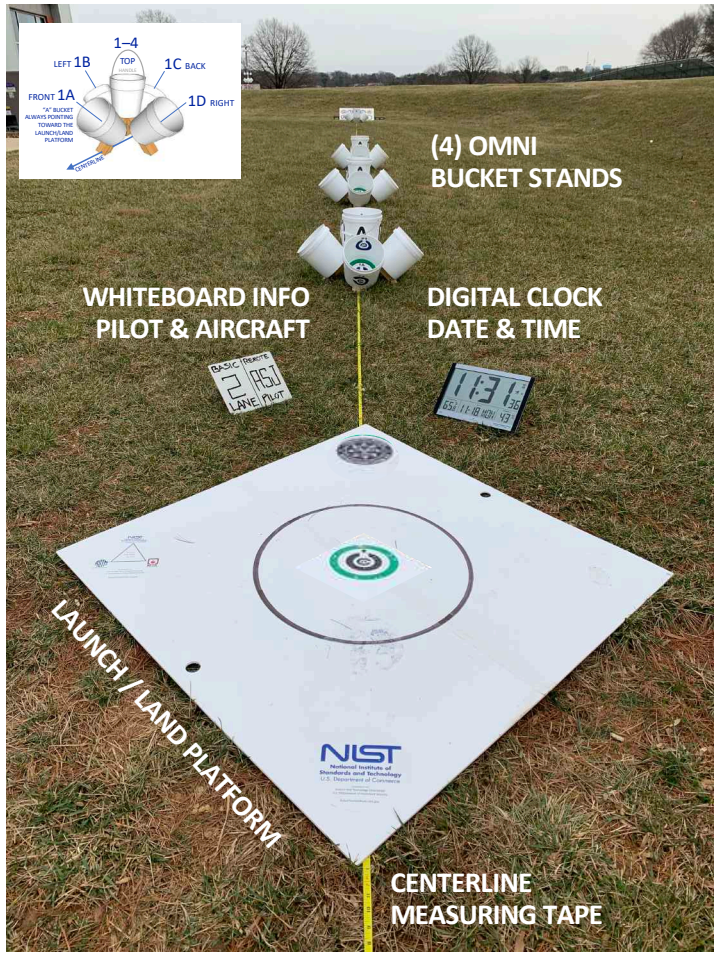


OMNI BUCKETS

Easy Fabrication and Stowing

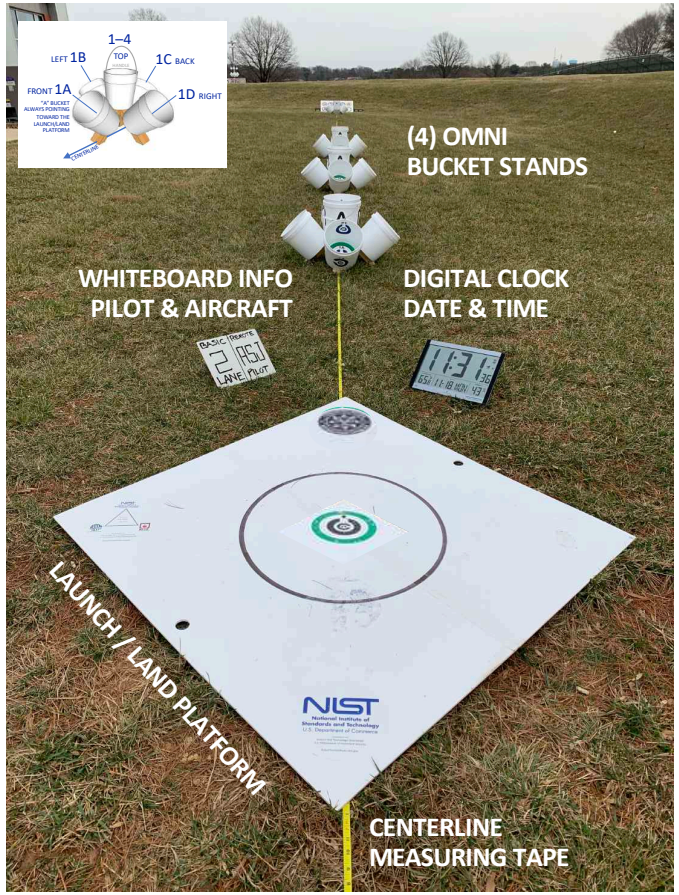
Open Test Lane

2 Gallon Buckets – Printed Stickers – Transportable

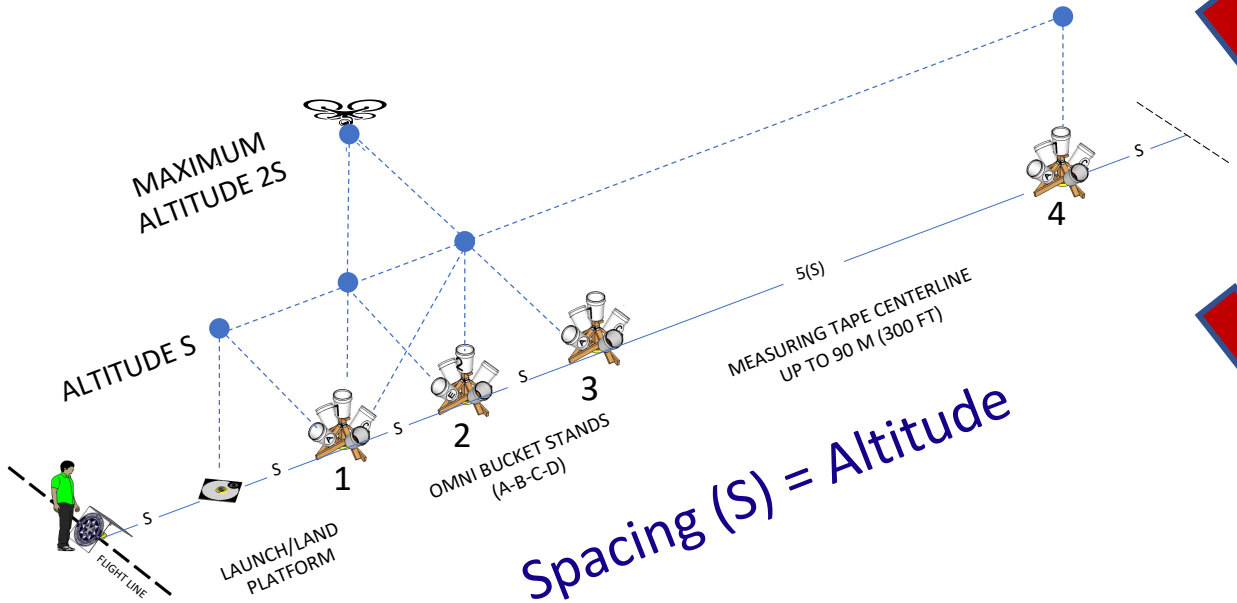


Scalable for Indoor/Outdoor Use

Open Test Lane



SPACING = S	ALTITUDES = S, 2(S), 5(S)	LENGTH = 10(S)
S = 3 m (10 ft)	3, 6, 15 m (10, 20, 50 ft)	30 m (100 ft)
S = 6 m (20 ft)	6, 12, 30 m (20, 40, 100 ft)	60 m (200 ft)
S = 9 m (30 ft)	9, 18, 45 m (30, 60, 150 ft)	90 m (300 ft)



5 POINTS

1 POINTS

1 POINT

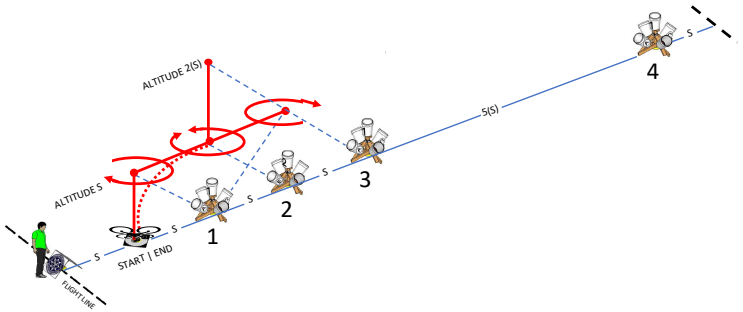
Basic Proficiency Evaluation for Remote Pilots (Part 107 Skills Test?)

Open Test Lane

Position

MAN/PAY 1

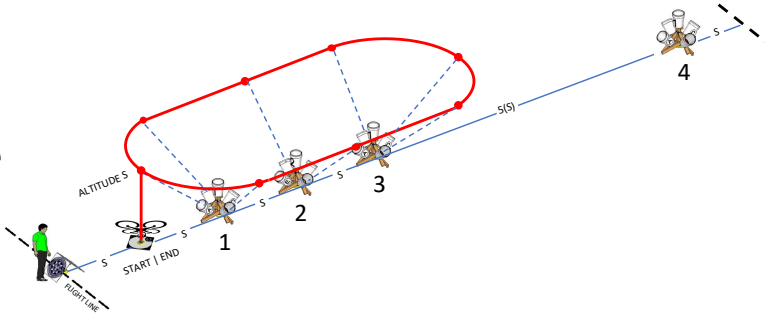
- Hover stably
- Basic maneuvers
- Land accurately
- 20 Buckets in 1 lap



Traverse

MAN/PAY 2

- Fly sideways along a line
- Left and right directions
- Land accurately
- 20 Buckets in 2 laps

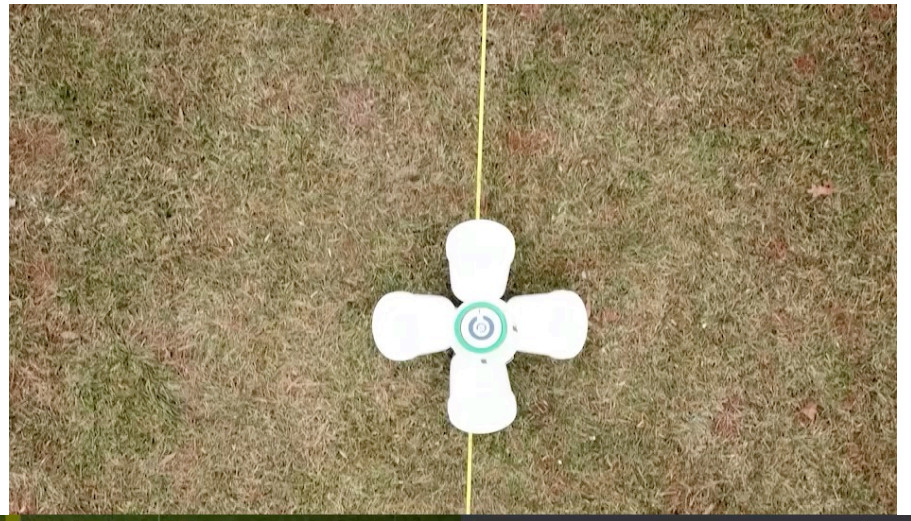


Simulated Versions Could Be Widely Implemented

Use Case Examples

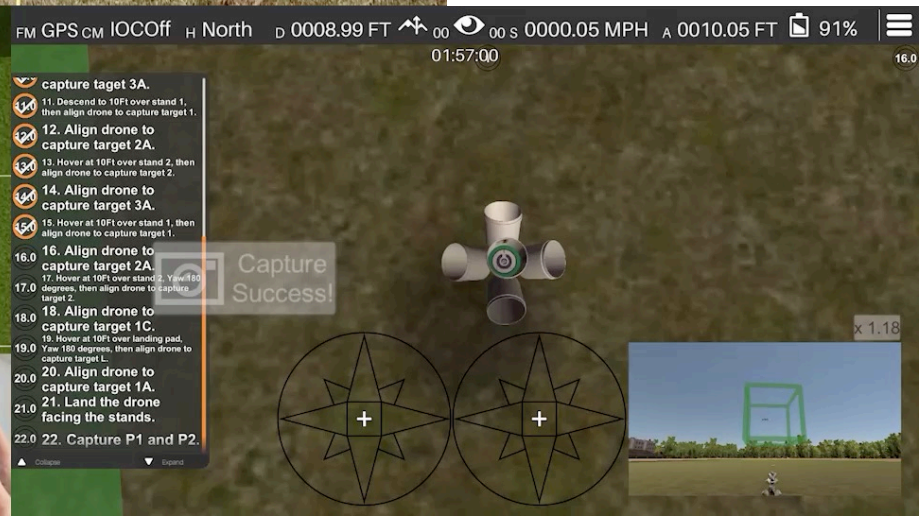
DJI Drone Simulator

Demo Version



Zephyr Drone Simulator

Little Arms Studio & Clemson Univ.



Conduct Tests Two Ways

Open Test Lane

Basic Maneuvering (MAN)

ALIGN WITH BUCKETS AND LAND ACCURATELY

Align with each bucket long enough to capture a **single alignment image (NO ZOOM)** showing the green ring inside the bucket. Score 5 points for a continuous green ring or 1 point for a partial. Similar scoring for accurate or partial landings.

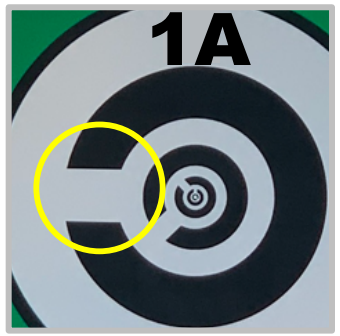
20 ALIGNMENTS TOTAL UP TO 100 POINTS

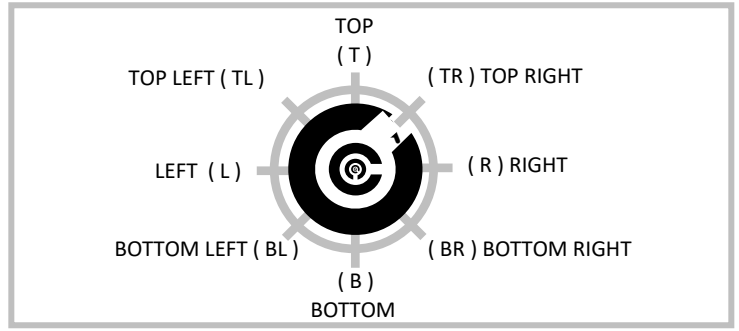
Payload Functionality (PAY)

ALIGN AND IDENTIFY ACUITY TARGETS

Align with each bucket long enough to capture a **single alignment image (NO ZOOM)** AND a **single acuity image of each target (MAX ZOOM)**. Score 1 point for each correct identification of the 5 increasingly small Concentric C gap directions.

