# Pitt Women's Basketball Sports Science Playbook 2025-2026

**Author's Note:**

*This guide was created by Kya D. Carroll, the 2024–2025 Sports Science and Strength & Conditioning Intern for Pitt Women's Basketball. It was developed to support and strengthen our ongoing sports science initiatives and to help maximize the program's available tools..*

*This resource is NOT meant to replace the art and intuition of coaching but rather to serve as a companion that may assist in decision-making and athlete support. My hope is that this guide is a helpful starting point for anyone looking to familiarize themselves with the technology and workflows we use.*

*I am grateful to have been part of this team, and I'm always happy to collaborate or answer any questions.*

Hail to Pitt!
—
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# Section 1: Hawkin Dynamics Force Plate

## 1.1 Standard Operating Procedures:

Step 1: Placement and Power-On

- Place the Hawkin Dynamics force plates on a flat, even surface. Ensure there is enough clearance around the plates.
- Hold down the power button on the side of the plates. Wait for the LED indicator to light up, signaling the plates are active.
- If foam pads are removed to turn on device, make sure to put them back in place around the force plates

Step 2: Open and Connect App

- On your iPad or tablet, open the Hawkin Dynamics app.
- Make sure Bluetooth is enabled on the tablet.
- Select your force plate device from the available list to pair it with the app.
- Make sure to "zero" the device

Step 3: Begin Testing Session

- Choose the appropriate jump test protocol (e.g., CMJ, Drop Jump).
- Choose the appropriate athlete
- Instruct the athlete on test execution and ensure proper posture (e.g., hands on hips, stable landing).
- Record 2–3 trials and save session data.

## 1.2 Different Testing:

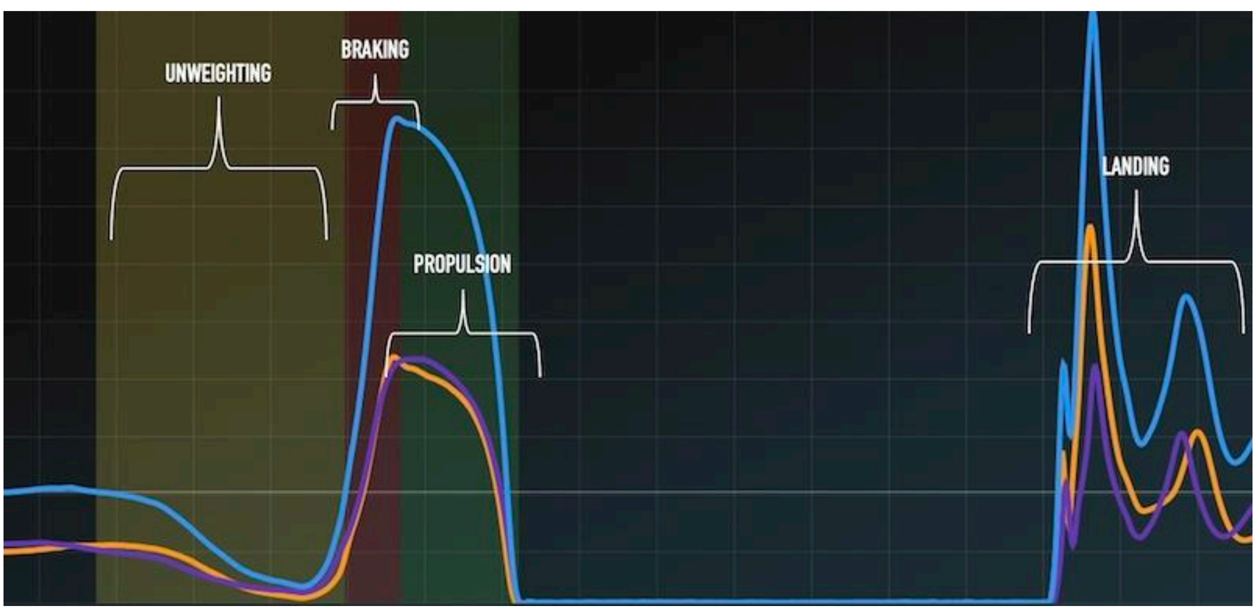
| Test | Purpose | Key Metrics Captured | Protocol |
|---|---|---|---|
| Countermovement Jump (CMJ) | Assess explosive lower-body power using natural dip and drive motion. | Jump height, mRSI, propulsion/braking force, impulse, TTT, CMD. | 1. Athlete should stand still on the force plates with slightly bent knees and hands on hips.<br>2. Press button to start test.<br>3. On beep, athlete performs a countermovement jump and lands back on plates. |
| Squat Jump (SJ) | Isolate concentric force output by removing SSC involvement. | Jump height, propulsive force/power. | 1. Athlete assumes squat position on plates and holds still.<br>2. On beep, they jump upward with no countermovement.<br>3. Must land back on force plates for results. |
| Drop Jump (DJ) | Evaluate reactive strength and stiffness via short SSC response. | Contact time, jump height, RSI, landing stiffness. | 1. In app, input drop height in cm.<br>2. Athlete steps off platform, lands on force plates, and jumps in one motion.<br>3. Must land and stick jump for metrics to record. |
| Multi-Rebound Jump | Assess repeated SSC efficiency over multiple contacts. | RSI-modified, contact time, fatigue trends. | 1. Athlete performs continuous jumps starting with a CMJ.<br>2. Must land and rebound multiple times on force plates.<br>3. Results process after final jump landing. |

