UAS 3D MAPPING CHALLENGE
FIRST RESPONDER

Stage 2.2 Orientation

First Responder UAS
3D Mapping Challenge
(UAS 5.0)

2 November 2023

#NIST #PSCR #FirstResponders #3DMappingChallenge

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#NIST #PSCR #FirstResponders #3DMappingChallenge

Stage 2 Contestants

Congratulations to the Continuing Contestants!

AAUNO	Aggie Autonomy	AMAV	ARCC	BlackBee Robotics
CNA-RIIS	Flyt Aerospace	Maroon Scanner	New Horizon Innovations	ResQVision
Team ManTech	Team ResponseWing	Uniform Sierra <> Purdue	University of Colorado	Voxel
Syndicus Aerospace (Finalist)	Fire Eye (Finalist)	EpiSci (Finalist)		

Stage 2.2 Contestants

Welcome Walk-on Contestants!

- Sign up for the UAS 5.0 newsletter and updates
  - UAS 5.0 website: firstresponderuaschallenge.org/uas5
- Review Official Rules for Stage 2 Walk-on Contestants on the UAS 5.0 website
  - Also available on Challenge.Gov: https://www.challenge.gov/?challenge=uas5
- Review FAQ on the UAS 5.0 website
- Download submission templates from the UAS 5.0 website
- This presentation and recording link will be posted on the UAS 5.0 website

Agenda

1. Challenge Goal
2. Stage 2.2 Overview
3. Timeline and Key Dates
4. Prizes
5. Participant Communication
6. Stage 2.2 Challenge Process Description
7. Questions

Challenge Goal

To advance UAS technologies by designing, building and operating affordable drone prototypes in support of NIST PSCR's research to provide an accurate, high-quality 3D map in real-time to support First Responders' indoor operations prior to entry.

Indoor Situational Awareness

Indoor disaster response with no GPS and 3D Mapping

First Responders need to conduct an effective response for rescue efforts indoors while operating with limited or no GPS signal.

Operationally Sound

Safety / Portable
Durable / Low-light

To improve both safety and mission outcome, they would benefit from a UAS that could maneuver in close space and provide accurate information.

Easy to Use

Affordable / Easy-to-Use
Blue or Green UAS Capable

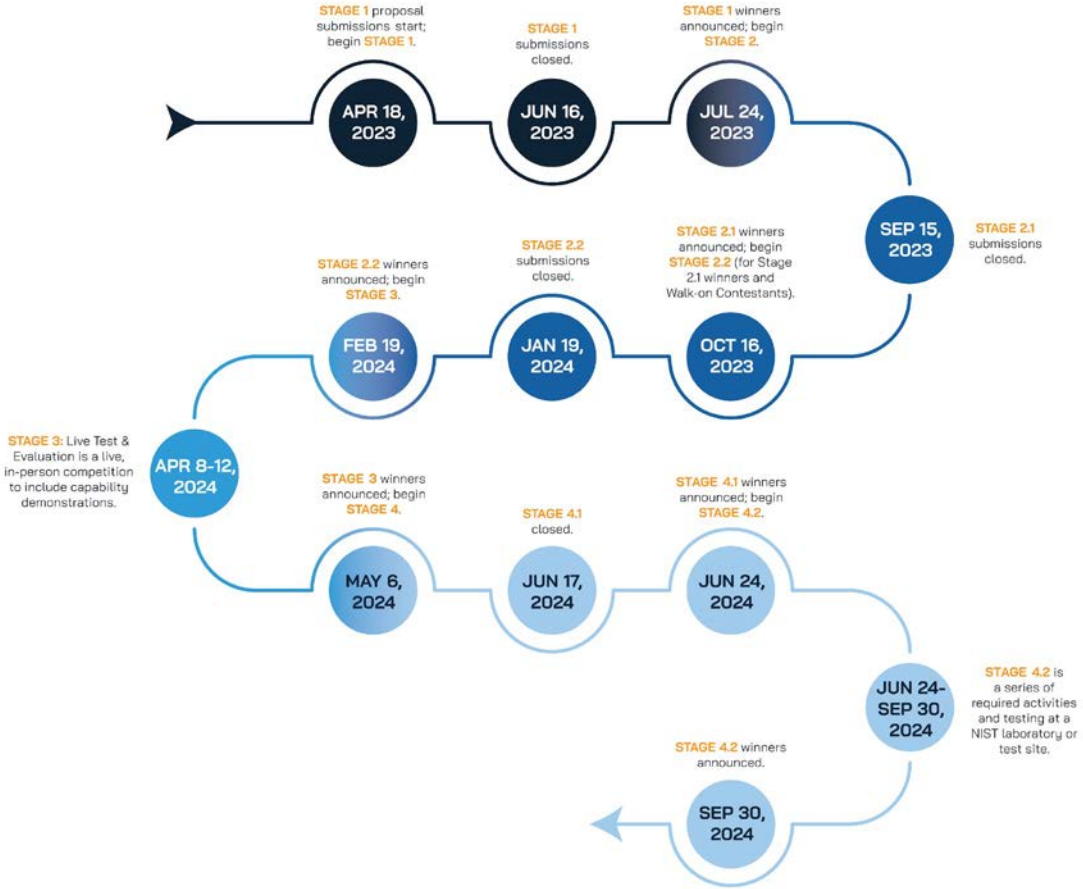
Develop a low cost, Blue/Green UAS capable platform that offers semi or fully autonomous operation

Stage 2.2 Overview

- **Goal:** Design and build a prototype that meets **all** design specifications and safety requirements
- You will achieve the goal through the following:
  - Implementing your project plan
  - Two milestones to demonstrate progress:
    - ~~Stage 2.1: Design Review (including first responder participation)~~ **COMPLETE**
    - Stage 2.2: Prototype Build & Safety Evaluation (video review)
  - 1 Mandatory check-in: Week of December 4 for **Continuing Contestants** only

All Contestants and Participants should remain focused on the goal of competing in Stage 3

Challenge Roadmap



STAGE 2 KEY DATES

November 2	Stage 2.2 Contestant Webinar
December 5, 7, and 8, 2023	Mandatory Check-ins, Stage 2.1 Feedback w/ Continuing Contestants
January 19, 2024	Stage 2.2 submission deadline (via Contestant Portal/bestincrowd.com)
February 19	Stage 2.2 winners announced; Stage 3 begins

Some dates may be adjusted

Challenge Prizes: Up to $987.5K Total

Stage 1 Up to 20 — $7.5K each, Up to $150K total

Stage 2.1 Up to 15 — $12.5K each, Up to $187.5K total
(Up to 5 additional teams will be awarded an invite to Stage 2.2 but not a cash award)

Stage 2.2 Up to 12 — $10K each, Up to $120K total and invited to compete in Stage 3
$5K each in travel prize to attend Stage 3, Up to $60K total

Stage 3

x 1	x 1	x 1	Up to 5
Grand Prize	*2nd Place*	*3rd Place*	*Best-In-Class Awards*
$100K	$50K	$30K	$10K each, Up to $50K total

(Up to 8 teams will be awarded an invite to Stage 4)

Stage 4.1 Up to 8 — $10K each, Up to $80K total

Stage 4.2 Up to 8 — $20K each*, Up to $160K total

*This prize requires contestants to attend the final event at the NIST laboratory or test site.