20 TARGETS TOTAL UP TO 100 POINTS



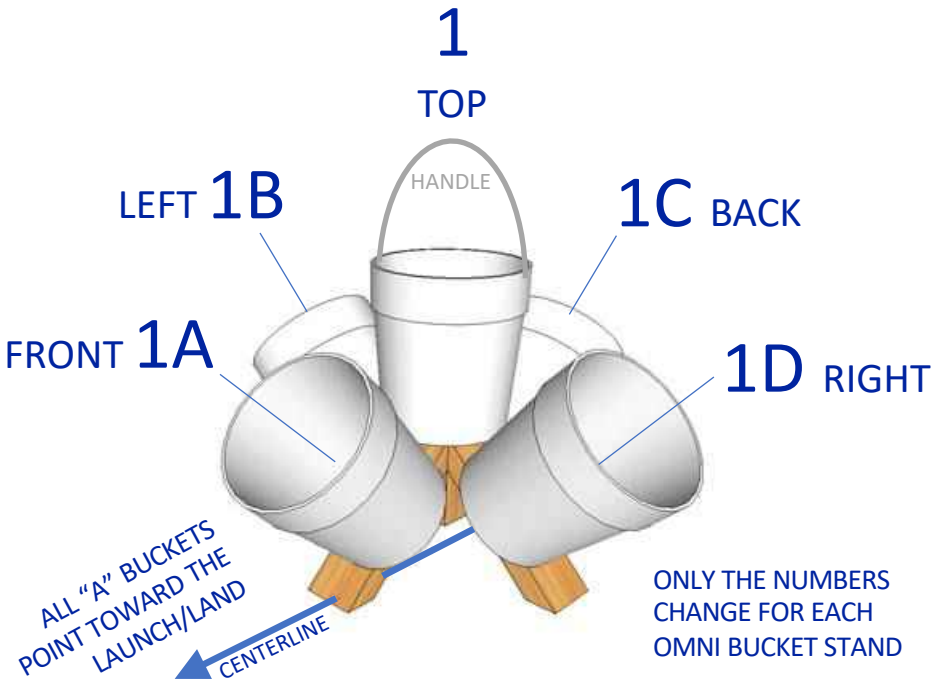


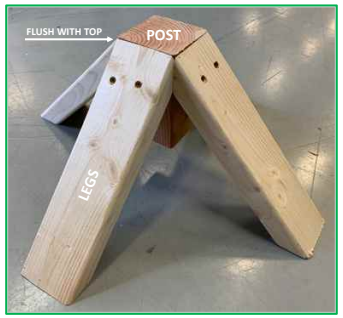
Omni Bucket Stands

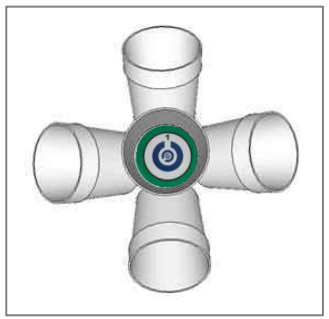
Open Test Lane

WHITE BUCKETS & GREEN RINGS

SHOWN NOT ALIGNED







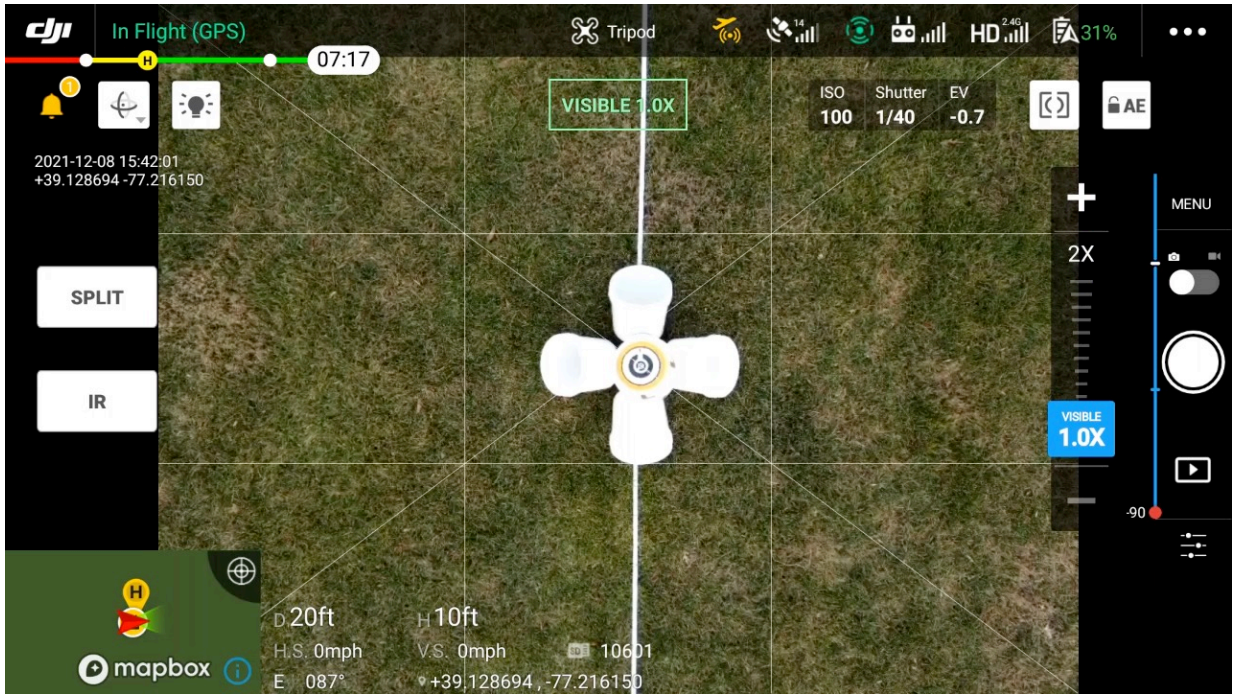
BLACK BUCKETS & COLOR RINGS

SHOWN ALIGNED

Payload Functionality Trials Add Operational Workload During Alignments

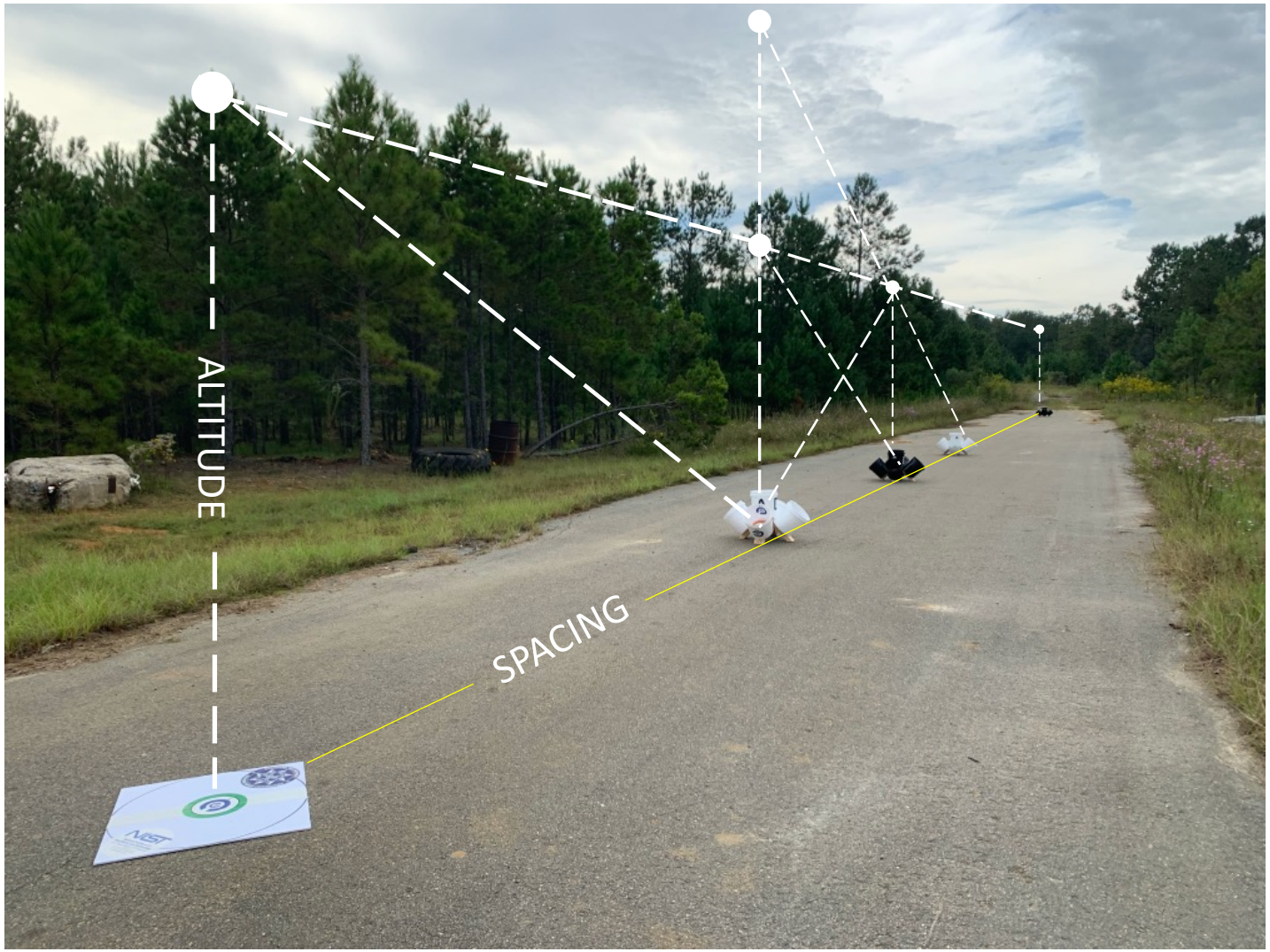
Open Test Lane

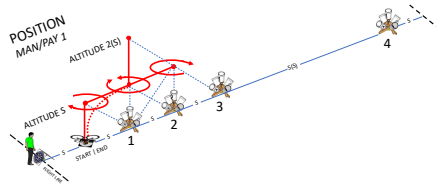
Camera Pointing, Zooming, and Exposure Control

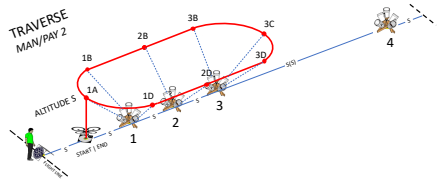


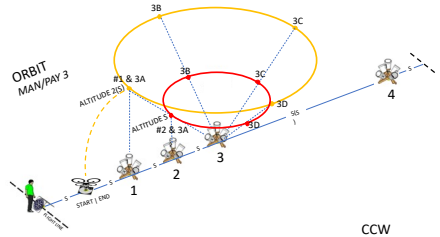
Alternating Black and White Omni Stands For Payload Functionality Trials

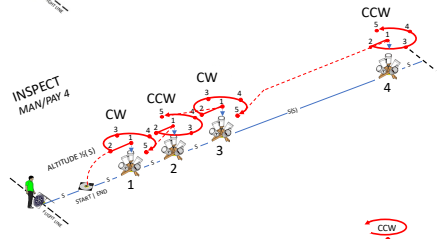
Open Test Lane

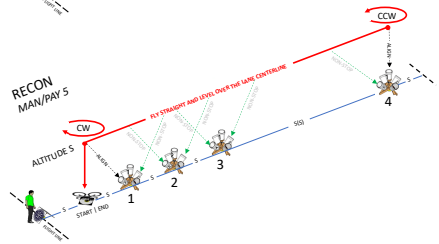






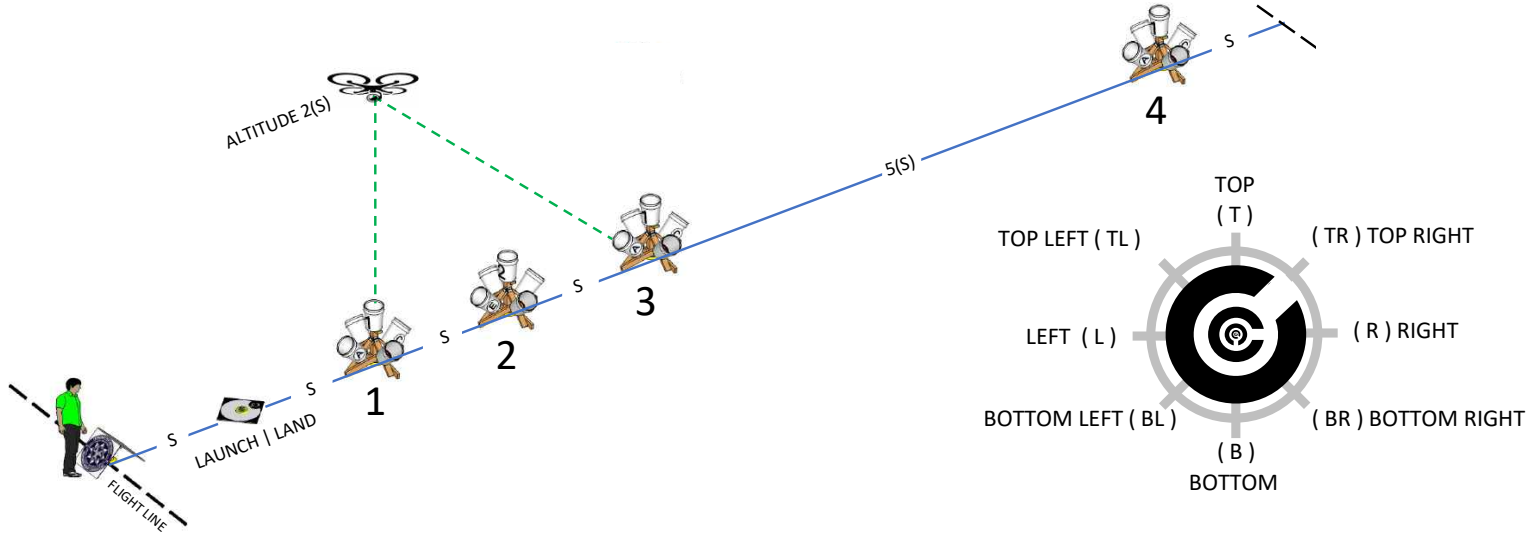


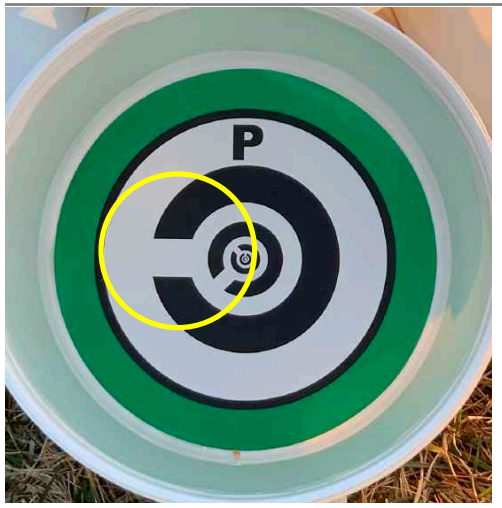


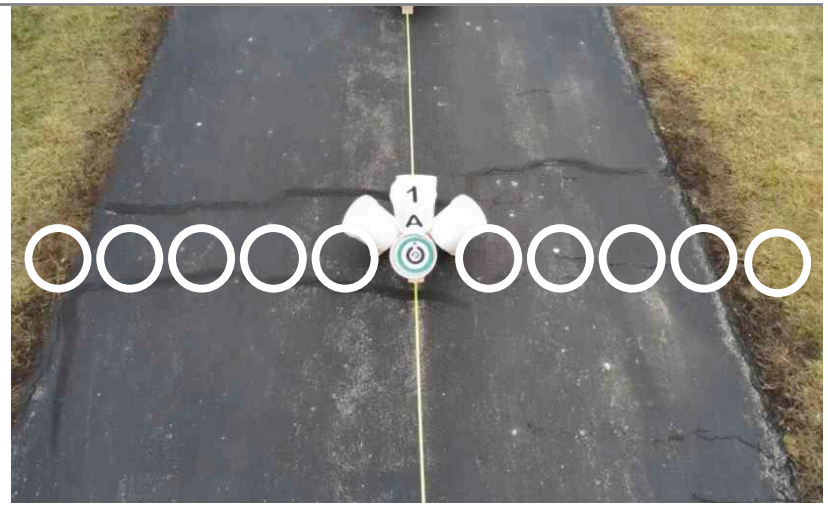


Choose An Appropriate Lane Spacing Based on Optics

Open Test Lane

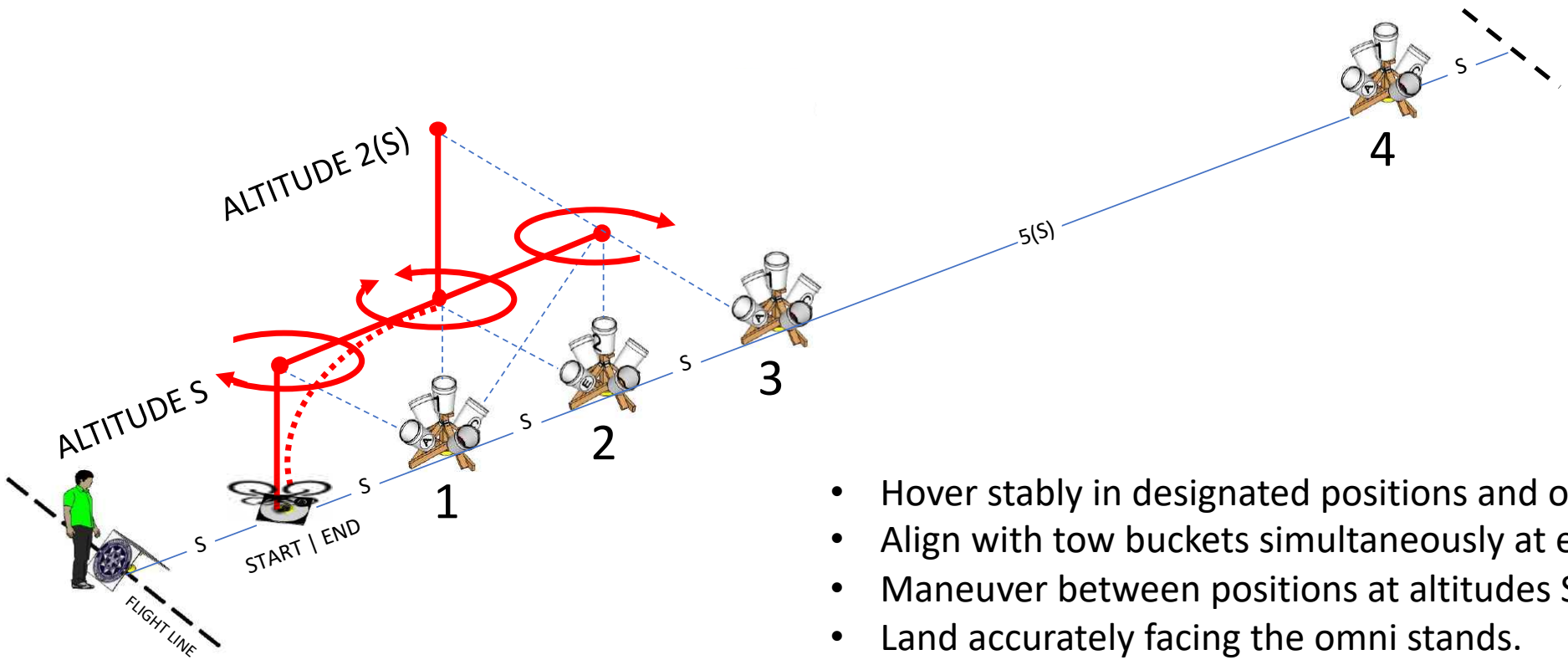






Position Test (MAN/PAY 1)