| | | | |
|---|---|---|---|
| Countermovement Rebound | Assess ability to transition between loaded jumps. | Delta jump height, braking-propulsive coordination. | 1. Athlete performs a CMJ, lands, then performs another CMJ immediately.<br>2. Must land both jumps cleanly on plates. |
| Mid-Thigh Pull (Isometric) | Measure maximal isometric force capacity. | Peak force, RFD (Rate of Force Development). | 1. Athlete stands on plates and pulls up on fixed bar.<br>2. Start test and allow pull for duration.<br>3. Manually stop or use preset test time. |
| Free Run | Dynamic movement tracking during unstructured running. | Step frequency, contact time, acceleration/deceleration patterns. | 1. Athlete runs freely across plates.<br>2. Metrics are captured continuously or manually stopped. |

## 1.3 THE CMJ:

### 1.3.1 Description & Protocol

- WHAT IT IS?
  - The Countermovement Jump (CMJ) is a vertical jump test used to assess an athlete's explosive lower-body performance and neuromuscular readiness. It's a quick, non-fatiguing, and reliable test often performed using force plates to capture detailed movement mechanics.
  - Hawkin CMJ Phases:
    - Unweighting: The athlete initiates movement by dropping downward, reducing force below body weight.
    - Braking: The athlete decelerates, producing high eccentric force to control the downward motion.
    - Propulsion: Force reverses upward as the athlete pushes off to jump, reflecting concentric output.
    - Landing: The athlete returns to the ground; landing forces may be analyzed for stiffness or asymmetry.




- HOW CAN I USE THIS TEST?
  - CMJ can be a useful tool for monitoring adaptation to specific stimuli (a strength and conditioning program, external on-court workload exposure), Readiness (CNS alertness for the game), and Fatigue (overtraining, chronic fatigue, external workload overexposure)

**PITT BB SPECIFIC PROTOCOL FOR COUNTER MOVEMENT JUMP (CMJ) TESTING**

***This is the most utilized test for our team, so knowing the protocol is very important!

***Very Important you follow this protocol completely and thoroughly to collect valid and reliable results

Before starting the test:

- Instruct athlete to step onto force plates and place their hands on their hips
- Before testing, ensure the athlete understands the instructions:
  - We cue to "Jump high AND Fast" with each jump

Starting the test:

1. Instruct the athlete to stand still on the plates with
2. knees slightly bent.
3. Press start test.
4. On beep, the athlete will jump (remembering the cue given earlier to jump high and fast)
5. Upon landing, instruct the athlete to stabilize and stand still in the starting position and then click "END" to end the test
6. Repeat steps 1-4 for the desired number of reps (2-3 valid jumps is our standard)

Saving the test

1. Once a jump is completed, click save test. This will save the test to the cloud, which you will be able to view latter

### 1.3.2 Metrics That Matter: Adaptation, Readiness, Fatigue

Here are some metrics that we as a staff deem important to monitor. We use a 2-tier system: Tier 1 will be the metrics first looked at and easily digestible, and Tier 2 will dive deeper to understand more about the athlete. (Adapted from Coach Hunter Eisenhower)

**Tier 1:**

1. **Jump Height:**

**What it is:**

- The "AURA" metric. Athletes love to hear this number, and it can be a driving motivator for them.
- Jump Height is a direct indicator of concentric force production and overall neuromuscular output and is one of the most universally understood and applied force plate metrics

**Why it matters:**

- **Adaptation:** Improvements in Jump Height across a consistent testing protocol suggest positive training adaptations—such as increased RFD, muscular strength, and coordination.
- **Readiness:** Decreased jump height on a given day may suggest suboptimal neuromuscular readiness. Consistently strong jump performance indicates the athlete is well-prepared for the load.
- **Fatigue:** If an athlete's jump height is below their rolling average and paired with sluggish TTT or altered movement strategy, it often points to accumulated fatigue.