Participant Communications Process

Contestants are encouraged to solicit support from UAS Challenge staff as follows:

- Join the challenge on the Contestant Portal (“bestincrowd.com”)
- Review FAQs (updates by mid-December) and submission templates
- Questions: direct emails to *susank@capconcorp.com*
- Social Media:
  - Contestants are encouraged to celebrate their winners’ status, connect with other contestants, post their progress on social media platforms, and share pictures of their competition adventure.
  - #NIST #PSCR #FirstResponders #3DMappingChallenge:
    - https://www.linkedin.com/company/uaschallenges/
    - https://twitter.com/uaschallenges/
    - https://www.instagram.com/uaschallenges/
    - https://www.facebook.com/uaschallenges

Challenge Process Description

Stage 2.2 Submission Requirements

Challenge Goal: Design, build, and fly a cost-effective UAS solution that provides an accurate, high-quality 3D map in real-time to support First Responders' indoor operations prior to entry.

Demonstrate a working UAS prototype that meets the Challenge Requirements & Objectives:

- Submit a Stage 2.2 entry by 9 PM EDT on January 19, 2024:
  1. Test Videos/Map/Scoresheet: Upload the four **videos** and final 3D **map deliverable** to an online server (link on the *Contestant Portal*). Submit the completed 3D test lane **scoresheet** through the *Contestant Portal*
  2. Technical Performance Measures (TPM) **Workbook**: Complete using the template and upload to the *Contestant Portal*. Note: evaluation standards for video test & safety readiness review are included in the TPM Workbook (2 Video Demonstration). Provide justification or rationale for all the fields (0 Requirements)

Links to all submission templates can be found on the UAS 5.0 website. All entries must be submitted through the Contestant Portal.

Stage 2.2 Submission Requirements Cont.

- Submit a Stage 2.2 entry by 9 PM EDT January 19, 2024:
  3. Bill of Materials (BOM): Complete using the designated tab (1 BOM) in the TPM Workbook
  4. Concept Summary (1-slide): Complete using the template and upload to the *Contestant Portal*
  5. Evidence of FCC Compliance: Upload a photo of the FCC ID, license, or letter of authorization from the FCC to the *Contestant Portal*
  6. <u>If you are a Walk-on contestant:</u> Upload Proof of Insurance ($1M liability coverage, NIST named additional insured) and completed Eligibility Verification form to the *Contestant Portal*

Links to all submission templates can be found on the UAS 5.0 website. All entries must be submitted through the Contestant Portal.

Video Demonstration

Video 1 (approx. 10 min)	Video 2 (approx. 5 min)	Video 3 (approx. 20-40 min)	Video 4 (approx. 30 min)
• System Summary: 4 min • System Safety Checks, UAS powered off: 3 min • System Safety Checks, UAS powered on: 3 min	Open Area Indoor Flight	3D Mapping Test Lane Test Procedure A	3D Mapping Test Lane Procedure B Post-Flight Measurement

Video Requirements for Video 3 only:

*The following video streams must be combined into a single quad-screen video:

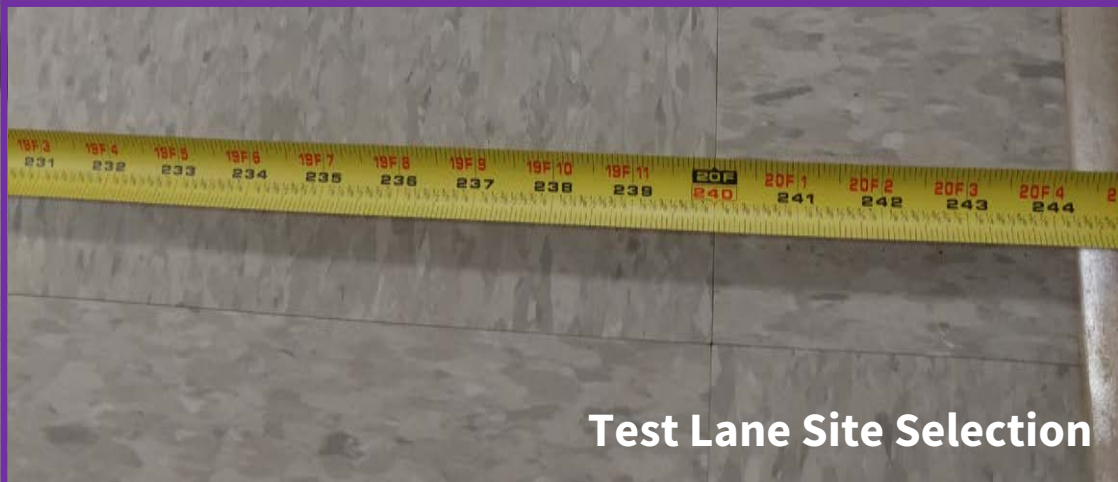
1. View of the operator interface, operator's hands, and 3D map progress rendering
2. View from near the start point
3. View from the end point
4. View from the onboard camera facing out towards the nose of the UAS

Technical Performance Measures

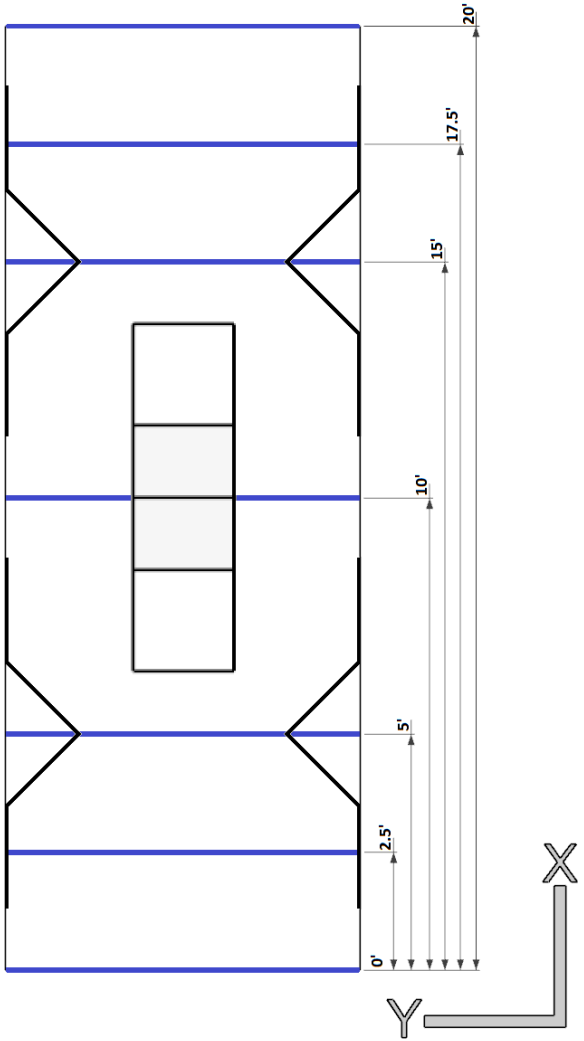
Operating Conditions: All flights will initiate from and operate indoors at all times. Assume an operational altitude range between 0 ft and 20 ft above ground level. Temperatures will average between 60 and 90 degrees Fahrenheit. Flights may need to traverse multiple interior rooms and floor levels while providing data to the ground control station located outside the flight testing area. Complete darkness is expected in some rooms. Hanging and ground obstacles are expected. Indoor smoke may be present.