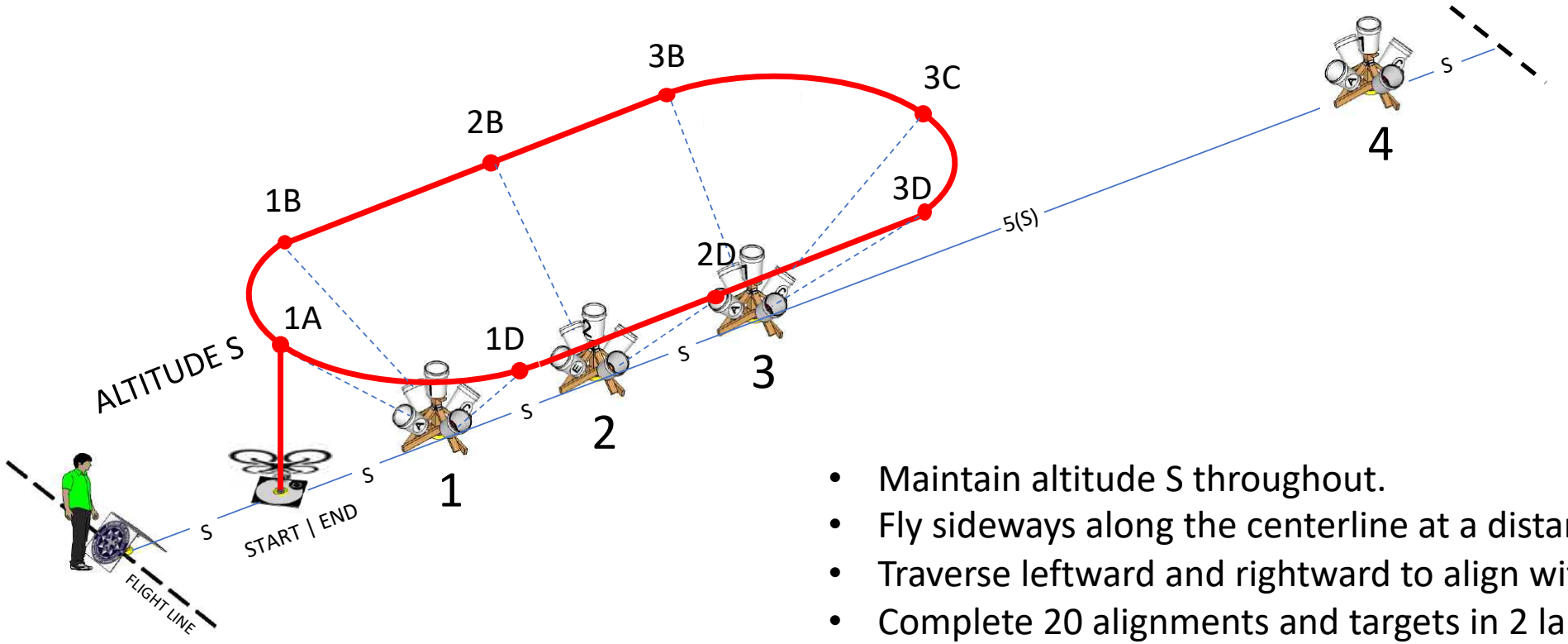
Open Test Lane



- Hover stably in designated positions and orientations.
- Align with tow buckets simultaneously at each position.
- Maneuver between positions at altitudes S and 2(S).
- Land accurately facing the omni stands.
- Complete 20 alignments and targets in 1 lap.

Traverse Test (MAN/PAY 2)

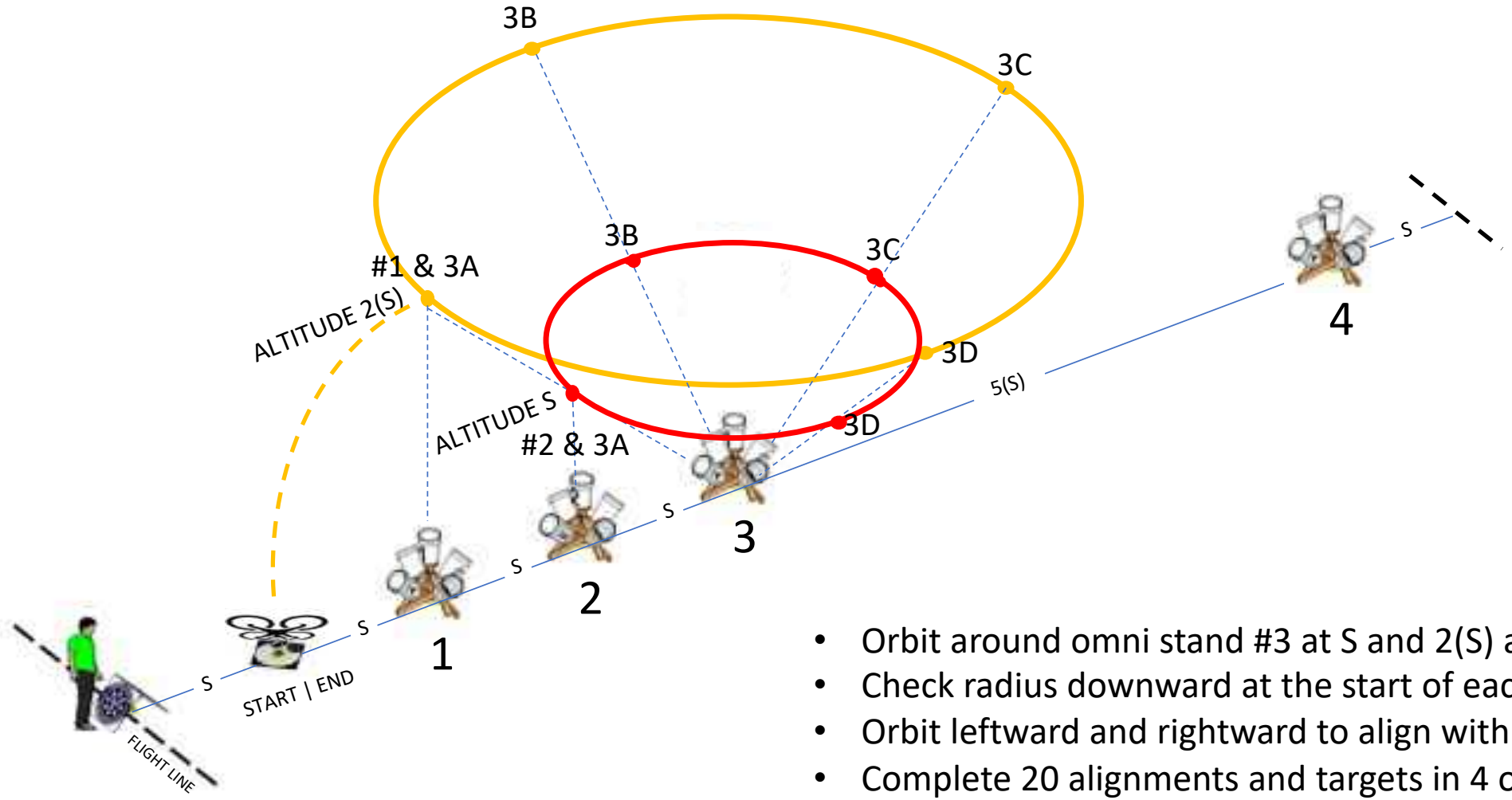
Open Test Lane



- Maintain altitude S throughout.
- Fly sideways along the centerline at a distance S.
- Traverse leftward and rightward to align with angled buckets.
- Complete 20 alignments and targets in 2 laps.

Orbit Test (MAN/PAY 3)

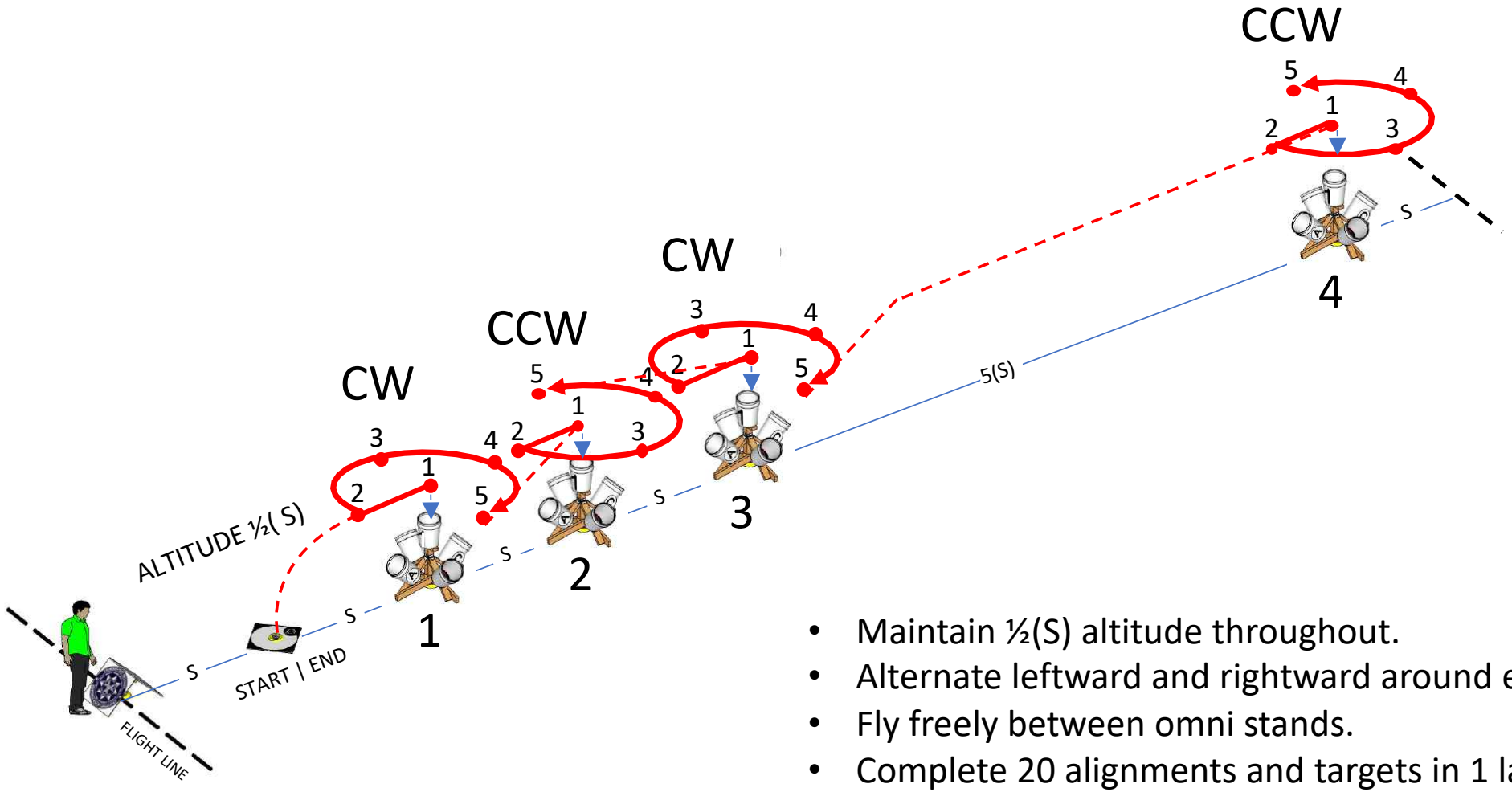
Open Test Lane



- Orbit around omni stand #3 at S and 2(S) altitudes.
- Check radius downward at the start of each orbit.
- Orbit leftward and rightward to align with angled buckets.
- Complete 20 alignments and targets in 4 orbits.

Inspect Test (MAN/PAY 4)

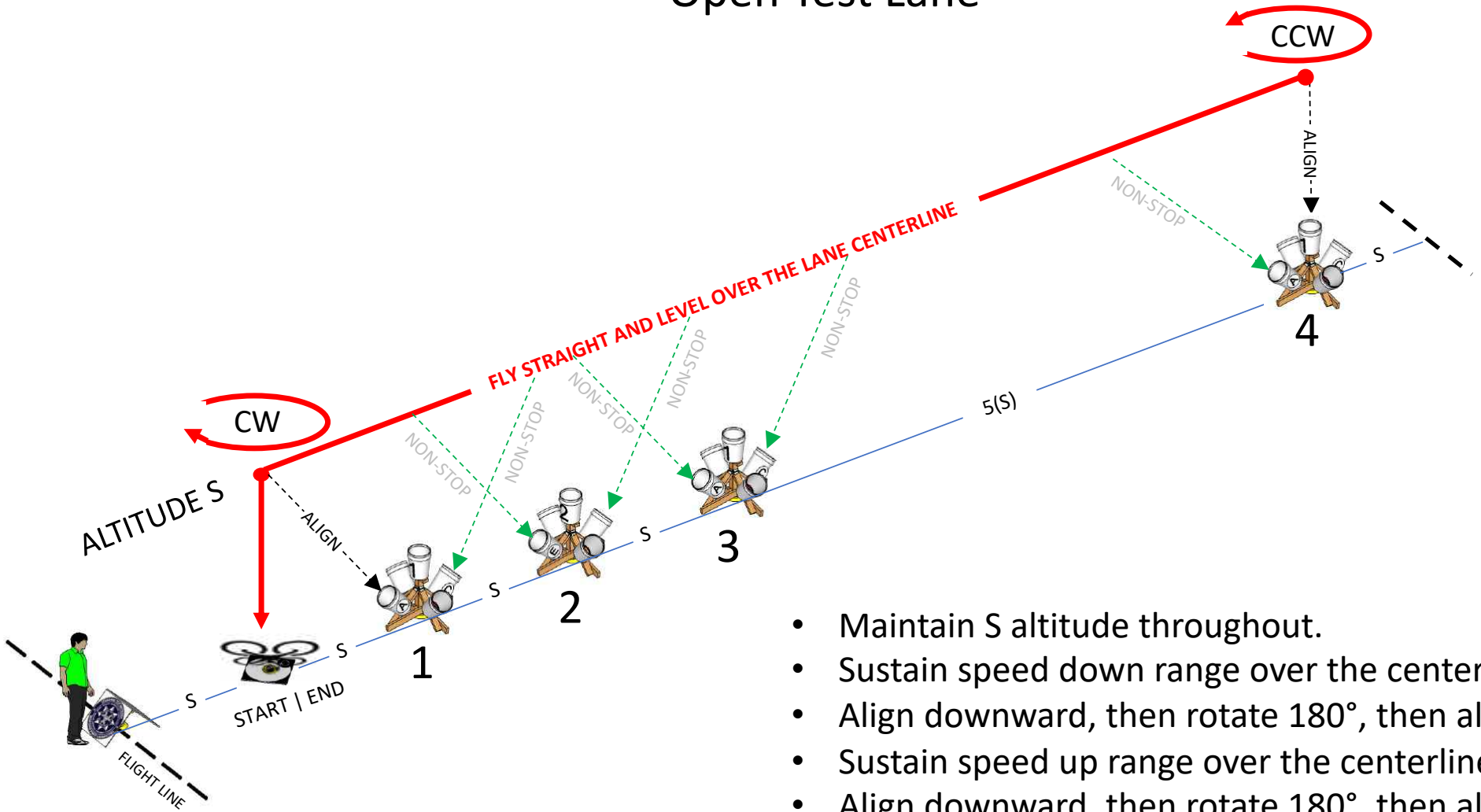
Open Test Lane



- Maintain ½(S) altitude throughout.
- Alternate leftward and rightward around each omni stand.
- Fly freely between omni stands.
- Complete 20 alignments and targets in 1 lap.