### 2. Time to Takeoff (TTT)

**What it is:**
The total duration from initiation of movement to the moment the athlete leaves the ground.

**Why it matters:**

- **Adaptation:** Decreases in TTT while maintaining Jump Height indicate enhanced neuromuscular efficiency.
- **Readiness:** Increased TTT, especially with unchanged or lower output, may reflect hesitancy or CNS dullness.
- **Fatigue:** Fatigued athletes often exhibit slower movement patterns, increasing TTT as a compensatory strategy.

### 3. Countermovement Depth (CMD)

**What it is:**
The vertical displacement during the downward phase of the CMJ (i.e., how deep the athlete dips).

**Why it matters:**

- **Adaptation:** Shallower but more efficient depths over time may reflect improved force transmission and motor control. Additionally, greater CMD and similar or decreased time to take off may indicate improved ability to move through an increased range of motion without sacrificing neuromuscular reaction time.
- **Readiness:** Excessive CMD may signal a compensatory strategy for lack of readiness—needing more time and space to generate force.
- **Fatigue:** CMD typically increases when athletes are fatigued, as they "sink" more to maintain output.

### 4. Modified Reactive Strength Index (mRSI)

**What it is:**
Jump Height ÷ Time to Takeoff – a ratio representing explosive efficiency.

**Why it matters:**

- **Adaptation:** Rising mRSI values over time indicate improved explosiveness.
- **Readiness:** A high mRSI score suggests the athlete is neurologically sharp and reactive.
- **Fatigue:** A decrease in mRSI can point to central or peripheral fatigue, especially when TTT increases or JH drops.

### 5. Braking Phase Duration

**What it is**:
The time spent in the eccentric portion of the jump before reversal. Reflects how long the athlete spends absorbing force.

**Adaptation:** A more efficient system often exhibits shorter braking durations with strong output.
**Readiness:** Longer durations may reflect protective or conservative movement.
**Fatigue:** Athletes may extend braking time under fatigue to maintain output.

6. **Bodyweight**

**What it is:**
The force plate measures of the athlete's mass during the quiet phase (pre-jump).

**Why it matters:**

- **Adaptation:** Changes in body comp (e.g., fat loss) paired with better performance indicate favorable adaptation.
- **Readiness:** Acute weight drops may suggest dehydration or under-fueling—both readiness red flags.
- **Fatigue:** Drops in body weight with declining performance may indicate accumulated stress or poor recovery.

**Tier 2:**

1. **Average Relative Propulsive Force**

**What it is:**
The mean vertical force applied during the propulsive (concentric) phase. It reflects how much force the athlete maintains while accelerating.

**Adaptation:** Improvements suggest enhanced concentric output.
**Readiness:** Drops may indicate a diminished ability to sustain output.
**Fatigue:** Decreases may reflect concentric fatigue or lower intent.

**Average Relative Braking Force (%)**
**What it is:**
The average vertical force produced during the braking phase expressed relative to body weight

**Adaptation:** Improvements indicate increased eccentric control and potential stiffness.
**Readiness:** Sharp drops in average braking force may flag poor eccentric readiness.
**Fatigue:** Lower braking output may suggest neuromuscular fatigue or reduced stiffness.

**Peak Relative Propulsive Power (N/kg)**
**What it is:**
The highest instantaneous power output during propulsion, normalized to body mass. Reflects neuromuscular explosiveness.

**Adaptation:** Higher values indicate improved power-to-weight ratio.
**Readiness:** High values signal strong explosive readiness.
**Fatigue:** Drop-offs may signal fatigue or decreased recruitment

**Summary of Metrics That Matter:**

| Metric | Interpretation / Utilization |
|---|---|
| Jump Height | Measures total vertical output. Influenced by both force and impulse. |
| Average Relative Propulsive Force (% of system weight) | Indicates concentric force output. High values show strong push-off capacity. |
| Average Relative Braking Force (% of system weight) | Reflects eccentric load production. Helps evaluate load tolerance and strategy. |
| Peak Relative Propulsive Power (W/kg) | A combination of speed and force expression during takeoff. |
| mRSI | Reflects jump efficiency: height achieved relative to time spent on ground. |
| Time to Takeoff (TTT) | How long athlete takes to leave the ground. Lower = faster, more reactive. |
| Countermovement Depth (CMD) | How deep the athlete loads during the countermovement. Affects impulse potential. |
| Braking Phase Time | How long the athlete spends in the eccentric phase. High = load-heavy strategy. |

**Things to Be Careful of When Interpreting Force Plate Metrics**

Force plate data is powerful—but **only when interpreted within context**. These metrics should serve as **tools to guide training conversations**, not definitive assessments of performance or athlete identity.