The Stage 3 event location is planned for **Salina, KS** from April 8-12, 2024; all teams competing for prize money in Stage 3 are required to attend.

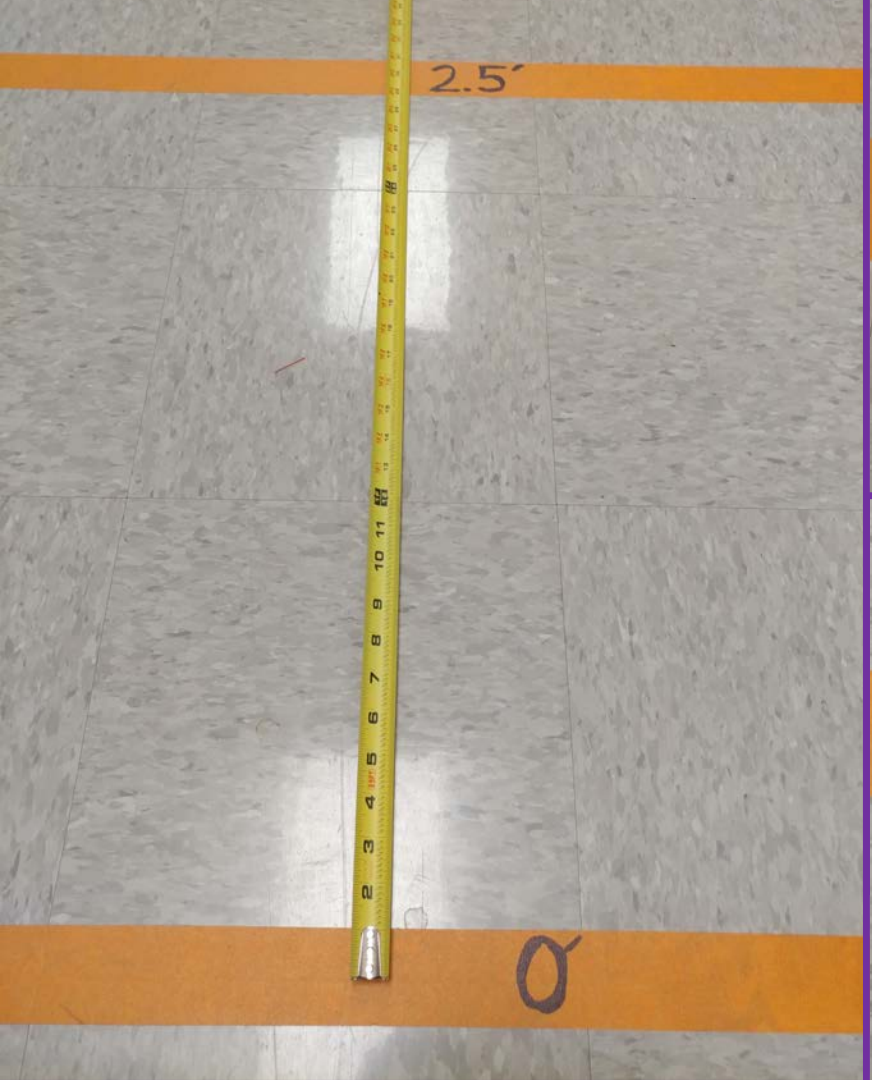
3D Mapping Test Lane



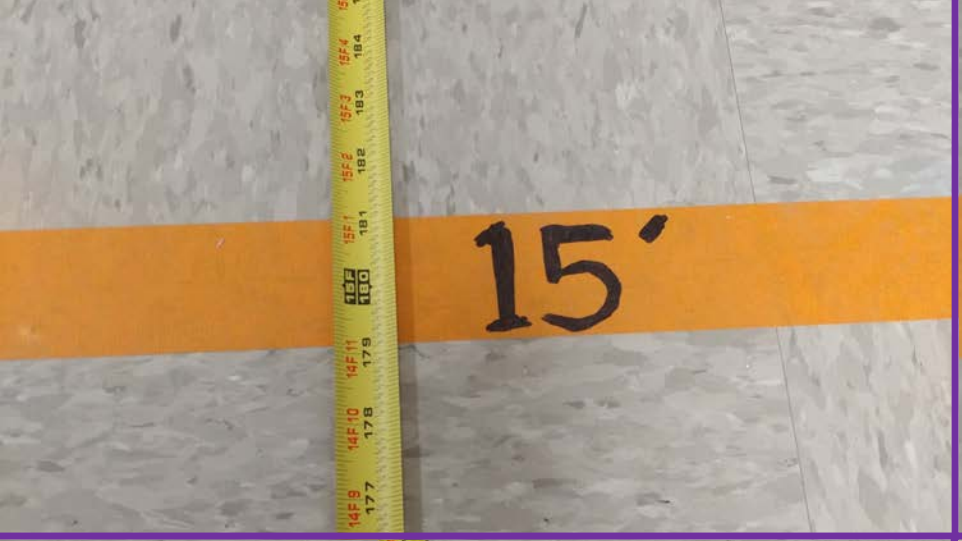