Recon Test (MAN/PAY 5)

Open Test Lane



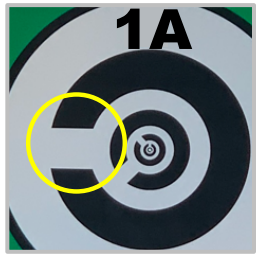
- Maintain S altitude throughout.
- Sustain speed down range over the centerline omni stand #4.
- Align downward, then rotate 180°, then align downward again.
- Sustain speed up range over the centerline to the Launch/Land.
- Align downward, then rotate 180°, then align downward again.
- Complete 20 alignments and targets in 5 laps.

Circuit Training with Scores

Open Test Lane

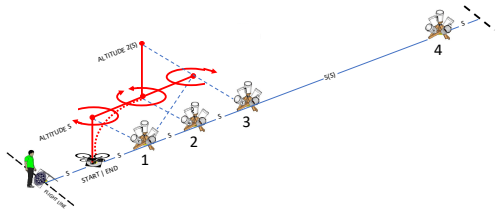
BASIC MANEUVERING
ALIGN WITH BUCKETS

Align with each bucket long enough to capture a **single alignment image (NO ZOOM)** showing the green ring inside the bucket. Score 5 points for a continuous green ring or 1 point for a partial. Similar scoring for accurate or partial landings



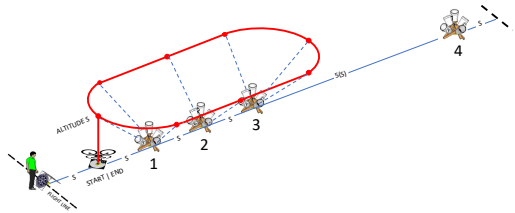
PAYLOAD FUNCTIONALITY
IDENTIFY ACUITY TARGETS

Align with each bucket long enough to capture a **single alignment image (NO ZOOM)** AND a **single acuity image of each target (MAX ZOOM)**. Score 1 point for each correct identification of the 5 increasingly small Concentric C gap directions.



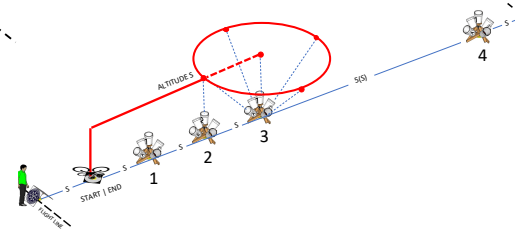
Position
MAN/PAY 1

- Hover stably
- Basic maneuvers
- Landing accuracy
- 20 alignments in 1 lap



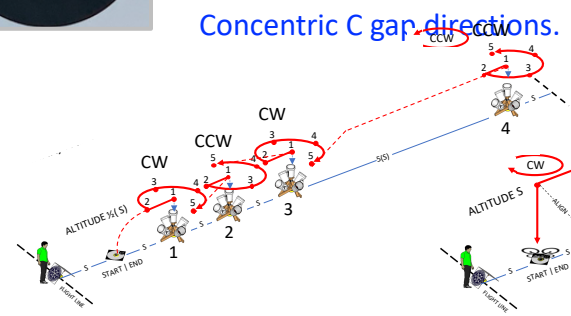
Traverse
MAN/PAY 2

- Fly sideways along a line
- Left and right directions
- Landing accuracy
- 20 alignments in 2 laps



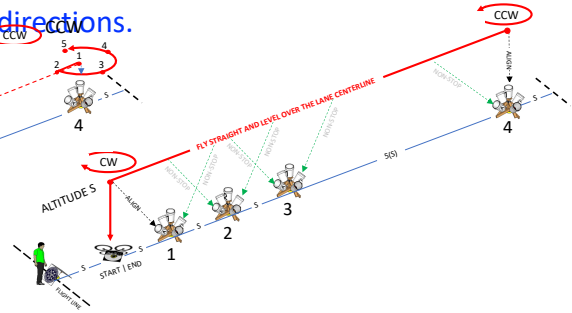
Orbit
MAN/PAY 3

- Orbit to identify objects
- Left and right directions
- S altitude
- 20 alignments in 4 laps



Inspect
MAN/PAY 4

- Fly freely to inspect objects
- Any proximity (use zooms)
- Any altitude
- 20 alignments in 1 lap



Recon
MAN/PAY 5

- Sustain speed over a line
- Establish hovers over objects
- S altitude, 160(S) distance
- 20 alignments in 5 laps

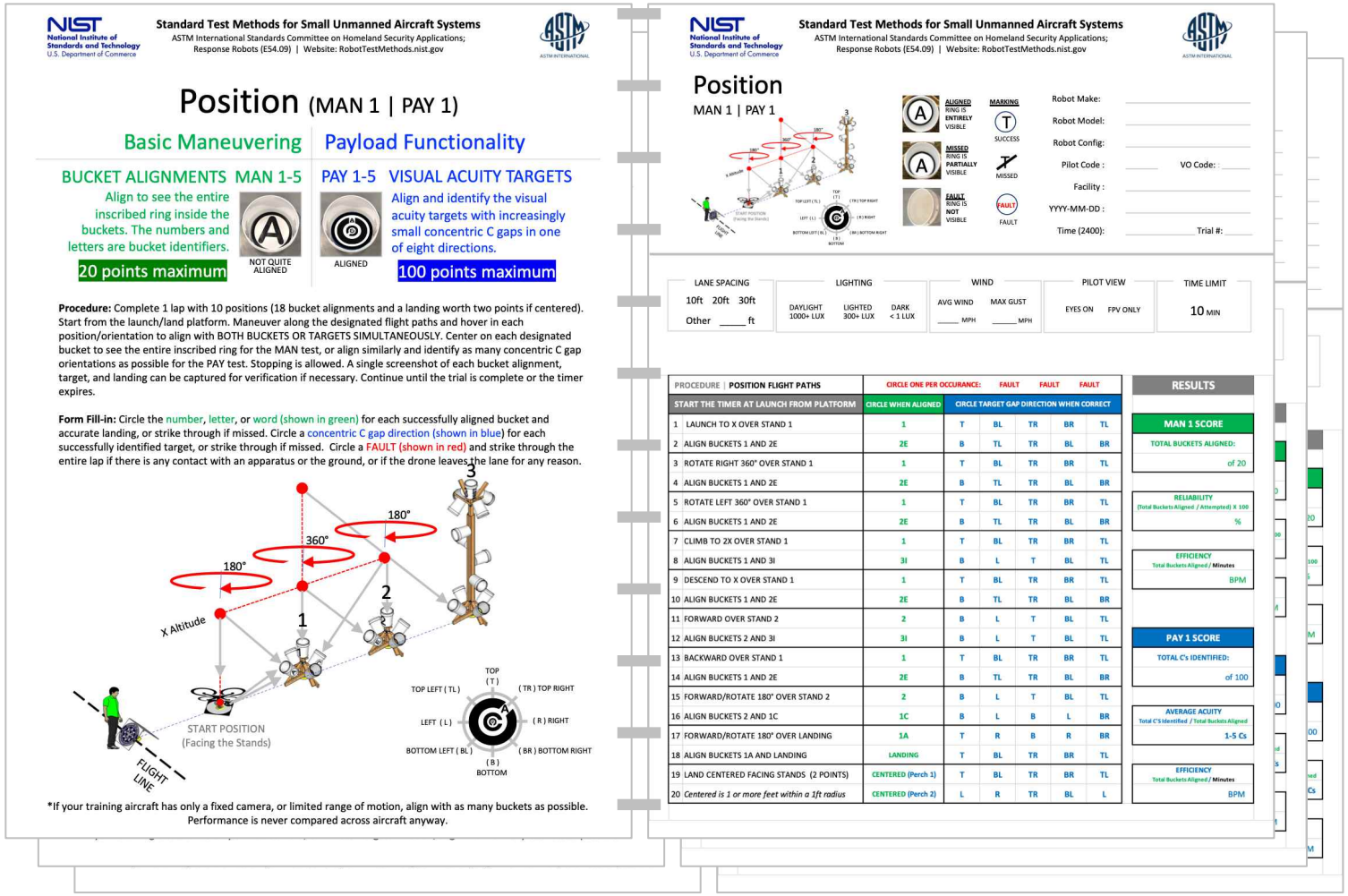
MAN: Align only 5 minutes / 100 points	MAN: Align only 5 minutes / 100 points max	MAN: Align only 5 minutes /100 points	MAN: Align only 5 minutes / 100 points	MAN: Align only 5 minutes / 100 points	500 PTS
PAY: Align and Identify 10 minutes / 100 points	PAY: Align and Identify 10 minutes / 100 points	PAY: Align and Identify 10 minutes / 100 points	PAY: Align and Identify 10 minutes / 100 points	PAY: Align and Identify 10 minutes / 100 points	500 PTS

*If your training aircraft has only a fixed camera, or limited range of motion, align with as many buckets as possible. Proficiency is compared using similar aircraft.

Track Scores Over Time

Open Test Lane

[Download Forms Books Here]



NIST National Institute of Standards and Technology U.S. Department of Commerce

Standard Test Methods for Small Unmanned Aircraft Systems
ASTM International Standards Committee on Homeland Security Applications;
Response Robots (E54.09) | Website: RobotTestMethods.nist.gov

ASTM INTERNATIONAL

Position (MAN 1 | PAY 1)

Basic Maneuvering | **Payload Functionality**

BUCKET ALIGNMENTS MAN 1-5

Align to see the entire inscribed ring inside the buckets. The numbers and letters are bucket identifiers.

20 points maximum

NOT QUITE ALIGNED

ALIGNED

PAY 1-5 VISUAL ACUITY TARGETS

Align and identify the visual acuity targets with increasingly small concentric C gaps in one of eight directions.

100 points maximum

Procedure: Complete 1 lap with 10 positions (18 bucket alignments and a landing worth two points if centered). Start from the launch/land platform. Maneuver along the designated flight paths and hover in each position/orientation to align with BOTH BUCKETS OR TARGETS SIMULTANEOUSLY. Center on each designated bucket to see the entire inscribed ring for the MAN test, or align similarly and identify as many concentric C gap orientations as possible for the PAY test. Stopping is allowed. A single screenshot of each bucket alignment, target, and landing can be captured for verification if necessary. Continue until the trial is complete or the timer expires.

Form Fill-in: Circle the number, letter, or word (shown in green) for each successfully aligned bucket and accurate landing, or strike through if missed. Circle a concentric C gap direction (shown in blue) for each successfully identified target, or strike through if missed. Circle a FAULT (shown in red) and strike through the entire lap if there is any contact with an apparatus or the ground, or if the drone leaves the lane for any reason.

*If your training aircraft has only a fixed camera, or limited range of motion, align with as many buckets as possible. Performance is never compared across aircraft anyway.

NIST National Institute of Standards and Technology U.S. Department of Commerce

Standard Test Methods for Small Unmanned Aircraft Systems
ASTM International Standards Committee on Homeland Security Applications;
Response Robots (E54.09) | Website: RobotTestMethods.nist.gov

ASTM INTERNATIONAL

Position
MAN 1 | PAY 1

ALIGNED — RING IS ENTIRELY VISIBLE — MARKING: SUCCESS
MISSED — RING IS PARTIALLY VISIBLE — MARKING: MISSED
FAULT — RING IS NOT VISIBLE — MARKING: FAULT

Robot Make:
Robot Model:
Robot Config:
Pilot Code : VO Code:
Facility :
YYYY-MM-DD :
Time (2400): Trial #:

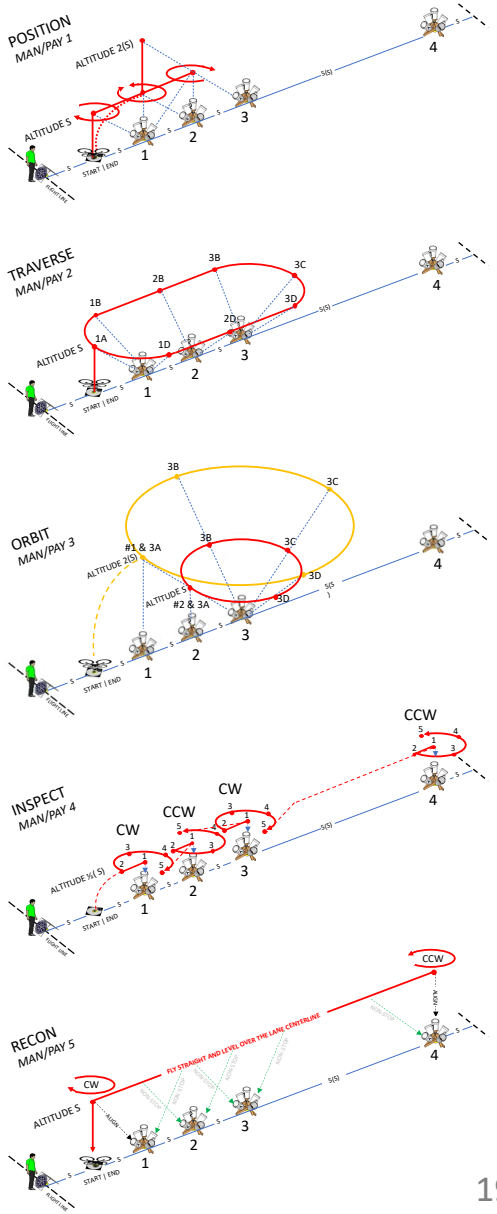
LANE SPACING	LIGHTING	WIND	PILOT VIEW	TIME LIMIT
10ft 20ft 30ft	DAYLIGHT 1000+ LUX	AVG WIND ____ MPH	EYES ON	10 MIN
Other ____ ft	LIGHTED 300+ LUX	MAX GUST ____ MPH	FPV ONLY	
	DARK < 1 LUX			

PROCEDURE | POSITION FLIGHT PATHS	CIRCLE ONE PER OCCURANCE:	FAULT	FAULT	FAULT
START THE TIMER AT LAUNCH FROM PLATFORM	CIRCLE WHEN ALIGNED	CIRCLE TARGET GAP DIRECTION WHEN CORRECT		
1 LAUNCH TO X OVER STAND 1	1	T BL TR BR TL		
2 ALIGN BUCKETS 1 AND 2E	2E	B TL TR BL BR		
3 ROTATE RIGHT 360° OVER STAND 1	1	T BL TR BR TL		
4 ALIGN BUCKETS 1 AND 2E	2E	B TL TR BL BR		
5 ROTATE LEFT 360° OVER STAND 1	1	T BL TR BR TL		
6 ALIGN BUCKETS 1 AND 2E	2E	B TL TR BL BR		
7 CLIMB TO 2X OVER STAND 1	1	T BL TR BR TL		
8 ALIGN BUCKETS 1 AND 3I	3I	B L T BL TL		
9 DESCEND TO X OVER STAND 1	1	T BL TR BR TL		
10 ALIGN BUCKETS 1 AND 2E	2E	B TL TR BL BR		
11 FORWARD OVER STAND 2	2	B L T BL TL		
12 ALIGN BUCKETS 2 AND 3I	3I	B L T BL TL		
13 BACKWARD OVER STAND 1	1	T BL TR BR TL		
14 ALIGN BUCKETS 1 AND 2E	2E	B TL TR BL BR		
15 FORWARD/ROTATE 180° OVER STAND 2	2	B L T BL TL		
16 ALIGN BUCKETS 2 AND 1C	1C	B L B L BR		
17 FORWARD/ROTATE 180° OVER LANDING	1A	T R B R BR		
18 ALIGN BUCKETS 1A AND LANDING	LANDING	T BL TR BR TL		
19 LAND CENTERED FACING STANDS (2 POINTS)	CENTERED (Perch 1)	T BL TR BR TL		
20 *Centered is 1 or more feet within a 1ft radius*	CENTERED (Perch 2)	L R TR BL L		

RESULTS

MAN 1 SCORE
TOTAL BUCKETS ALIGNED: of 20
RELIABILITY (Total Buckets Aligned / Attempted) X 100 %
EFFICIENCY Total Buckets Aligned / Minutes BPM

PAY 1 SCORE
TOTAL C's IDENTIFIED: of 100
AVERAGE ACUITY Total C's Identified / Total Buckets Aligned 1-5 Cs
EFFICIENCY Total Buckets Aligned / Minutes BPM



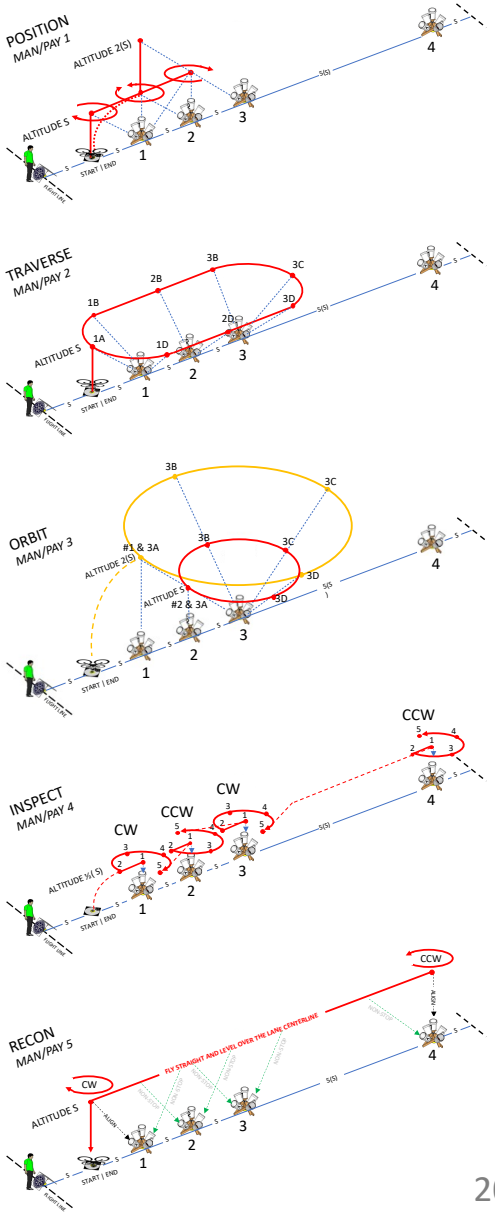
Scoring Metrics for Test Trials

Open Test Lane

1. **Completeness (Primary)**
   If you can't finish a trial without faults, just keep track of how far into the trial sequence you get until you're reliably finishing the trials.