**1. Metrics Should Not Be Interpreted in Isolation**

One data point can be misleading. For example:

- A high **Jump Height** may look positive, but if **Time to Takeoff** and **Countermovement Depth** increase excessively, it may reflect compensation or fatigue.
- An increase in **mRSI** might appear beneficial, but if **Jump Height** has decreased and **TTT** dropped even more, this could reflect a stiffer, more cautious strategy—not improved explosiveness.

**2. Force Plates Do Not Measure Performance — They Provide Insight**

These tools do not quantify sport-specific skills like shooting, rebounding, or decision-making. Instead, they provide insight into:

- Neuromuscular status
- Readiness
- Potential fatigue
- Long-term adaptation

**Emphasize to athletes and coaches**: *Force plate trends are helpful signals—not judgments.*

**3. Be Careful with Modified Reactive Strength Index (mRSI)**

**Common trap:**

- An athlete's mRSI improves simply because **Time to Takeoff** decreases—not because **Jump Height** improves.
- This could mean they're being more conservative with their countermovement, using a stiffer strategy that may not translate well to dynamic movement or sport performance.

**Watch for:**

- mRSI increasing while jump height is declining → often a sign of altered (not better) jump mechanics.

**4. Countermovement Depth (CMD) Can Mask Readiness**

- Deeper CMD may inflate Jump Height even if an athlete is fatigued.
- Athletes may "compensate" with deeper squats to maintain numbers.
- Inconsistent ROM makes longitudinal tracking difficult—**always monitor CMD alongside other metrics**.

**5. Bodyweight Changes Can Confound Other Metrics**

- An athlete who suddenly weighs less may produce different force outputs.
- Use relative metrics (e.g., watts/kg) when appropriate.
- Ensure that drops in bodyweight are contextualized (e.g., hydration, body comp change, or stress).

**Best Practice: Look for Clusters and Trends**

Rather than focusing on single metrics, consider:

- **Patterns across time**
- **Combinations of indicators** (e.g., low JH + high CMD + longer TTT = likely fatigue)
- **Contextual variables** like sleep, nutrition, practice load, and reported soreness
-

### 1.3.3 How to Monitor Meaningful Changes:

1. Smallest Worthwhile Change:

- To calculate: Multiply group standard deviation (SD by 0.2.)
    - EX: JH group SD = 2.2. SWC = 2.2 X 0.2
- This is a statistical method to monitor any significant changes in the metrics of interest. This can be used to evaluate adaptations, fatigue and readiness and if there are significant changes.

2. Z Scores:

- Another Method (I like the most) for looking at deviations from a group or individual's average. This score tells us how many standard deviations away from the mean a specific value is. My rule of thumb is to flag z scores of +/- 1.5. These are seen as significant changes and should be evaluated further.
- Many applications can calculate this metric (Excel, Google Sheets). The Hawkin Cloud also has an editable setting to flag these scores immediately

### 1.3.4 Benchmark Values

**In-Season CMJ Benchmark Chart – Guards and Posts**

This section provides benchmark values from countermovement jump (CMJ) testing collected in-season (Nov 7–Feb 18) using force plates. All data is based on performance from team starters, ensuring the benchmarks reflect athletes consistently exposed to game demands. Metrics are grouped by position to account for different neuromuscular profiles.

**How to Use This Chart:**

- **Metric:** The CMJ variable being measured (e.g., Jump Height, Peak Power).
- **Mean:** The average score from the position group during the selected in-season period.
- **Min / Max:** The lowest and highest value observed in the group.
- **Watch Zone:** The lowest score observed — repeated trends at or below this value may indicate readiness issues or underperformance.
- **Recommended Range:** The expected zone of performance (Mean ± 1 standard deviation) where most athletes should fall if healthy and recovered.

**Benchmark Summary: Guards**

These values reflect the neuromuscular output and efficiency of in-season guards. They are most useful when assessing readiness during competition blocks or identifying athletes who may benefit from targeted development strategies. Due to the speed and agility demands of the position, guards generally require quicker ground contact times, high relative power, and consistent jump height outputs.