Test Lane Site Selection



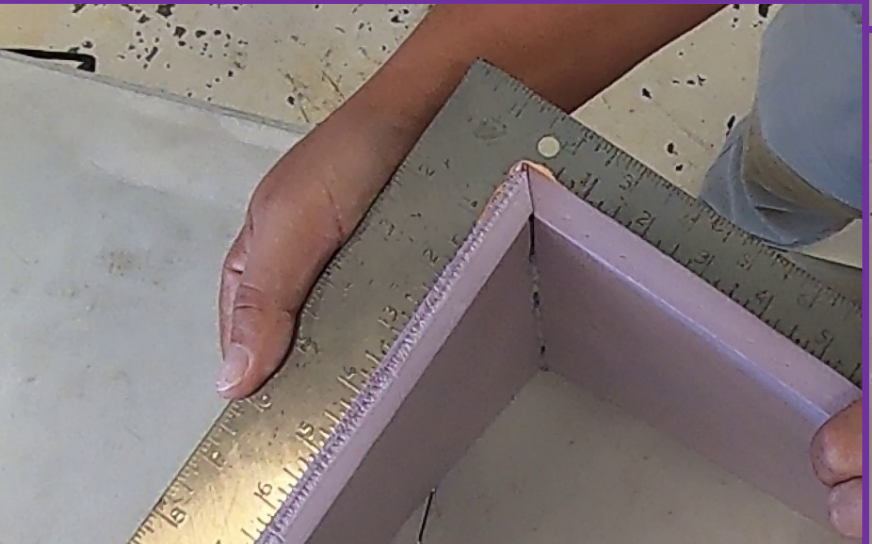
Marking Test Lane



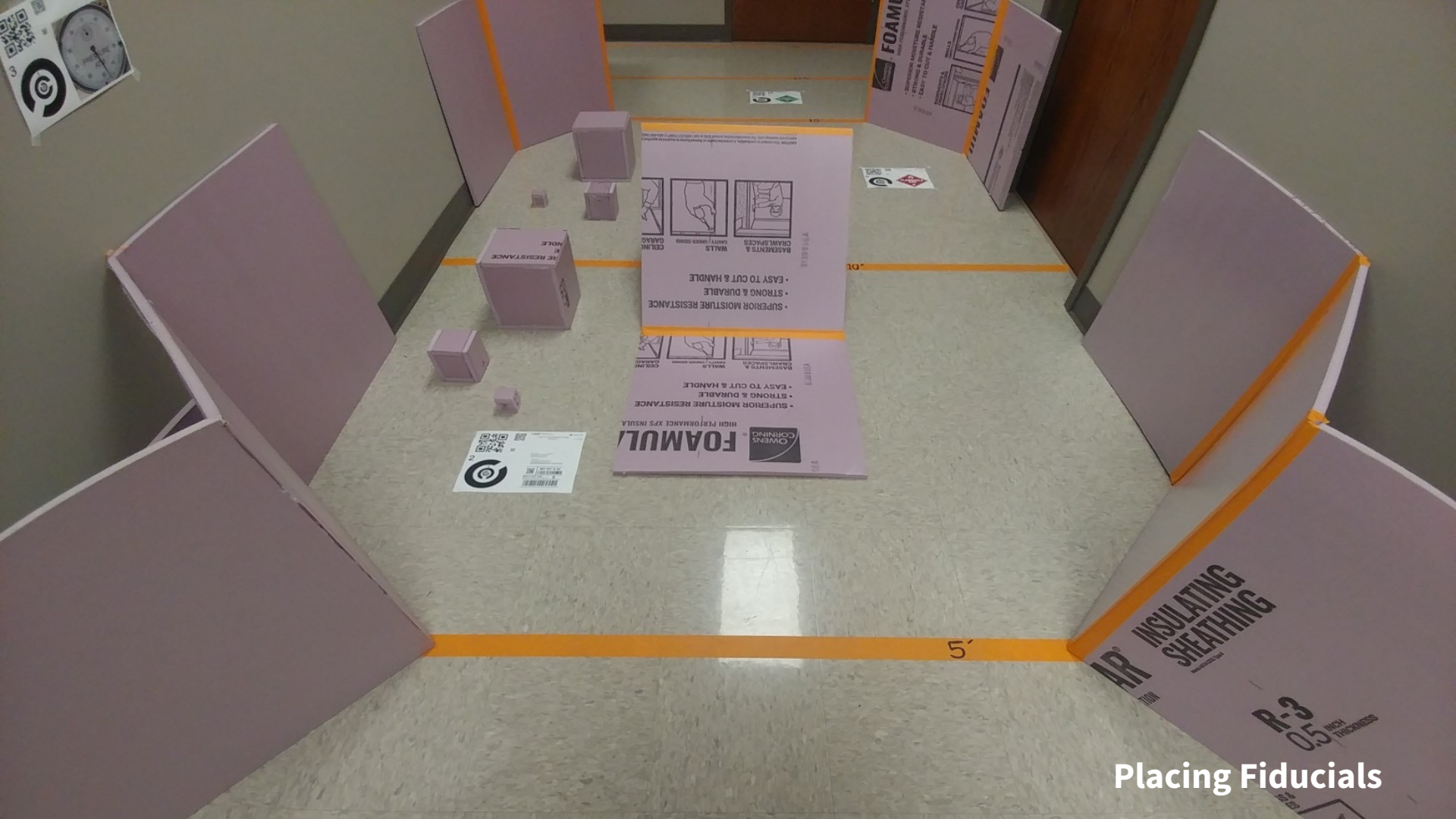
Marking Test Lane Cont.



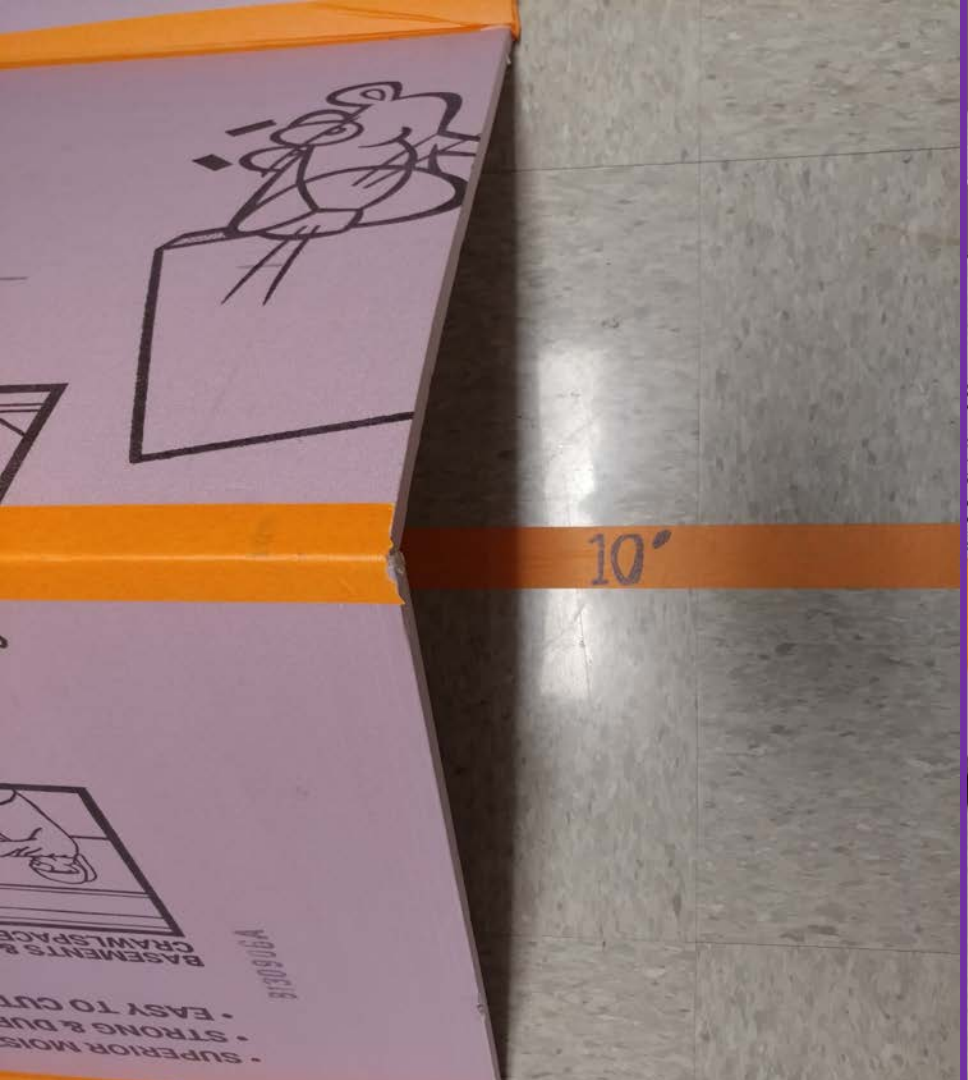
Marking Test Lane Cont.