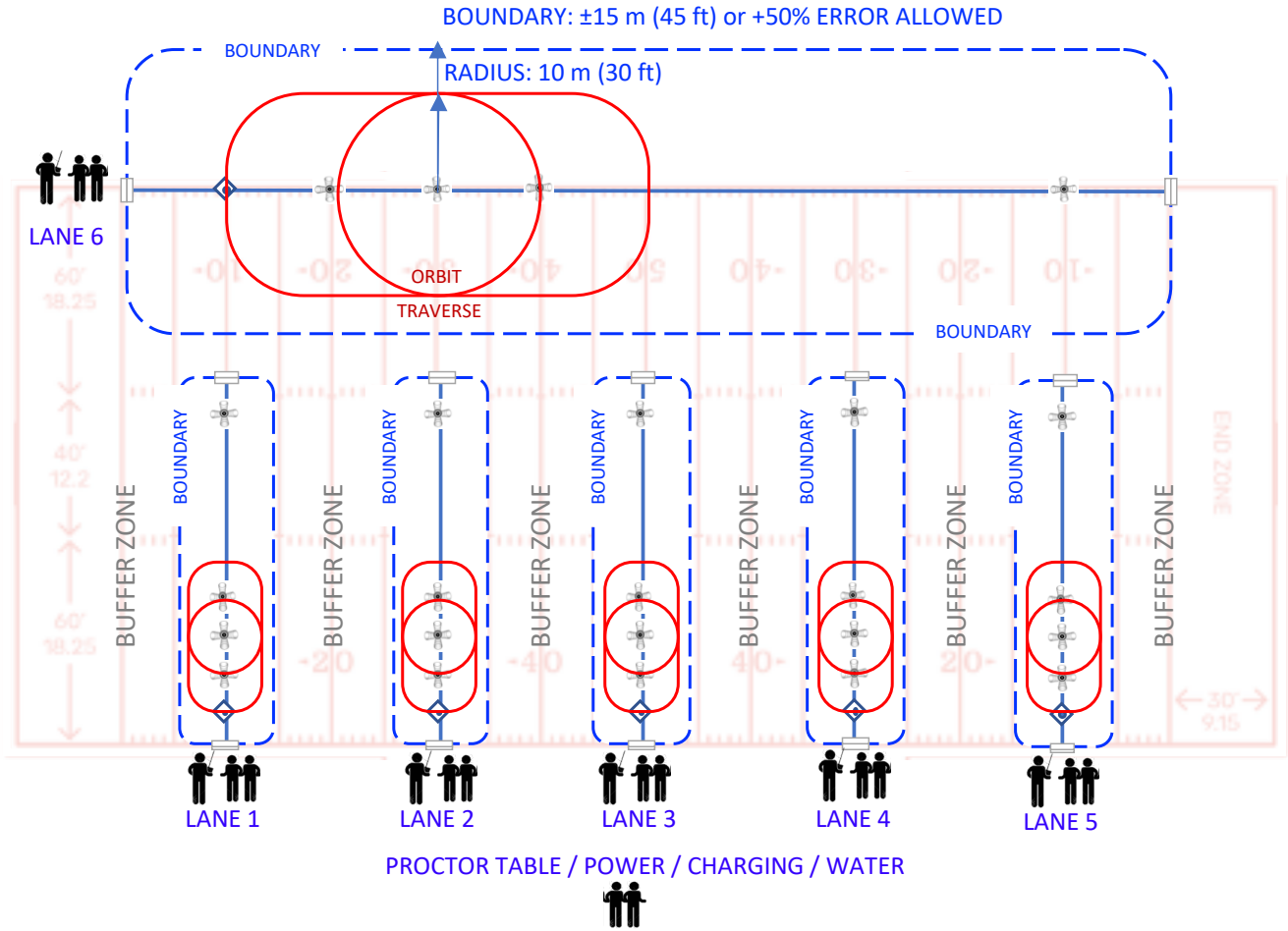
2. **Score (Secondary)**
   For complete trials, you can start tracking your scores over time to find the average of the most recent five trials. That's a good indication of your proficiency that can be compared to others using similar systems in similar test lanes.

3. **Efficiency (Optional)**
   If two systems or pilots are consistently completing trials, and their average scores are perfect, then the average elapsed time of the last 5 trials can help identify the most efficient systems or pilots exhibiting the most effective techniques.



Football Field Layout

Open Test Lane



LANE SPACING
10 m (30 ft)

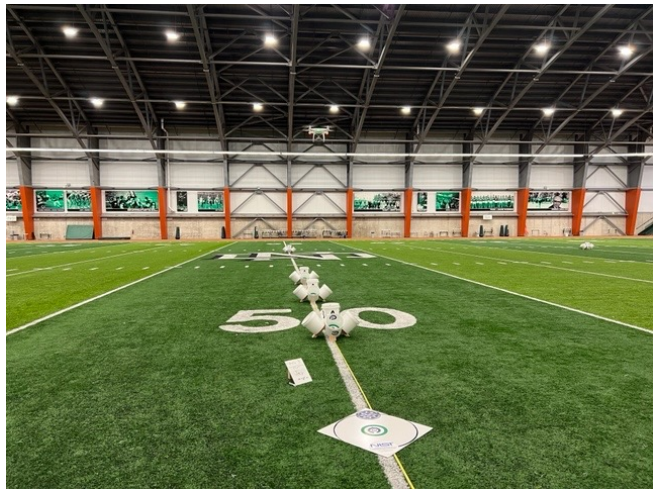
BOUNDARY (+50%)
± 15 m (45 ft)

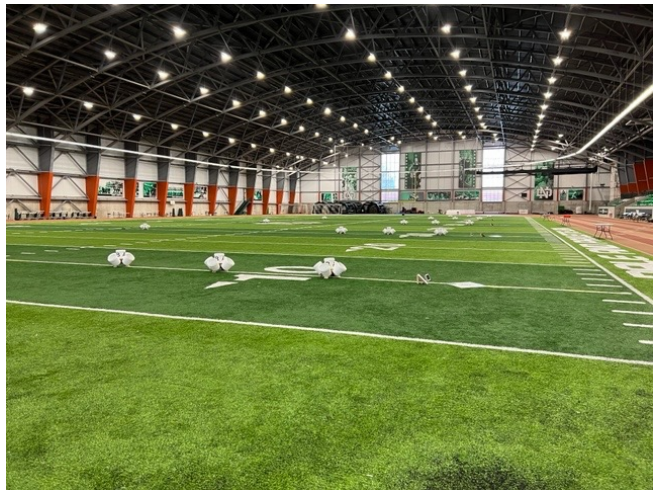
LANE LENGTH
100 m (300 ft)

LANE SPACING
3 m (10 ft)

BOUDARY (+50%)
±5 m (15 ft)

LANE LENGTH
30 m (100 ft)





SENSOR PANELS & FLIGHT LINES

LAUNCH/LAND PLATFORM

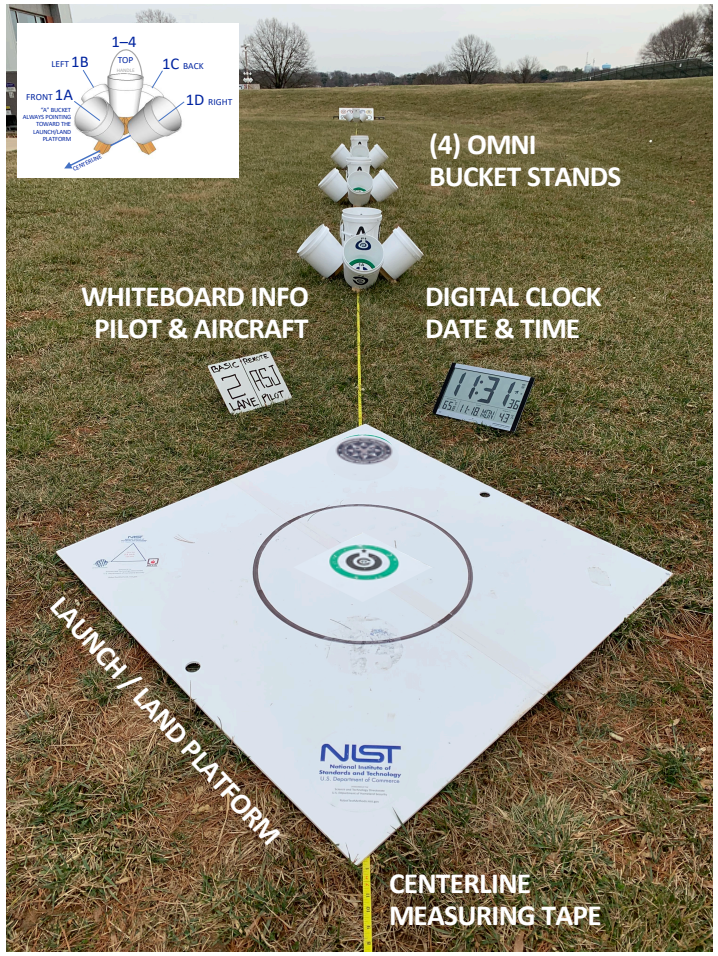
OMNI BUCKET STANDS #1, #2, #3, #4

ORBIT PATH AND TRAVERSE PATH

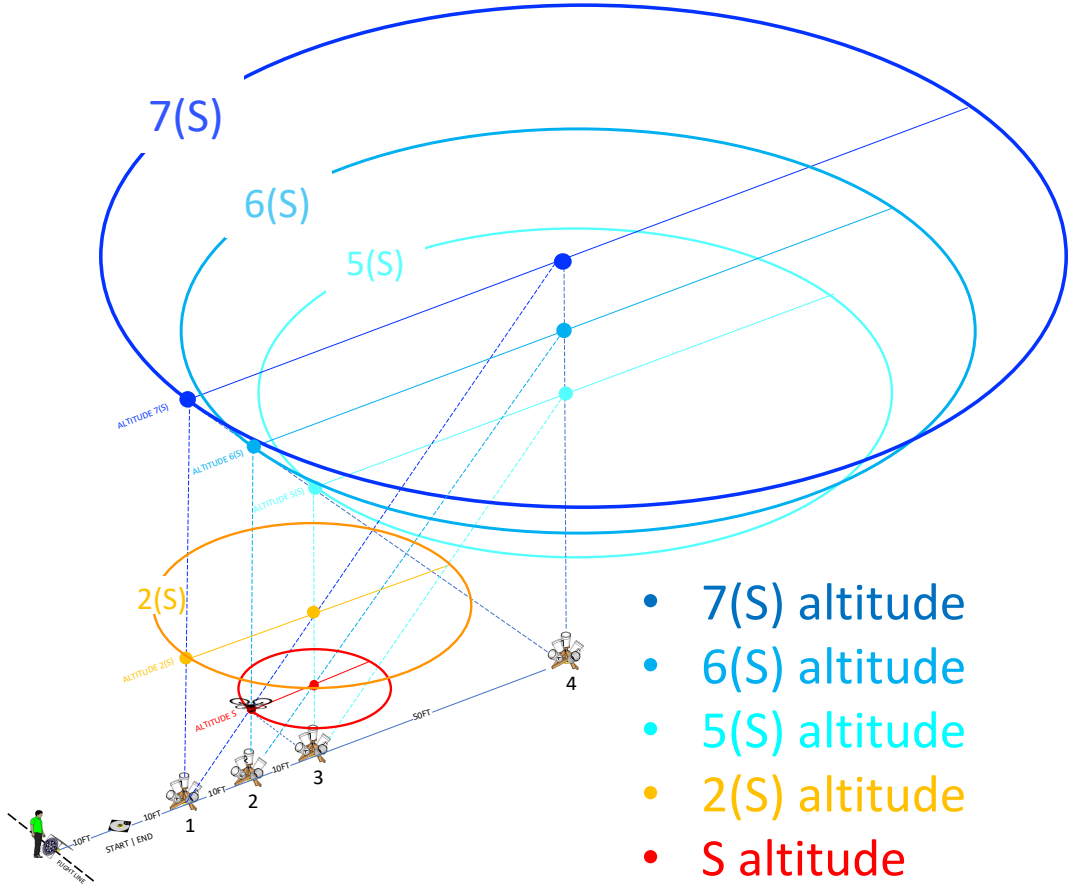
PILOT, VISUAL OBSERVER, AND FORM FILLER

Same Lane Supports Other Flight Paths

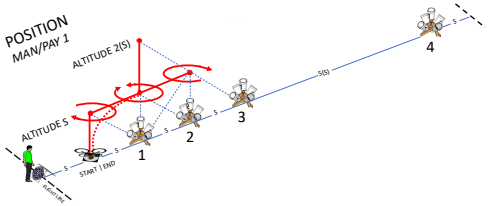
Open Test Lane

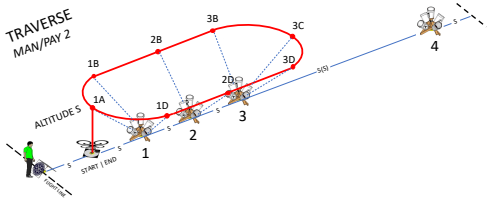


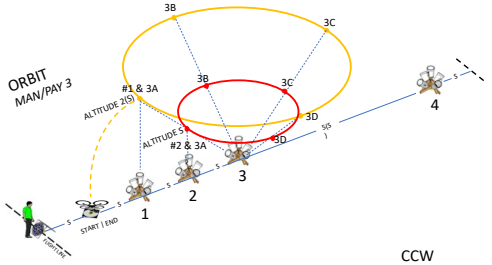
5 Different Orbits in Every Lane Spacing
(S) = 10ft, 20ft, 30ft, or other

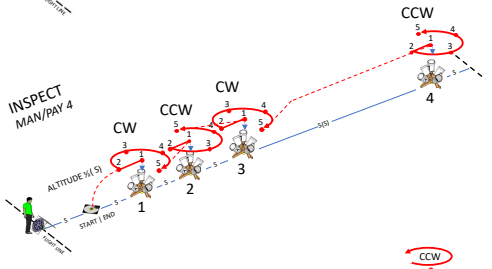


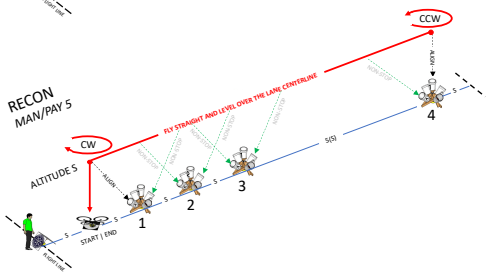
- 7(S) altitude
- 6(S) altitude
- 5(S) altitude
- 2(S) altitude
- S altitude