| Metric | Mean | Min | Max | Watch Zone | Recommended Range |
|---|---|---|---|---|---|
| Jump Height (in) | 13.06 | 10.63 | 14.99 | 10.63 | 13.06 ± 2.22 |
| Avg. Relative Propulsive Force (%) | 210.67 | 206.0 | 215.0 | 206.0 | 210.67 ± 4.51 |
| Avg. Relative Braking Force (%) | 209.67 | 194.0 | 223.0 | 194.0 | 209.67 ± 14.64 |
| Peak Relative Propulsive Power (W/kg) | 51.94 | 46.67 | 57.35 | 46.67 | 51.94 ± 5.34 |
| mRSI | 0.52 | 0.48 | 0.56 | 0.48 | 0.52 ± 0.04 |
| Time to Takeoff (s) | 0.63 | 0.57 | 0.68 | 0.57 | 0.63 ± 0.06 |
| Countermovement Depth (in) | -10.57 | -11.64 | -8.67 | -11.64 | -10.57 ± 1.65 |
| Braking Phase (s) | 0.13 | 0.11 | 0.14 | 0.11 | 0.13 ± 0.02 |

**Benchmark Summary: Posts**

These values represent jump characteristics typical of post players during the in-season period. While posts may show slightly longer movement durations or deeper countermovement depths, the focus remains on force production and efficiency. These benchmarks should guide training emphasis on power development, eccentric control, and readiness monitoring in taller or more force-dominant athletes.

| Metric | Mean | Min | Max | Watch Zone | Recommended Range |
|---|---|---|---|---|---|
| Jump Height (in) | 11.6 | 10.57 | 12.64 | 10.57 | 11.6 ± 1.46 |
| Avg. Relative Propulsive Force (%) | 208.5 | 203.0 | 214.0 | 203.0 | 208.5 ± 7.78 |
| Avg. Relative Braking Force (%) | 208.0 | 200.0 | 216.0 | 200.0 | 208.0 ± 11.31 |
| Peak Relative Propulsive Power (W/kg) | 49.03 | 44.7 | 53.36 | 44.7 | 49.03 ± 6.12 |
| mRSI | 0.48 | 0.47 | 0.49 | 0.47 | 0.48 ± 0.01 |
| Time to Takeoff (s) | 0.62 | 0.58 | 0.67 | 0.58 | 0.62 ± 0.06 |
| Countermovement Depth (in) | -9.49 | -9.95 | -9.04 | -9.95 | -9.49 ± 0.64 |
| Braking Phase (s) | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 ± 0.0 |

## 1.3.5 CMJ Example Interpretation

**Example Comparison between Starter benchmarks and Benched players' values**

This section provides an example of how countermovement jump (CMJ) data can be interpreted using principles from Daniel Bove's 'Takeoff' framework. The interpretations included here are intended to help guide understanding of movement strategies and neuromuscular efficiency. These summaries should not be used in isolation for decision-making but rather as a tool within a broader athlete monitoring approach.

**Note: Mimi and Lauren are returning from injury, and as such, their CMJ values may not reflect true capacity. Interpretation of their profiles should be viewed with caution and within the context of their return-to-play timelines.

[redacted] - Guard

| Metric | Player Value | Guard Benchmark | Δ |
|---|---|---|---|
| Jump Height (in) | 16.04 | 13.06 | +2.98 |
| Avg. Relative Propulsive Force (%) | 212.0 | 210.67 | +1.33 |
| Avg. Relative Braking Force (%) | 201.0 | 209.67 | -8.67 |
| Peak Relative Propulsive Power (W/kg) | 56.49 | 51.94 | +4.55 |
| mRSI | 0.57 | 0.52 | +0.05 |
| Time to Takeoff (s) | 0.72 | 0.63 | +0.09 |
| Countermovement Depth (in) | -13.6 | -10.57 | -3.03 |
| Braking Phase (s) | 0.15 | 0.13 | +0.02 |

Interpretation

[redacted] demonstrates high concentric output with strong jump height and power, but a longer time to takeoff and deeper countermovement suggest a force-dominant strategy. This profile aligns with a 'strength-reliant' jumper who achieves output through increased range and time, rather than efficient elastic transfer.

[redacted] – Guard

| Metric | Player Value | Guard Benchmark | Δ |
|---|---|---|---|
| Jump Height (in) | 12.5 | 13.06 | -0.56 |
| Avg. Relative Propulsive Force (%) | 243.0 | 210.67 | +32.33 |
| Avg. Relative Braking Force (%) | 217.0 | 209.67 | +7.33 |
| Peak Relative Propulsive Power (W/kg) | 54.03 | 51.94 | +2.09 |
| mRSI | 0.56 | 0.52 | +0.04 |
| Time to Takeoff (s) | 0.57 | 0.63 | -0.06 |
| Countermovement Depth (in) | -7.24 | -10.57 | +3.33 |
| Braking Phase (s) | 0.1 | 0.13 | -0.03 |

Interpretation

[redacted] displays a strength-dominant movement strategy characterized by moderate force production and quick time to takeoff. However, the shallow countermovement and signs of reduced braking efficiency suggest limited use of the stretch-shortening cycle. This reflects a jumper who produces output through strength and timing rather than elastic transference, potentially limiting efficiency and long-term neuromuscular adaptability.