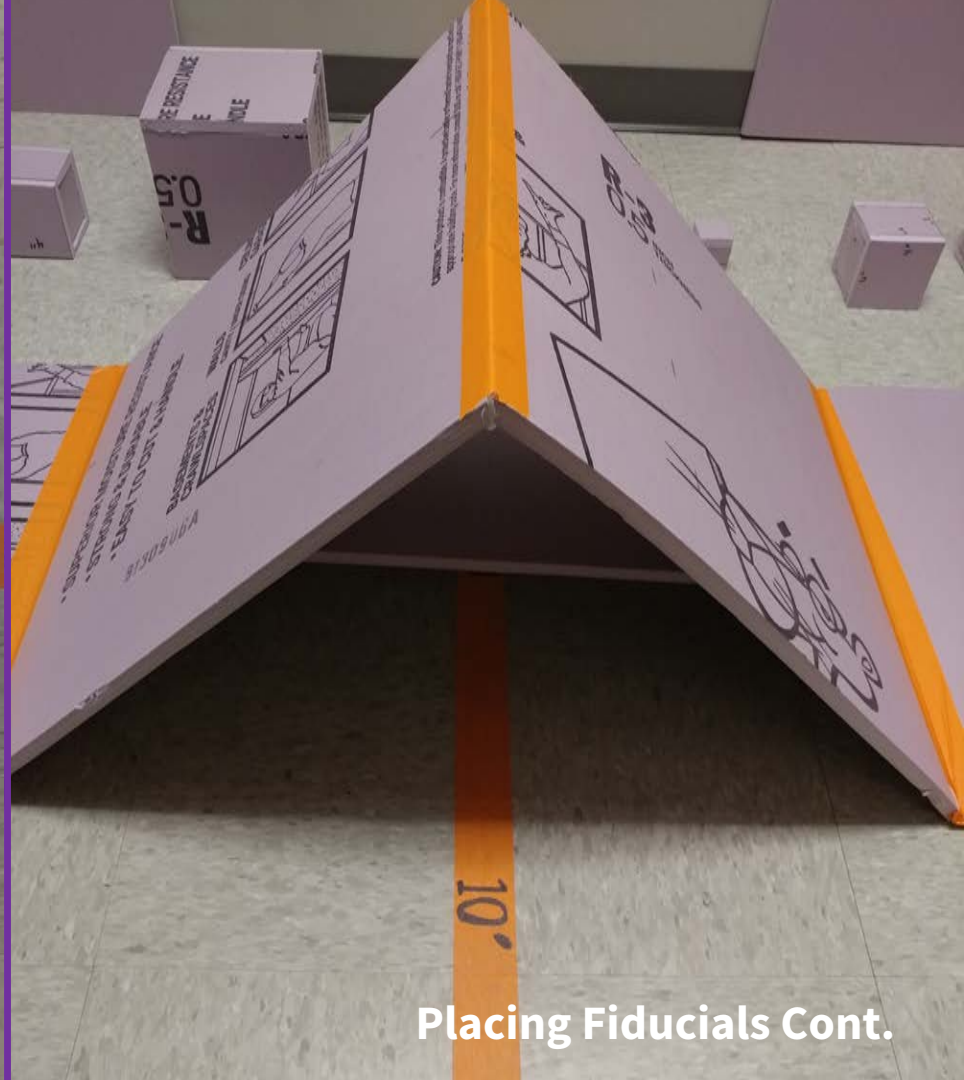


Constructing Fiducials



Placing Fiducials



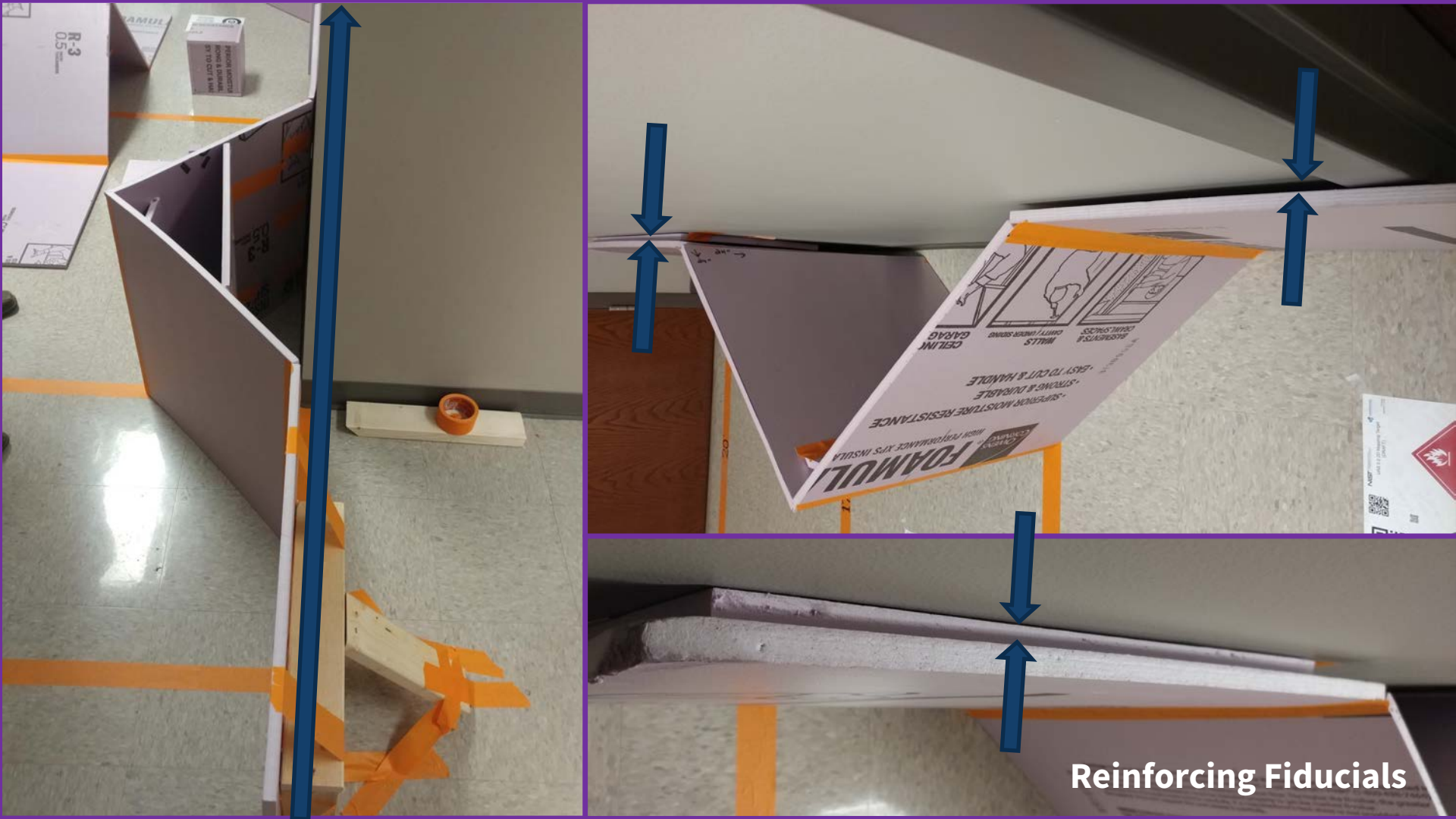


Placing Fiducials Cont.