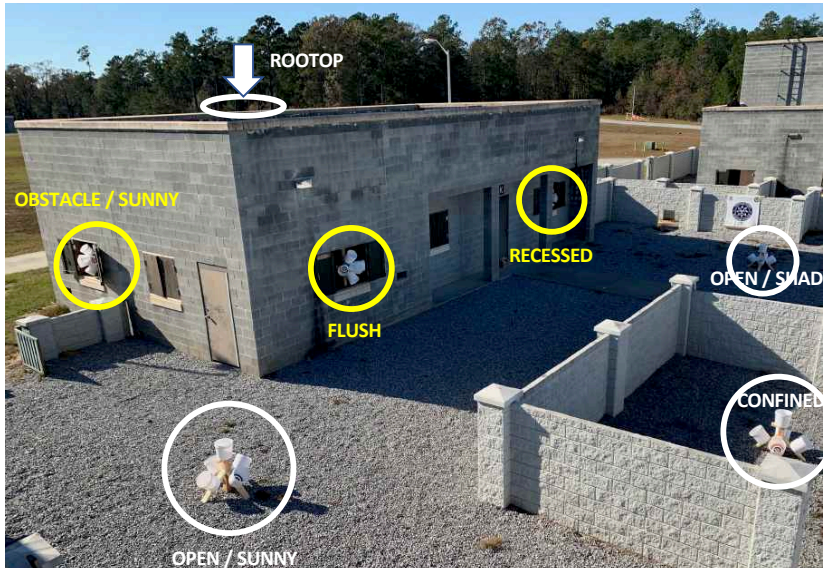
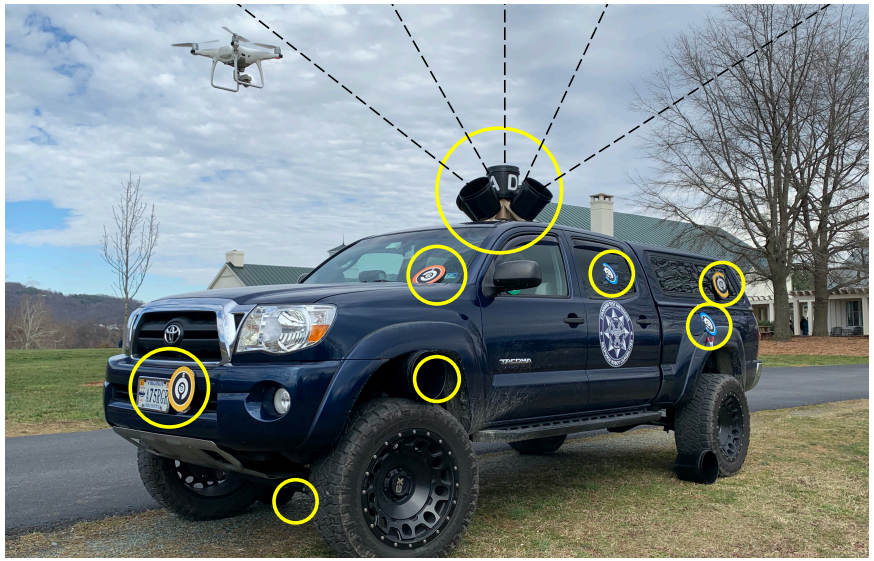




Related Scenarios with the Same Scoring Tasks

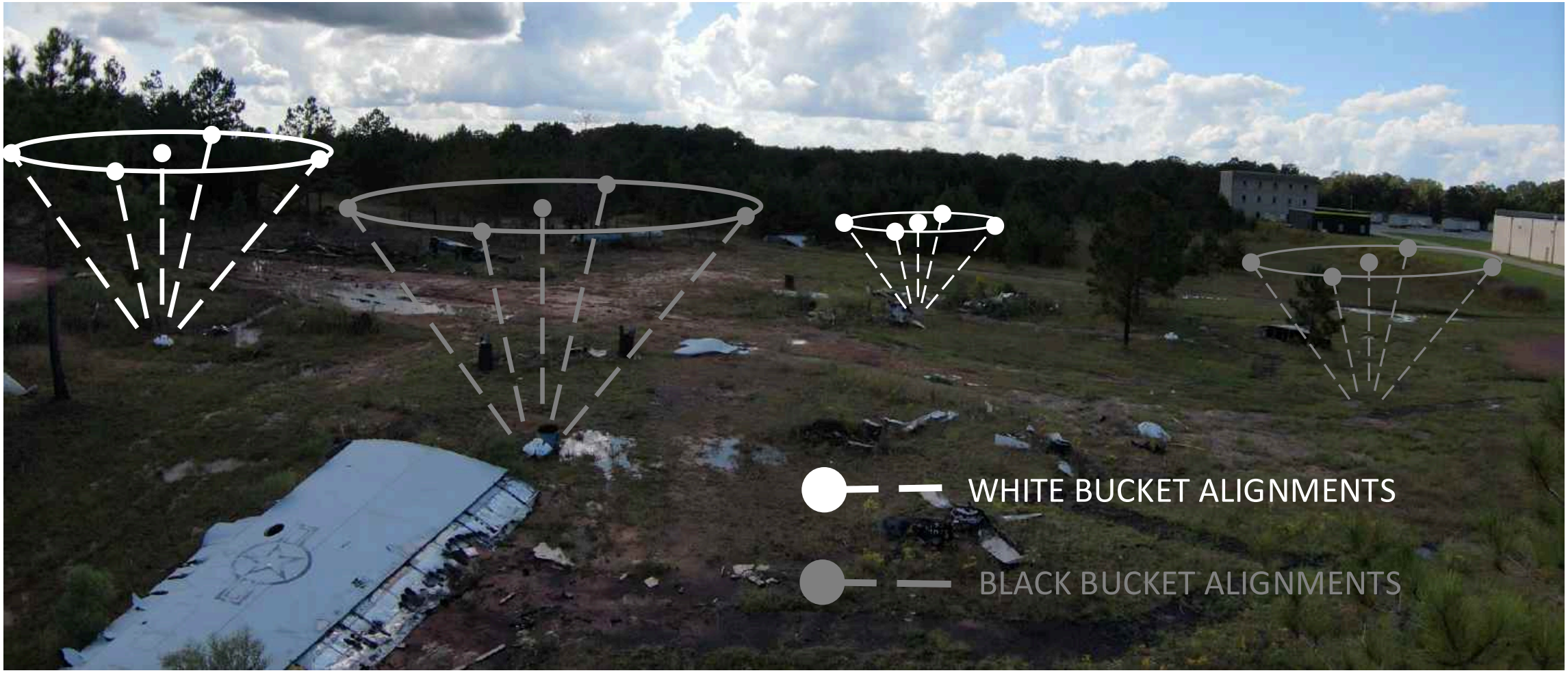
Open Scenarios

All scenarios have 20 targets for up to 100 pts each

WIDE AREA SEARCH	URBAN AREA SEARCH	VEHICLE IDENTIFICATION
		

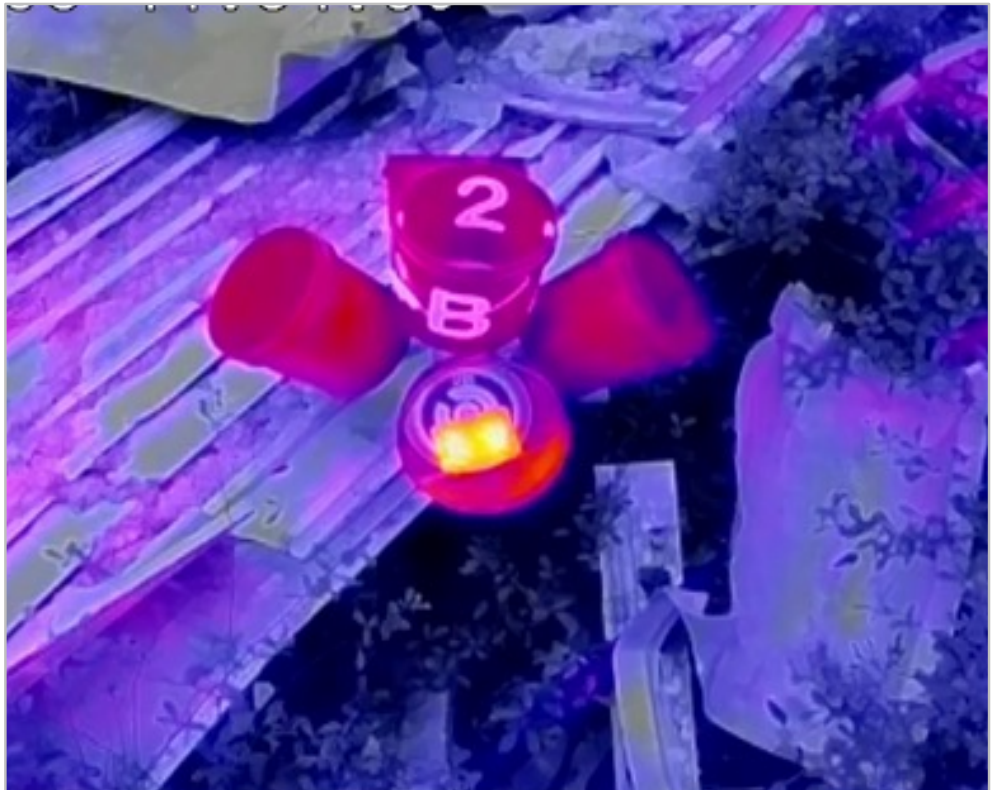
Wide Area Search from a Designated Altitude with the Same Scoring Tasks

Open Scenarios



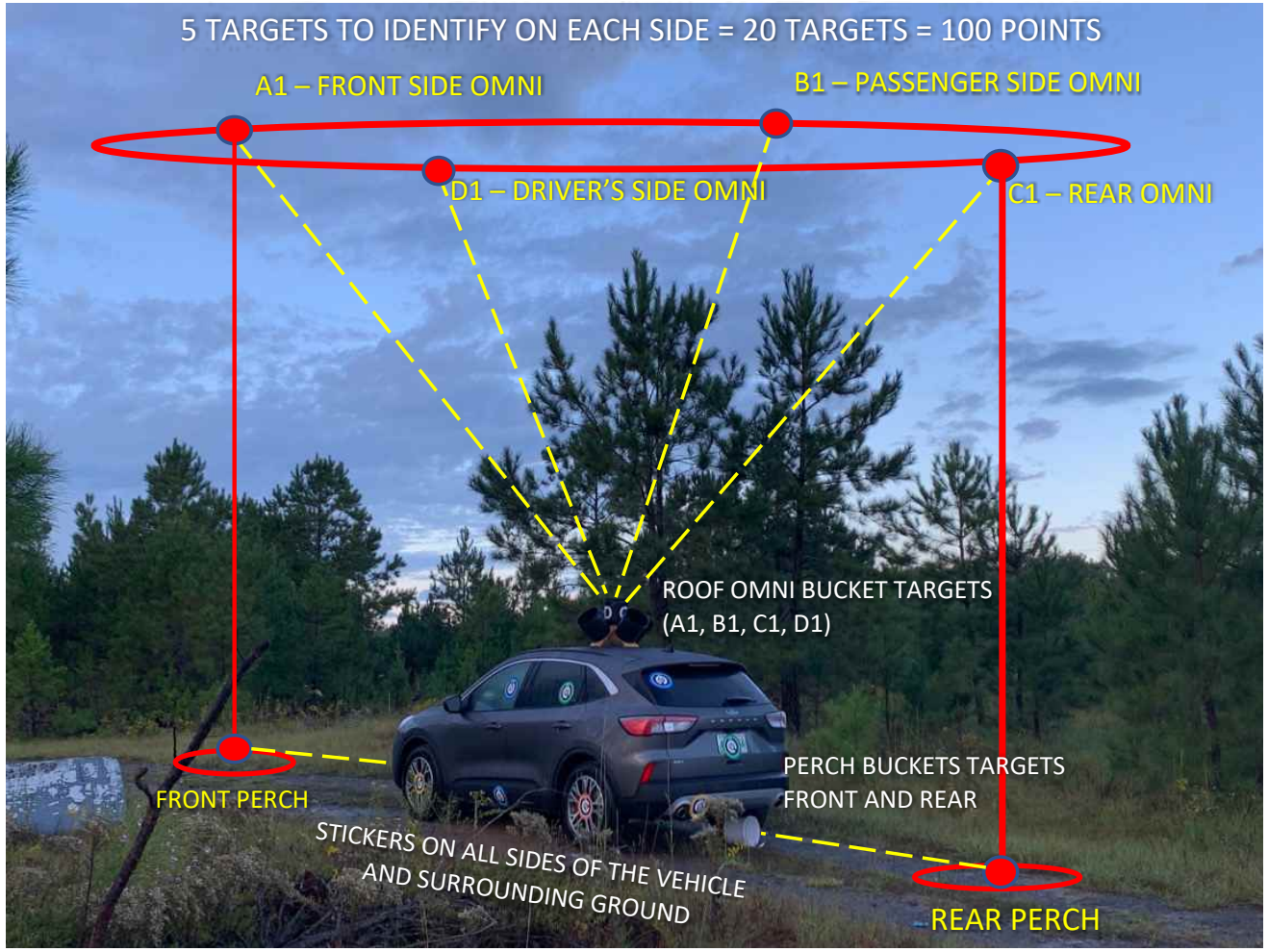
Scoring Tasks Are Placed with Objects of Interest

Open Scenarios



Vehicle Identification From a Designated Altitude (Plus Perches Front & Rear)

Open Scenarios



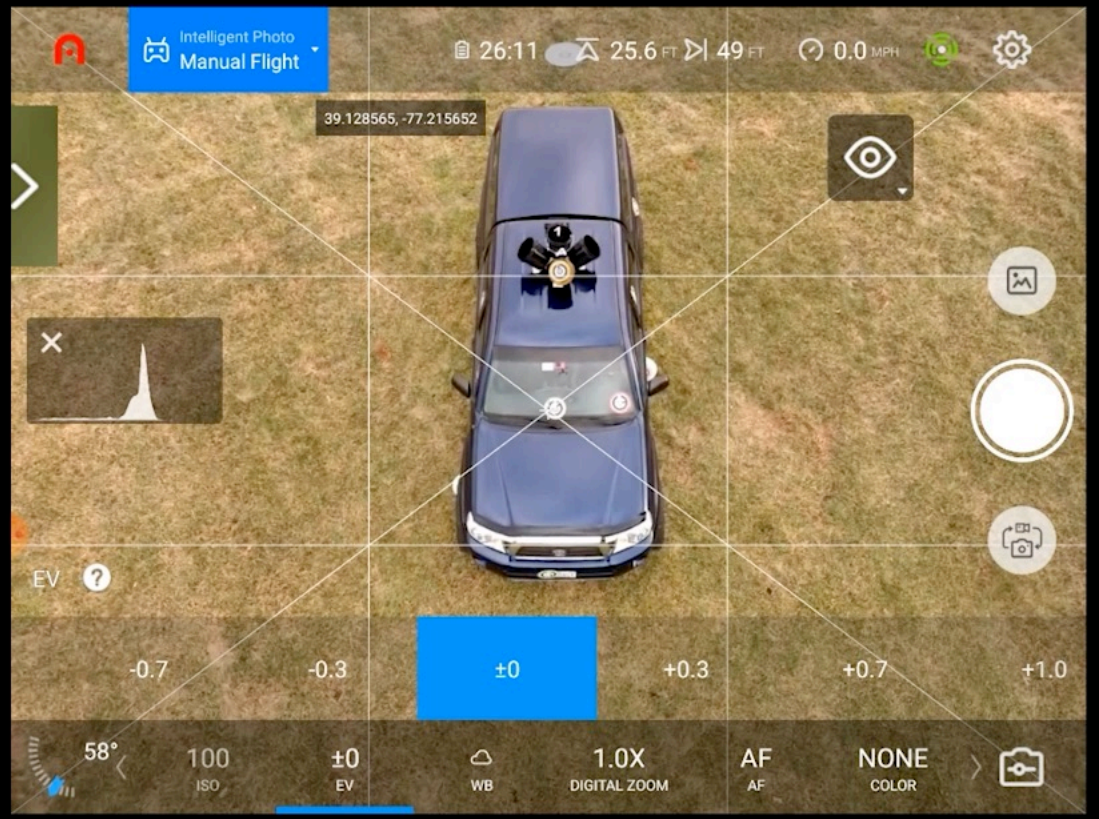
1	A1 – FRONT SIDE – ROOFTOP OMNI BUCKET
2	A2 – FRONT SIDE – WINDSHIELD CENTER FOR INTERIOR OBJECTS
3	A3 – FRONT SIDE – VIN #
4	A4 – FRONT SIDE – LICENSE PLATE
5	A5 – FRONT SIDE – PERCH POSITION UNDERBODY BUCKET
6	B1 – PASSENGER SIDE – ROOFTOP OMNI BUCKET
7	B2 – PASSENGER SIDE – FRONT WINDOW FOR INTERIOR OBJECTS
8	B3 – PASSENGER SIDE – REAR WINDOW FOR INTERIOR OBJECTS
9	B4 – PASSENGER SIDE – EXTERIOR FEATURE OR SURROUNDING GROUND
10	B5 – PASSENGER SIDE – EXTERIOR FEATURE OR SURROUNDING GROUND
11	C1 – REAR SIDE – ROOFTOP OMNI BUCKET
12	C2 – REAR SIDE – WINDOW CENTER FOR INTERIOR OBJECTS
13	C3 – REAR SIDE – LICENSE PLATE
14	C4 – REAR SIDE – EXTERIOR FEATURE OR SURROUNDING GROUND
15	C5 – REAR SIDE – PERCH POSITION UNDERBODY BUCKET
16	D1 – DRIVER SIDE – ROOFTOP OMNI BUCKET
17	D2 – DRIVER SIDE – FRONT WINDOW FOR INTERIOR OBJECTS
18	D3 – DRIVER SIDE – REAR WINDOW FOR INTERIOR OBJECTS
19	D4 – DRIVER SIDE – EXTERIOR FEATURE OR SURROUNDING GROUND
20	D5 – DRIVER SIDE – EXTERIOR FEATURE OR SURROUNDING GROUND