[redacted] – Guard

| Metric | Player Value | Guard Benchmark | Δ |
|---|---|---|---|
| Jump Height (in) | 12.84 | 13.06 | -0.22 |
| Avg. Relative Propulsive Force (%) | 222.0 | 210.67 | +11.33 |
| Avg. Relative Braking Force (%) | 212.0 | 209.67 | +2.33 |
| Peak Relative Propulsive Power (W/kg) | 50.54 | 51.94 | -1.40 |
| mRSI | 0.59 | 0.52 | +0.07 |
| Time to Takeoff (s) | 0.55 | 0.63 | -0.08 |
| Countermovement Depth (in) | -8.86 | -10.57 | +1.71 |
| Braking Phase (s) | 0.12 | 0.13 | -0.01 |

Interpretation

[redacted] presents an efficient and balanced profile with consistent values across eccentric and concentric phases. She displays good control and transfer between braking and propulsive actions, resembling a fluid jumper archetype described in Takeoff. Her strategy shows mature coordination and minimal energy leakage.

[redacted] – Post

| Metric | Player Value | Post Benchmark | Δ |
|---|---|---|---|
| Jump Height (in) | 11.59 | 11.6 | -0.01 |
| Avg. Relative Propulsive Force (%) | 193.0 | 208.5 | -15.50 |
| Avg. Relative Braking Force (%) | 218.0 | 208.0 | +10.00 |
| Peak Relative Propulsive Power (W/kg) | 43.25 | 49.03 | -5.78 |
| mRSI | 0.44 | 0.48 | -0.04 |
| Time to Takeoff (s) | 0.66 | 0.62 | +0.04 |
| Countermovement Depth (in) | -11.83 | -9.49 | -2.34 |
| Braking Phase (s) | 0.13 | 0.12 | +0.01 |

Interpretation

[redacted] presents a braking-dominant strategy with relatively low propulsive output, power production, and jump height. Although she produces braking force, she struggles to convert that into meaningful vertical displacement or explosive power. This indicates inefficiencies in the eccentric-to-concentric coupling, potentially due to reduced elastic utilization or low concentric force capacity.

# Section 2: Catapult

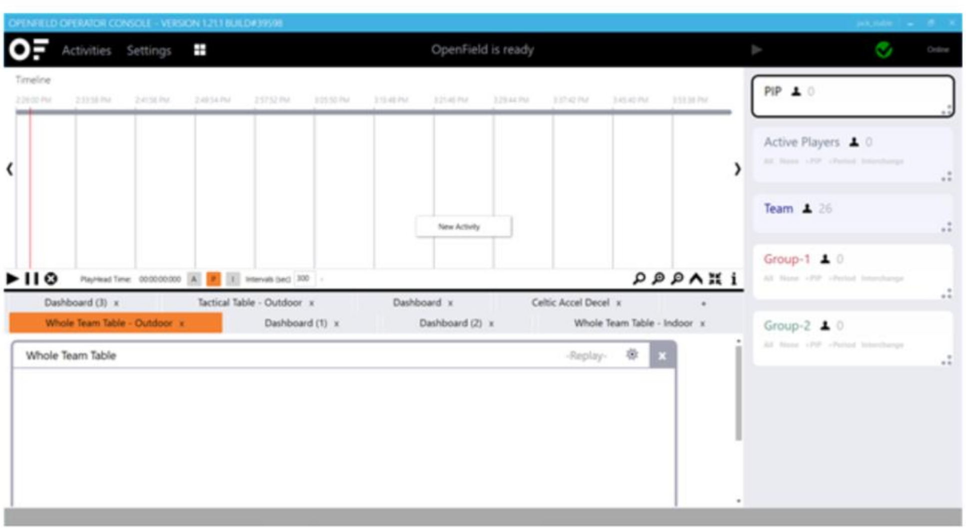
## 2.1 Catapult T7 SOP & Workflow

This section outlines the essential steps to use the Catapult T7 system with ClearSky indoor positioning, including device setup, session capture, and data transfer post-session. This is a simplified operational workflow based on manufacturer documentation and practical best practices.