Placing Fiducials Cont.

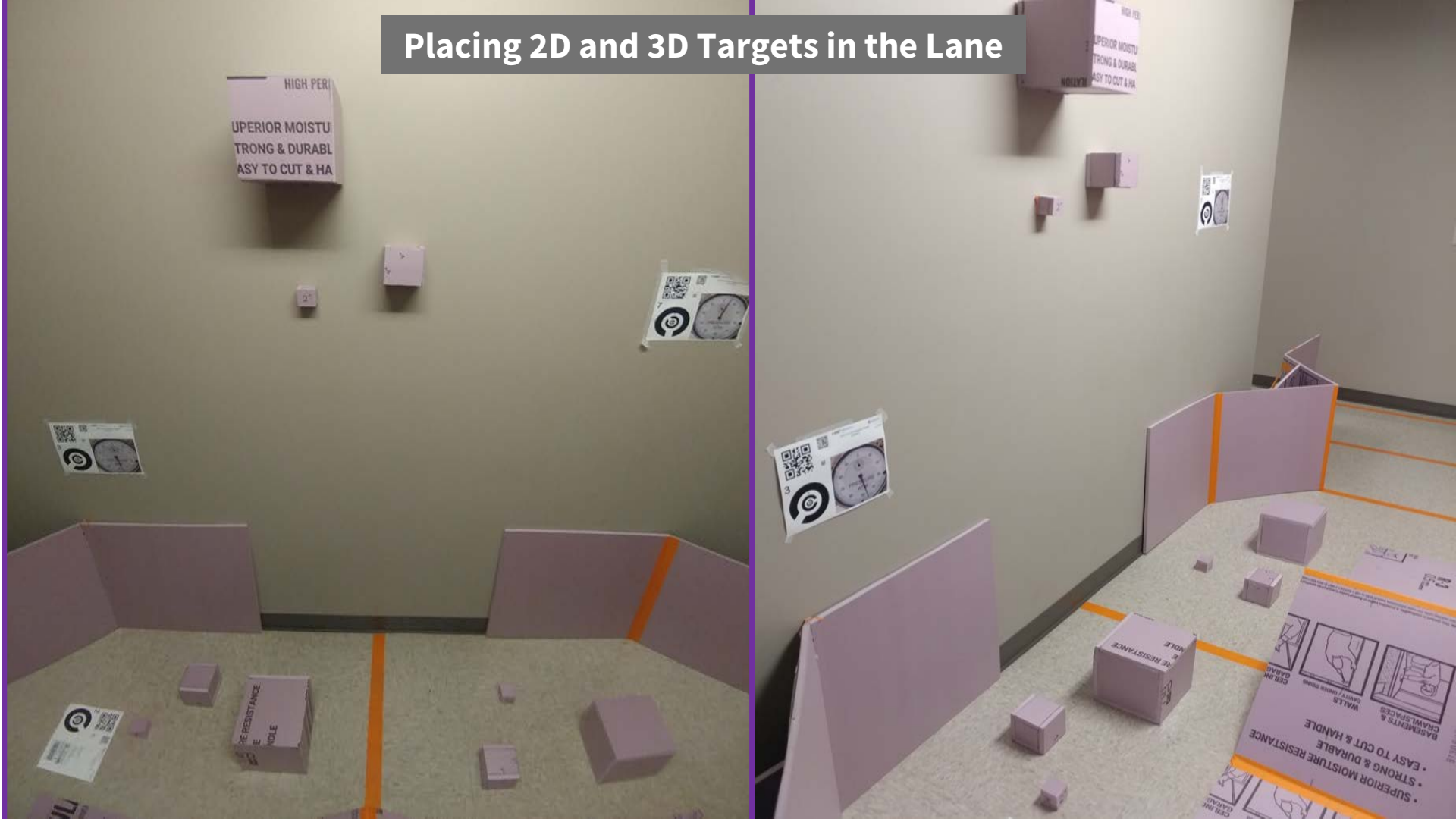
2D Target: Landolt Rings

Verifying Scale of 2D Targets

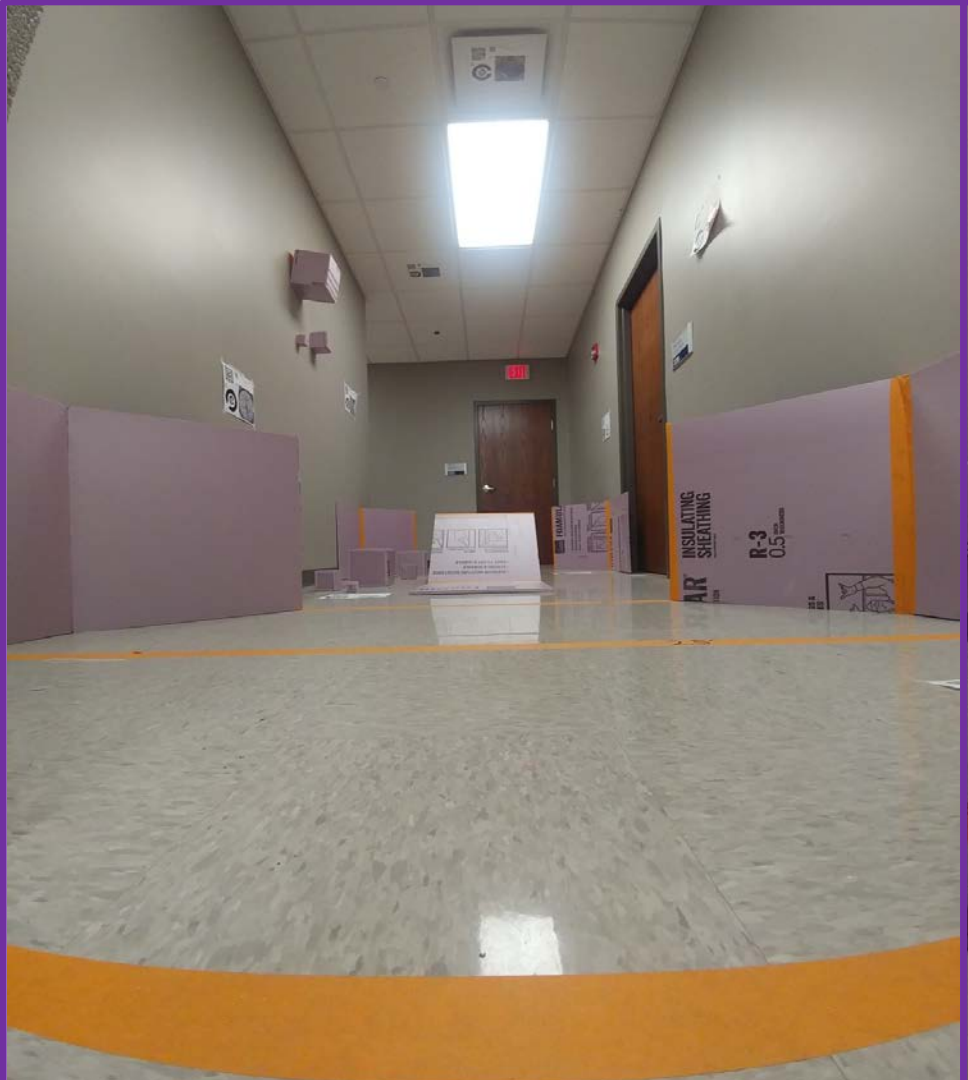

Reinforcing Fiducials


HIGH PERI
UPERIOR MOISTU