NIST National Institute of Standards and Technology U.S. Department of Commerce

Standard Test Methods for Small Unmanned Aircraft Systems

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

ASTM INTERNATIONAL



Test: Open Scenario - Vehicle
Drone: Autel EVO 2
Pilot: MD State Police

Test Director: Adam Jacoff
Facility: NIST Gaithersburg
Date: 2021-12-10

Final Score:

A1	A2	A3	A5	A4	D1	D5	D2	D3	D4
3	+3	+3	+4	+3	+3	+3	+3	+3	+3
C1	C3	C4	C2	C5	B1	B4	B2	B3	B5
+3	+4	+4	+3	+4	+3	+4	+4	+4	+3

= 70/100

Elapsed Time (mm:ss)

02:28

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

Standard Test Methods for Small Unmanned Aircraft Systems

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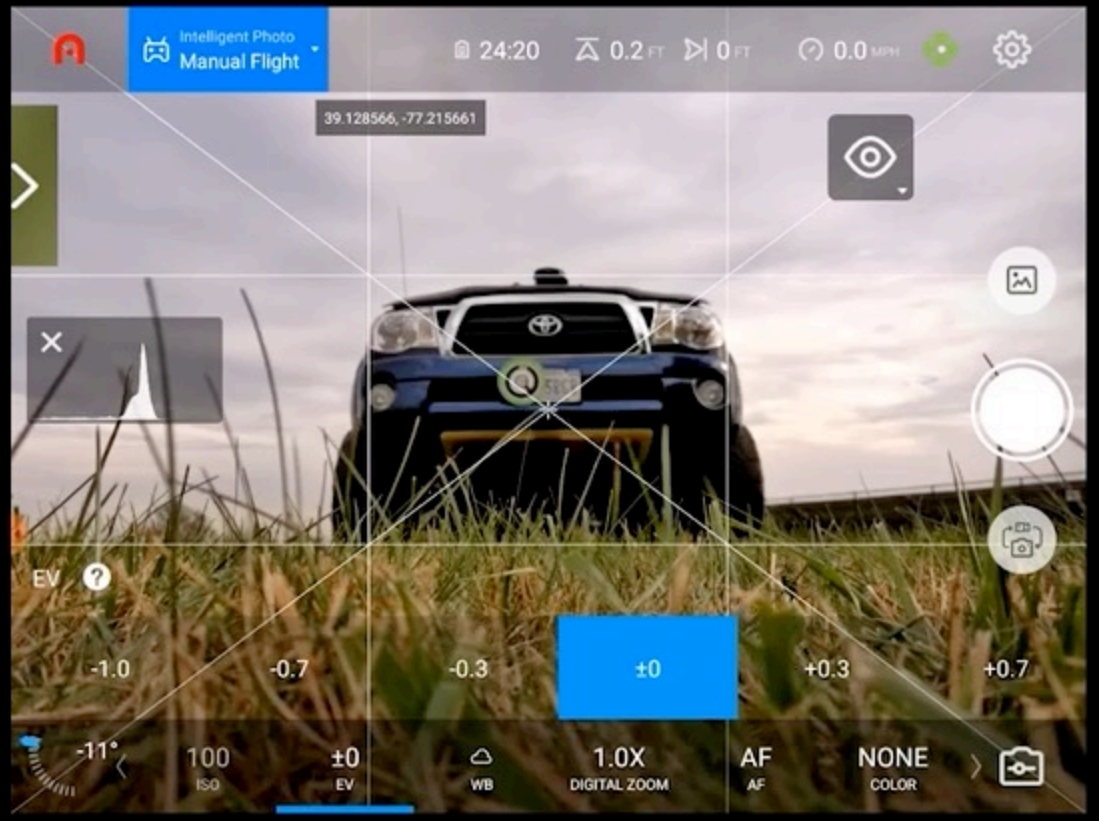
ASTM INTERNATIONAL



Test: Open Scenario - Vehicle
Drone: Autel EVO 2
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Date: 2021-12-10

Final Score:

A1	A2	A3	A5	A4	D1	D5	D2	D3	D4
3	+3	+3	+4	+3	+3	+3	+3	+3	+3
C1	C3	C4	C2	C5	B1	B4	B2	B3	B5
+3	+4	+4	+3	+4	+3	+4	+4	+4	+3

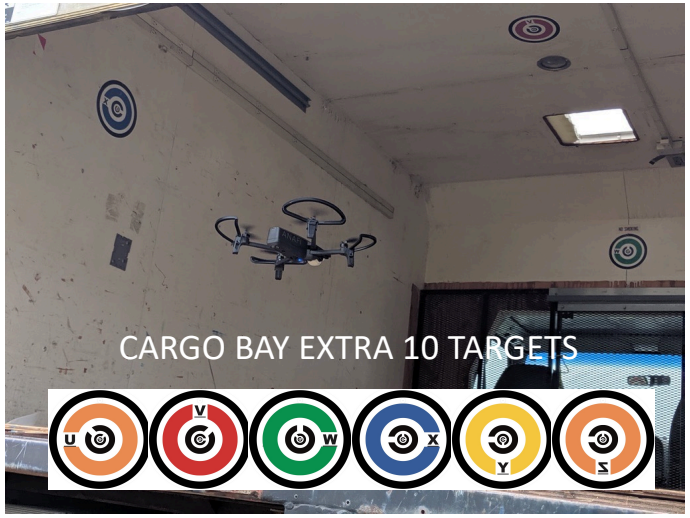
= 70/100

Elapsed Time (mm:ss)

04:59

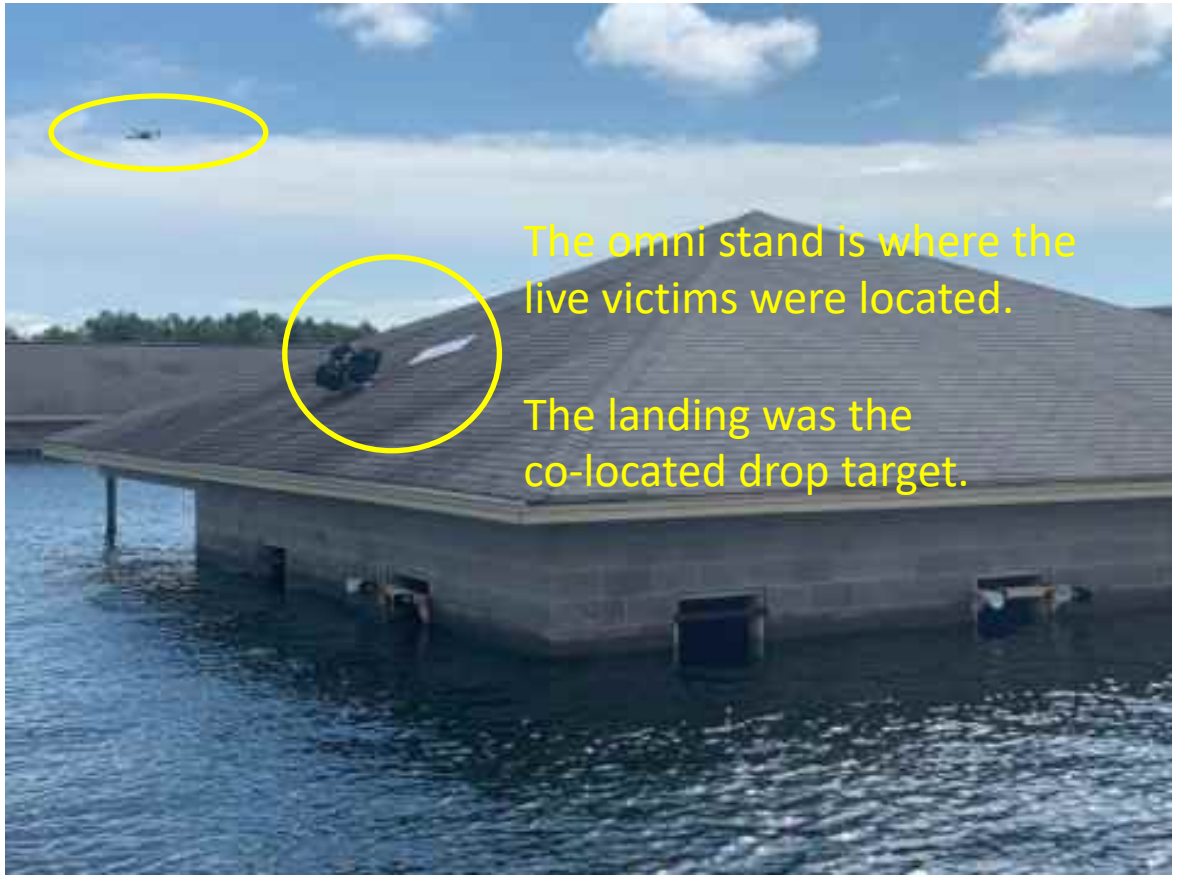
Other Related Scenarios with the Same Scoring Tasks

Open Scenarios



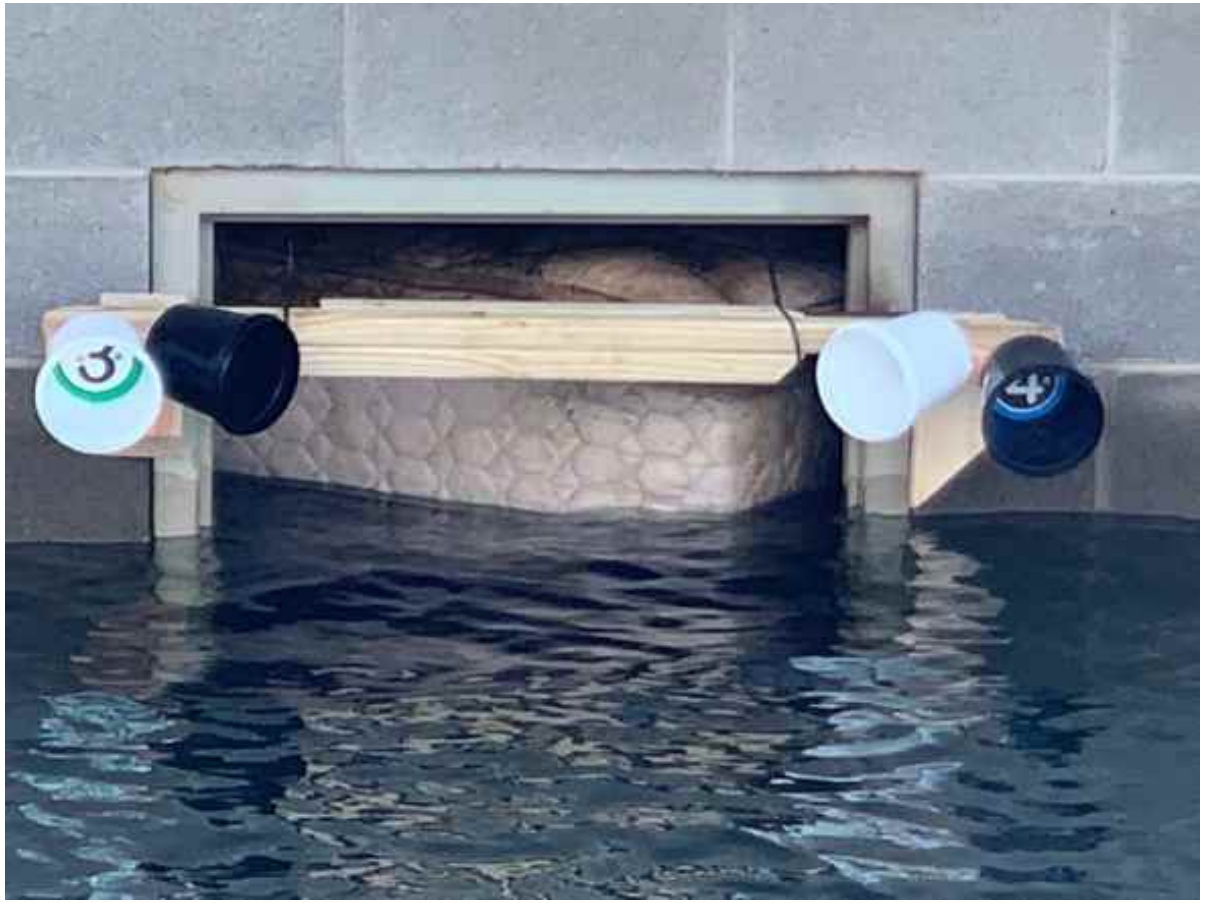
Other Related Scenarios with the Same Scoring Tasks

Open Scenarios



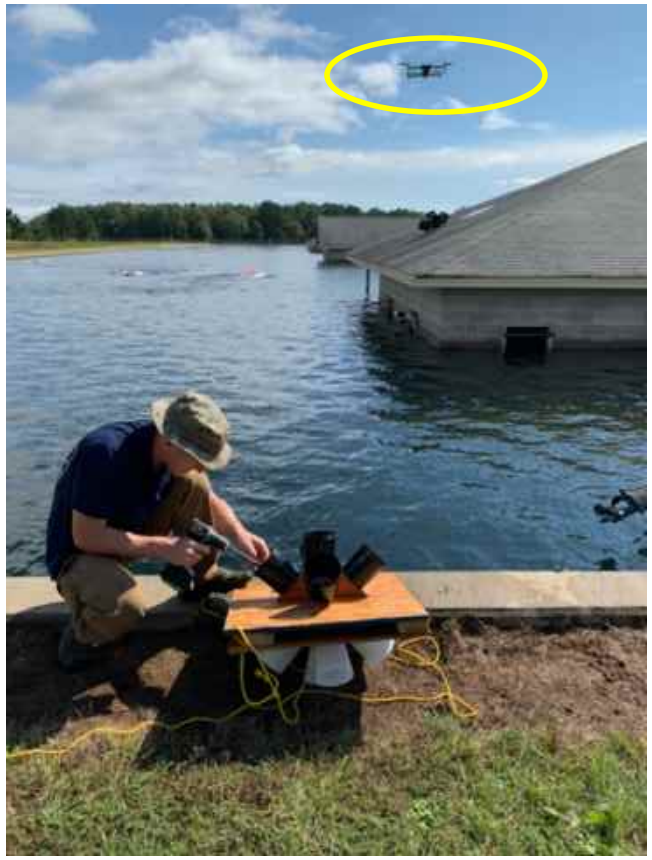
These More Difficult Detailed Inspection Tasks Were Mixed In For Drones or Aquatic Systems