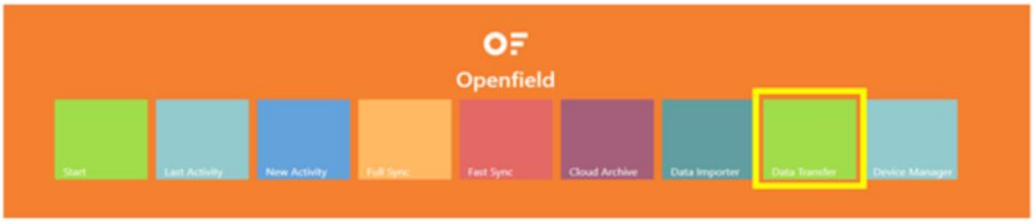
1. Using ClearSky for Indoor Tracking

1. Ensure T7 devices are fully charged and turned on by holding the side power button for 3 seconds.
3. Launch OpenField Console on the laptop and check for live data stream (intermittent orange bars near the play symbol).
4. Assign T7 devices to athletes via the Mapping tab.
5. In OpenField, create a new activity with the device type set to 'LPS (Clearsky)'.
6. Distribute T7 devices to athletes (LEDs at the top, logo facing)


device type, venue, teams, ect. Select 'Create Activity'.



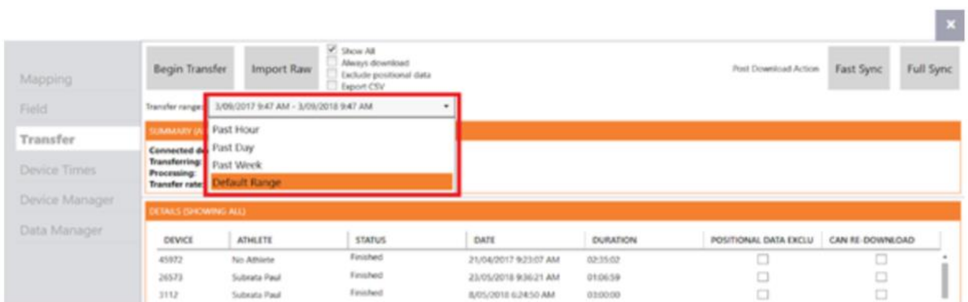
2. Downloading and Uploading Data




1.

After the session ends, collect and power off each device.
2. Place devices in the T7 Dock and connect it to the PC using USB.
3. Open OpenField Console and navigate to 'Data Transfer'.
4. Select the session(s) and click 'Begin Transfer'.
5. Upload the session to the OpenField Cloud manually after download.

Note: All uploads must be completed post-session due to no live tracking availability during the 2024–25 season.




3.

Cutting Up Sessions and Creating Periods

To analyze sessions in detail, OpenField allows tagging specific segments of a session (e.g., warm-ups, drills, scrimmage). Use the timeline feature in OpenField to break sessions into labeled periods.

1. Open the session timeline in OpenField Console or Cloud.
2. Right-click in the timeline → select 'New Activity' to label the overall session (e.g., Practice, Game).
3. Within that activity, click the '+' next to 'Period' to create individual segments (e.g., Warm-Up, Live Play).
4. Name each Activity and Period clearly and use consistent naming across sessions.

a. PITT WBB NAMING FOR ACTIVITES

i. Practices = Practice mm.dd.yyyy
ii. Games = Vs. Kansas mm.dd.yyyy
iii. Shoot Around = Shoot Around mm.dd.yyyy
iv. Conditioning = Conditioning mm.dd.yyyy

5. Save your work and upload to the cloud if not done already.

4. Login and Support

OpenField Console and Cloud Login:

- Username: **PittsburghBasketball**
- Password: **Pittwbb2025!!**

Support Contact (US): us_support@catapultsports.com

## 2.2 Metrics That Matter: Volume & Intensity

**** Below is the list of metrics we like to look at for understanding external load and intensity for on-court activities:**

### Understanding the Metrics

- Avg PL (Sess): Total PlayerLoad accumulated per session. This reflects session volume and can be used to estimate overall external load.

- PL Per Minute: Indicates session intensity. Higher values suggest more work was performed in less time. This is useful when evaluating how intense a session is compared to others of similar duration.

- High D (Sess): High Decelerations represent the number of high-magnitude deceleration efforts detected in a session. These movements place eccentric stress on the musculoskeletal system and are critical for movement control, particularly in stop-and-go sports.

- Average Duration (min): Session length contributes to total load. Longer sessions generally result in higher volume but may not always reflect high intensity.

- High Explosive Efforts: The number of explosive movements—accelerations, decelerations, and changes of direction—that exceed **2.5g** of force.
  This metric reflects neuromuscular load and is useful for monitoring high-intensity movement frequency

### Volume vs. Intensity

• Volume metrics ( Avg PL (Sess), Avg Duration) help quantify how much work is being done.
• Intensity metrics (PL Per Minute, High Explosive Efforts) indicate how demanding each minute of the session is.
**Balancing these dimensions helps avoid overtraining and optimize performance adaptations.