TRONG & DURABL
ASY TO CUT & HA
ILATION
2"
3D Targets

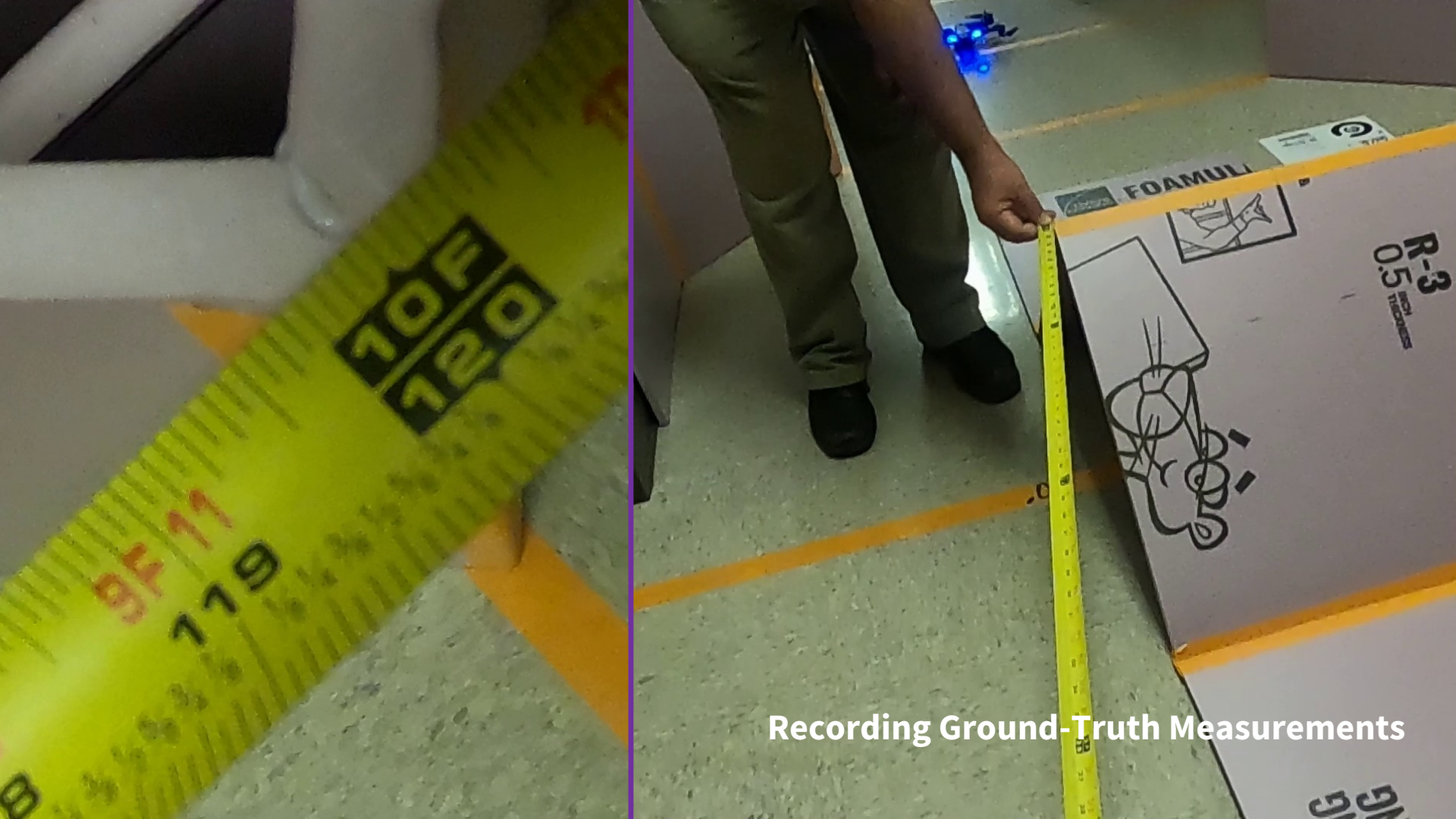
Placing 2D and 3D Targets in the Lane



Completed 3D Mapping Test Lane



Completed 3D Mapping Test Lane Cont.