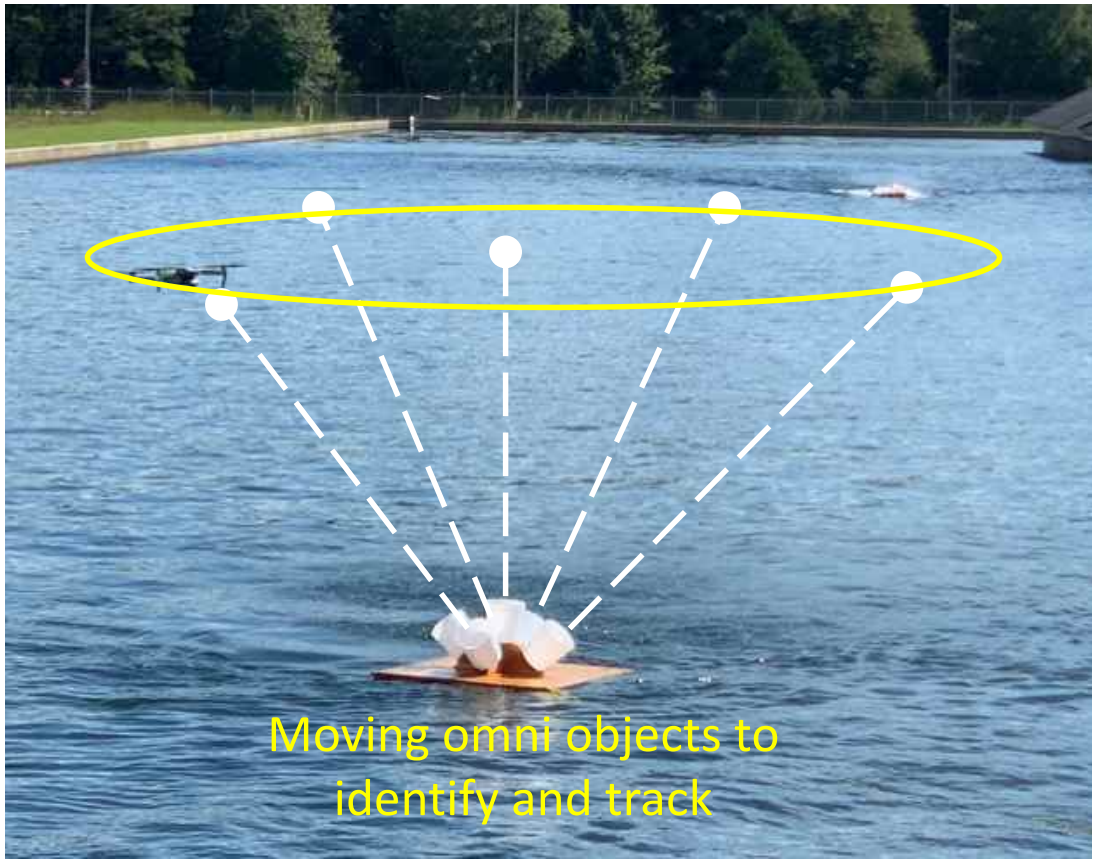
Open Scenarios



Other Related Scenarios with the Same Scoring Tasks

Open Scenarios





Trifold with Form and new Checkride Scoresheet

Open Test Lane and Related Scenarios

NIST National Institute of Standards and Technology U.S. Department of Commerce

ASTM INTERNATIONAL

Standard Test Methods for Small Unmanned Aircraft Systems

Basic Proficiency Evaluation for Remote Pilots

Flying safely in our national air space requires knowledge and skill. The FAA's Part 107 written test ensures remote pilots understand air space restrictions and safety precautions. This brochure introduces a basic skills test for remote pilots to evaluate "positive aircraft control" at all times. More comprehensive tests are available online.

These standard test methods provide a reproducible way to train and measure remote pilot proficiency for professionals and recreational pilots. Organizations can establish their own minimum proficiency requirements to improve operations while reducing risk to ground personnel and manned aircraft in the area.

Website: RobotTestMethods.nist.gov

Version: 2020E

BASIC PROFICIENCY FORM (10 MINUTE TIME LIMIT)

Pilot:

Org:

Email:

Zip Code: Date (MM/DD/YY):

Make: Model:

CAPTURE ONLY ONE IMAGE OF EACH BUCKET – CIRCLE ALIGNED IMAGES AND LANDINGS

	CAPTURE PRE-LAUNCH CLOCK IMAGE – **LAUNCH TIME (HH:MM:SS)**	: :
	PHASE 1: PERFORM POSITION TEST ALONG CENTERLINE	CIRCLE ALIGNED
1	**LAUNCH AND HOVER** OVER STAND #1 TO ALIGN WITH	1 & 2A
2	**YAW LEFTWARD 360°** OVER STAND #1 TO ALIGN WITH	1 & 2A
3	**YAW RIGHTWARD 360°** OVER STAND #1 ALIGN WITH	1 & 2A
4	**CLIMB VERTICALLY** OVER STAND #1 TO ALIGN WITH	1 & 3A
5	**DESCEND VERTICALLY** OVER STAND #1 TO ALIGN WITH	1 & 2A
6	**PITCH FORWARD** OVER STAND #2 TO ALIGN WITH	2 & 3A
7	**PITCH BACKWARD** OVER STAND #1 TO ALIGN WITH	1 & 2A
8	**PITCH FORWARD** OVER STAND #2 THEN **YAW LEFT 180°**	2 & 1C
9	**PITCH FORWARD** OVER LANDING THEN **YAW RIGHT 180°**	L & 1A
10	**LAND IN CIRCLE** (ONE OR MORE LEGS) – WORTH 2 POINTS	1pt & 1pt
	PHASE 2: PERFORM TRAVERSE TEST LEFTWARD	CIRCLE ALIGNED
11	**HOVER** OVER THE LAUNCH PLATFORM TO ALIGN WITH	1A
12	**ORBIT 90° LEFTWARD** AROUND STAND #1 TO ALIGN WITH	1B
13	**ROLL LEFTWARD** TO STAND #2 TO ALIGN WITH	2B
14	**ROLL LEFTWARD** TO STAND #3 TO ALIGN WITH	3B
15	**ORBIT 90° LEFTWARD** AROUND STAND #3 TO ALIGN WITH	3C
16	**ORBIT 90° LEFTWARD** AROUND STAND #3 TO ALIGN WITH	3D
17	**ROLL LEFTWARD** TO STAND #2 TO ALIGN WITH	2D
18	**ROLL LEFTWARD** TO STAND #1 TO ALIGN WITH	1D
19	**ORBIT 90° LEFTWARD** AROUND STAND #1 TO ALIGN WITH	1A
20	**LAND IN CIRCLE** (ONE OR MORE LEGS) – WORTH 1 POINT	1pt
	PHASE 3: PERFORM TRAVERSE TEST RIGHTWARD	CIRCLE ALIGNED
21	**HOVER** OVER THE LAUNCH PLATFORM TO ALIGN WITH	1A
22	**ORBIT 90° RIGHTWARD** AROUND STAND #1 TO ALIGN WITH	1D
23	**ROLL RIGHTWARD** TO STAND #2 TO ALIGN WITH	2D
24	**ROLL RIGHTWARD** TO STAND #3 TO ALIGN WITH	3D
25	**ORBIT 90° RIGHTWARD** AROUND STAND #3 TO ALIGN WITH	3C
26	**ORBIT 90° RIGHTWARD** AROUND STAND #3 TO ALIGN WITH	3B
27	**ROLL RIGHTWARD** TO STAND #2 TO ALIGN WITH	2B
28	**ROLL RIGHTWARD** TO STAND #1 TO ALIGN WITH	1B
29	**ORBIT 90° RIGHTWARD** AROUND STAND #1 TO ALIGN WITH	1A
30	**LAND IN CIRCLE** (ONE OR MORE LEGS) – WORTH 1 POINT	1pt
	CAPTURE CLOCK IMAGE AFTER LANDING – **LAND TIME (HH:MM:SS)**	: :
	STOP THE TIMER OR CALCULATE RESULT – **ELASPED TIME (MM:SS)**	:
	_____ / 40 MINIMUM PASSING SCORE – **TOTAL SCORE (POINTS)**	

CIRCLE ONE: **FAIL (SCORE | TIME | SAFETY)** OR **PASS**

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Standard Test Methods for Small Unmanned Aircraft Systems
ASTM International Standards Committee on Homeland Security Applications;
Response Robots (E54.09) | Website: RobotTestMethods.nist.gov

ASTM INTERNATIONAL

Version: 2020B2

Open Test Lane and Related Scenarios

CHECKRIDE SCORESHEET

The aircraft performs a series of maneuvering paths around the omni bucket stands in the test lane or as embedded scoring tasks in the related scenarios. Each flight path includes alignments with one or more buckets to identify recessed targets inside. Successful alignment is achieved when the drone can maintain the designated position, orientation, and altitude long enough to verify an unobstructed view of the inscribed ring at the bottom of the bucket. A single alignment image is captured of each bucket to use for scoring after the trial. Additional targets inside each bucket evaluate camera pointing, zooming, and exposure control to measure visual and thermal acuity and identify color shifts, hazardous material labels, or other objects of interest. Faults for extreme deviations from the intended flight paths or contact with any of the test apparatuses ends the trial to ensure safety.

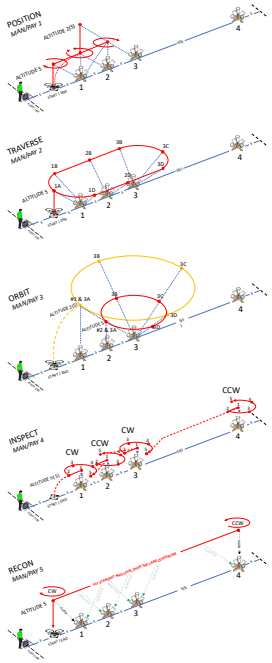
POSTION (MAN/PAY 1)
Evaluate basic flight maneuvers between designated hover positions, orientations, and altitudes along the lane centerline to demonstrate positive aircraft control at all times. The drone performs a series of maneuvers including climb, descend, yaw, pitch, and roll to simultaneously align with two buckets in each position, orientation, and altitude. The aircraft then lands centered on the platform with the chassis or any ground contact within a 30 cm (12 in) radius circle.

TRAVERSE (MAN/PAY 2)
Evaluate drones flying sideways parallel to objects while looking forward to identify features as if along a building, woods line, truck/bus, etc. The drone flies at altitude (S) to complete two laps in both directions around the omni bucket stands to align with the designated buckets. The drone also lands centered on the platform with the chassis or any ground contact within a 30 cm (12 in) radius circle.

ORBIT (MAN/PAY 3)
Evaluate drones flying circular flight paths at different altitudes around objects while looking inward to identify features on all four sides. The drone orbits at altitude 2(S) in both directions then altitude (S) in both directions to align with the designated buckets. Each orbit starts with an initial downward bucket alignment to check the radius before proceeding leftward and rightward. Accurate landings are not included.

INSPECT (MAN/PAY 4)
Evaluate drones flying in closer proximity around objects to inspect 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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Standard Test Methods for Small Unmanned Aircraft Systems
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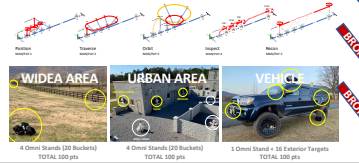
Version: 2020B2

Open Test Lane and Scenarios

CHECKRIDE SCORESHEET



Robot Make: _____

Robot Model: _____

Robot Config: _____

Pilot Code : _____ VO Code: _____

Facility : _____

YYYY-MM-DD : _____

Time (2400): _____ Lane #: _____

LANE SPACING (S)	LIGHTING	WIND	PILOT VIEW	TIME LIMIT
10 FT 20 FT 30 FT _____ FT (CIRCLE ONE OR FILL IN)	DAYLIGHT 1000+ LUX / LIGHTED 300+ LUX / DARK < 1 LUX (CIRCLE ONE)	AVERAGE _____ MPH / GUSTS _____ MPH	LINE OF SIGHT FACING LANE OPTIONAL V.O. / INTERFACE ONLY BACK TO LANE MANDATORY V.O. (CIRCLE ONE)	10 MIN / 20 MIN / _____ MIN (CIRCLE ONE OR FILL IN)

MANUEVERING SCORE: Circle the bucket number for full alignments (5 pts), or write a "1" over the bucket number for partial alignments (1 pt), or "X" through the bucket number for missed buckets (0 pts). **PAYLOAD SCORE:** Circle correctly identified gap orientations using the answer key (1 pt each).

Key: 2020B	OPEN TEST LANE 1 Position	2 Traverse	3 Orbit	4 Inspect	5 Recon
1	1 T BL R BR L HOVER	1A TR B TR L BR LEFTWARD	1 T BL R BR L LEFTWARD	1 T BL R BR L	4 TL B TR R BR
2	2A L BR T TL R YAW LEFT	1B R TL T BL B	3A BR T TL R BL	1A TR B TR L BR	BR T BL L TL upside down
3	1 T BL R BR L	2B TL R TR L BR	3B B TR R BL T	1B R TL T BL B	L B TR L BL T
4	2A L BR T TL R YAW RIGHT	3B B TR R BL T	3C BL R BL T BR	1C BR R TL L BR	1A TR B TR L BR NEXT LAP
5	1 T BL R BR L	3C BL R BL T BR	3D L TL R BR T RIGHTWARD	1D B TL R BL T	4 TL B TR R BR NEXT STAND
6	2A L BR T TL R CLIMB	3D L TL R BR T	1 T BL R BR L NEXT STAND	2 BL T BR R TL	BR T BL L TL upside down
7	1 T BL R BR L	2D TR B TL B BL	3A BR T TL R BL	2A L BR T TL R	L B TR L BL T
8	3A BR T TL R BL DESCEND	1D B TL R BL T	3D L TL R BR T	2D TR B TL B BL	1A TR B TR L BR NEXT LAP
9	1 T BL R BR L	1A TR B TR L BR	3C BL R BL T BR	2C T BL R TL B	4 TL B TR R BR
10	2A L BR T TL R FORWARD	L B TR L BL T	3B B TR R BL T RIGHTWARD	2B TL R TR L BR NEXT STAND	BR T BL L TL upside down
11	2 BL T BR R TL	1A TR B TR L BR	2 BL T BR R TL LEFTWARD	3 R TL B BL R	L B TR L BL T
12	3A BL T BR R TL BACKWARD	1D B TL R BL T	3A BR T TL R BL	3A BR T TL R BL	1A TR B TR L BR NEXT LAP
13	1 T BL R BR L	2D TR B TL B BL	3B B TR R BL T	3B B TR R BL T	4 TL B TR R BR
14	2A L BR T TL R FWD & YAW LEFT	3D L TL R BR T	3C BL R BL T BR	3C BL R BL T BR	BR T BL L TL upside down
15	2 TR B TL L BR upside down	3C BL R BL T BR	3D L TL R BR T RIGHTWARD	3D L TL R BR T NEXT STAND	L B TR L BL T
16	1C BR R TL L BR FWD & YAW RIGHT	3B B TR R BL T	2 BL T BR R TL	4 TL B TR R BR	1A TR B TR L BR NEXT LAP
17	L B TR L BL T	2B TL R TR L BR	3A BR T TL R BL	4A T BL B TR L	4 TL B TR R BR
18	1A TR B TR L BR LAND	1B R TL T BL B	3D L TL R BR T	4D BR B TL B TR	BR T BL L TL upside down
19	P1 BL R TL L BL	1A TR B TR L BR	3C BL R BL T BR	4C R BL T TR B	L B TR L BL T
20	P2 L BR T TL B	L B TR L BL T	3B B TR R BL T	4B TR L BL R TL	1A TR B TR L BR
TOTAL	MAN /100	MAN /100	MAN /100	MAN /100	MAN /100
	PAY /100	PAY /100	PAY /100	PAY /100	PAY /100
Elapsed Time	: :	: :	: :	: :	: :
	PASS FAIL	PASS FAIL	PASS FAIL	PASS FAIL	PASS FAIL

Answer key is relative to top of image when in the correct position.

SCENARIOS Search	Vehicle
1 T BL R BR L	A1 T BL R BR L
1A TR B TR L BR	A2 TR B TR L BR
1B R TL T BL B	A3 R TL T BL B
1C BR R TL L BR	A4 BR R TL L BR
1D B TL R BL T	A5 B TL R BL T
2 BL T BR R TL	B1 BL T BR R TL
2A L BR T TL R	B2 L BR T TL R
2D TR B TL B BL	B3 TL R TR L BR
2C T BL R TL B	B4 T BL R TL B
2B TL R TR L BR	B5 TR B TL B BL
3 R TL B BL R	C1 R TL B BL R
3A BR T TL R BL	C2 BR T TL R BL
3B B TR R BL T	C3 B TR R BL T
3C BL R BL T BR	C4 BL R BL T BR
3D L TL R BR T	C5 L TL R BR T
4 TL B TR R BR	D1 TL B TR R BR
4A T BL B TR L	D2 T BL B TR L
4D BR B TL B TR	D3 TR L BL R TL
4C R BL T TR B	D4 R BL T TR B
4B TR L BL R TL	D5 BR B TL B TR
MAN /100	MAN /100
PAY /100	PAY /100
: :	: :
PASS FAIL	PASS FAIL

*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 systems.

Finally Ready for Balloting!

Open Test Lane and Related Scenarios

Standard Test Method for Evaluating Aerial Drone Capabilities and Remote Pilot Proficiency: Open Test Lane and Related Outdoor Object Identification Scenarios