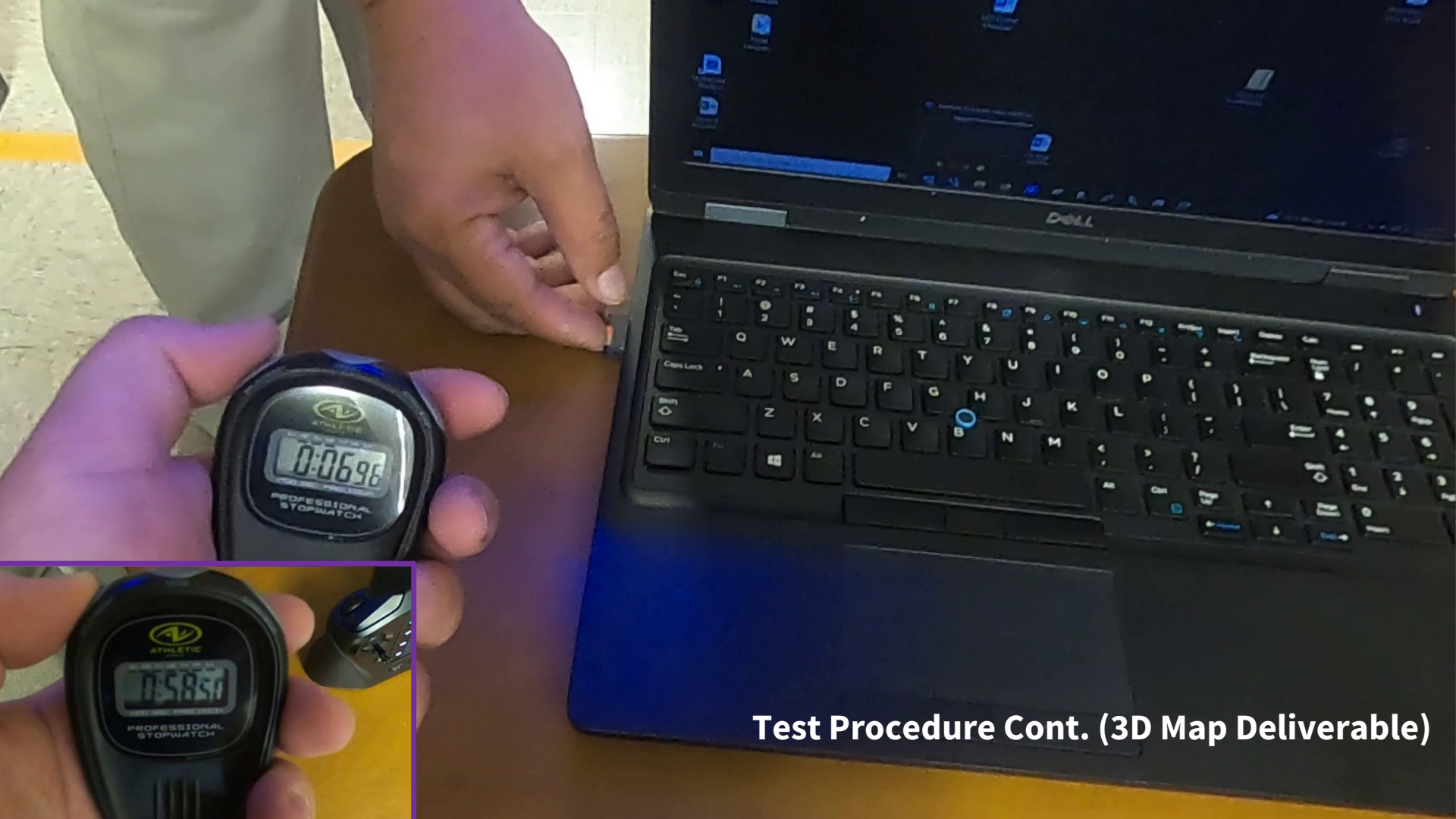


Recording Ground-Truth Measurements


Quad-View (Onboard Camera View Not Shown)


0:00:08
FOAMULAR
INSULATING SHEATHING
R-3
2.5'
Test Procedure


ATHLETIC
Test Procedure Cont.



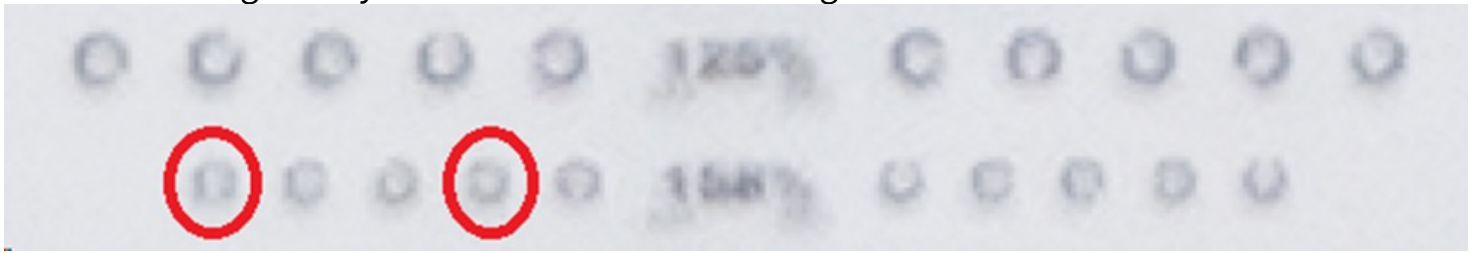
Test Procedure Cont. (3D Map Deliverable)

Measurement

Measurements (Record on Camera: Video B) See the *3D Mapping Test Lane Guidebook* for details

- Surface Coverage Gaps –The 20 fiducial panels are what you will use to evaluate the gaps (count the panels with gaps greater than 1ft x 1ft).
- Relative Dimensional Error – Digitally reproduce the measurements made with the tape measure and fiducials.
- 2D Targets – Count the number of rings with clearly visible openings using only 3D map data (50 possible, 5 on each of the 10 target sheets)

  Some technologies may not be able to see the 2D targets

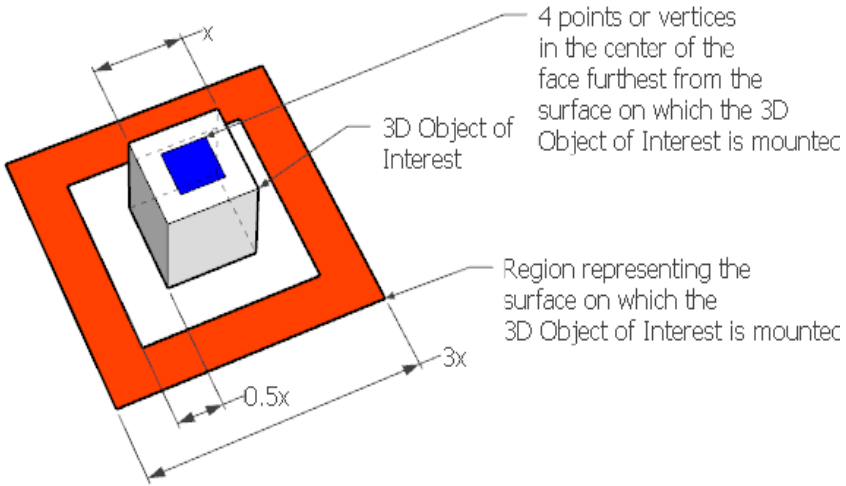


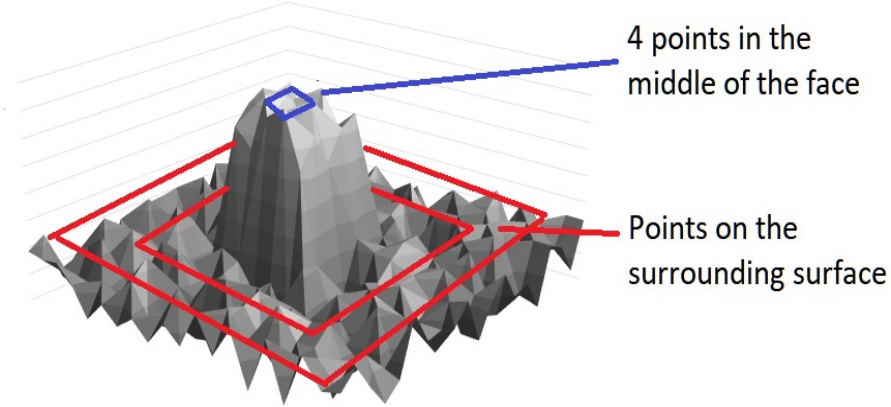
(**Circled Rings Deemed Not Readable**)

Measurement Cont.

3D Targets – Successful detection relies on **both** resolution and evaluation of Separation from mounting surface.

- Resolution: at least 4 points or vertices on one face
- Separation: the target must extend beyond the mounting surface at least half its known edge length





Mapping Speed: The split-time measurement divided by the length of the test lane (min. 7.5 seconds to fly the 15ft lane to yield 2ft/sec)


Questions?
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