### 2.3 Normative Values

**** Below are the normative values of Preseason and In-Season practice, Non-Conference and Conference games for guards and Bigs during 2024-2025 season.**

| Metric | Guards - Preseason Practice | Guards - In-Season Practice | **Guards - Conference Games** | Guards - Non-Conference Games | Bigs - Preseason Practice | Bigs - In-Season Practice | **Bigs - Conference Games** | Bigs - Non-Confere Games |
|---|---|---|---|---|---|---|---|---|
| Avg PL (Sess) | 756 | 507 | **824** | 720 | 845 | 522 | **872** | 809 |
| PL Per Minute | 5.12 | 4.61 | **4.82** | 4.07 | 5.6 | 4.77 | **4.84** | 4.45 |
| High Explosive Effs (avg) | 54 | 39 | **55** | 41 | 72 | 41 | **62** | 58 |
| High D (Sess) | 13.0 | 10 | **13** | 10 | 14 | 10 | **14** | 15 |
| Avg Dur (Sess) (min) | 149.0 | 112 | **172** | 178 | 151 | 111 | **182** | 178 |

## 2.4 Planning & Monitoring

**Using Load Data to Inform Planning and Monitoring:**

The average metrics collected from preseason, in-season practices, and games offer valuable insights for designing next season's conditioning and practice strategies. By analyzing both volume and intensity metrics, we can better understand the specific demands placed on athletes and plan accordingly.

**Planning with Acute: Chronic Workload Ratio (ACWR):**

The ACWR compares an athlete's acute (short-term, e.g., 1-week) workload to their chronic (long-term, e.g., 4-week average) workload. Maintaining a ratio between 0.8 and 1.3 is generally considered optimal. Ratios >1.5 may indicate an elevated injury risk, while <0.8 may signal undertraining. Tracking this ratio weekly allows staff to adjust the load to maintain readiness and reduce injury risk.

****The Catapult cloud can create this and display other metrics in an easily designable dashboard. Check out dashboards already created within the cloud!**

**Example Application:**

1. Use average game loads as benchmarks to prepare athletes for competition demands.
2. Preseason should gradually build up both volume and intensity to match or slightly exceed game demands.
3. In-season practices for guards may need more explosive work compared to bigs, as shown by lower average explosive efforts.
4. Plan weekly loads to remain within safe ACWR range by combining lighter and heavier sessions.

# Section 3:
## Gymaware

### 3.3 Velocity-Based Training (VBT)

Velocity-based training (VBT) is a method of strength training that prescribes and adjusts training load based on movement velocity. Rather than relying solely on %1RM, VBT monitors bar speed to assess readiness, effort, and fatigue in real time.

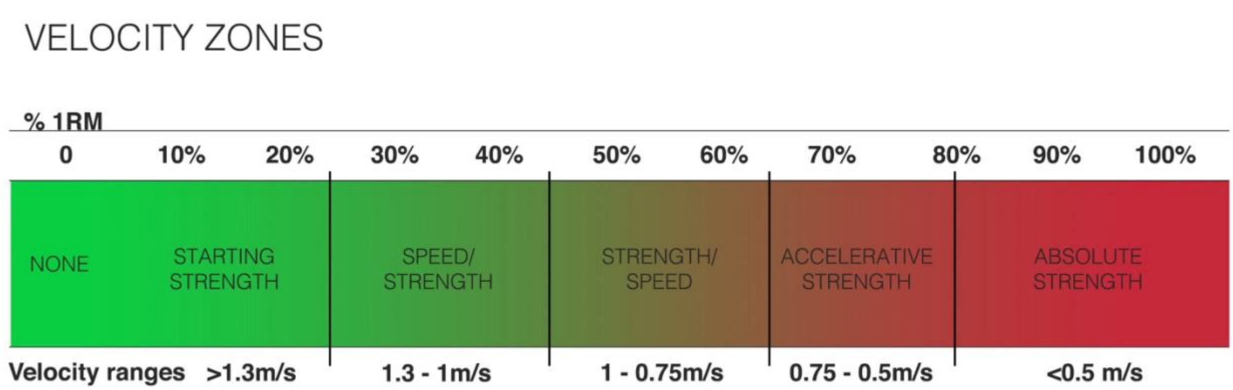
Key benefits of VBT:
• Enhances autoregulation — athletes lift based on daily performance, not fixed loads.
• Tracks power output and training intent.
• Identifies fatigue via velocity drop-offs.
• Individualizes training stimulus without constant max testing.

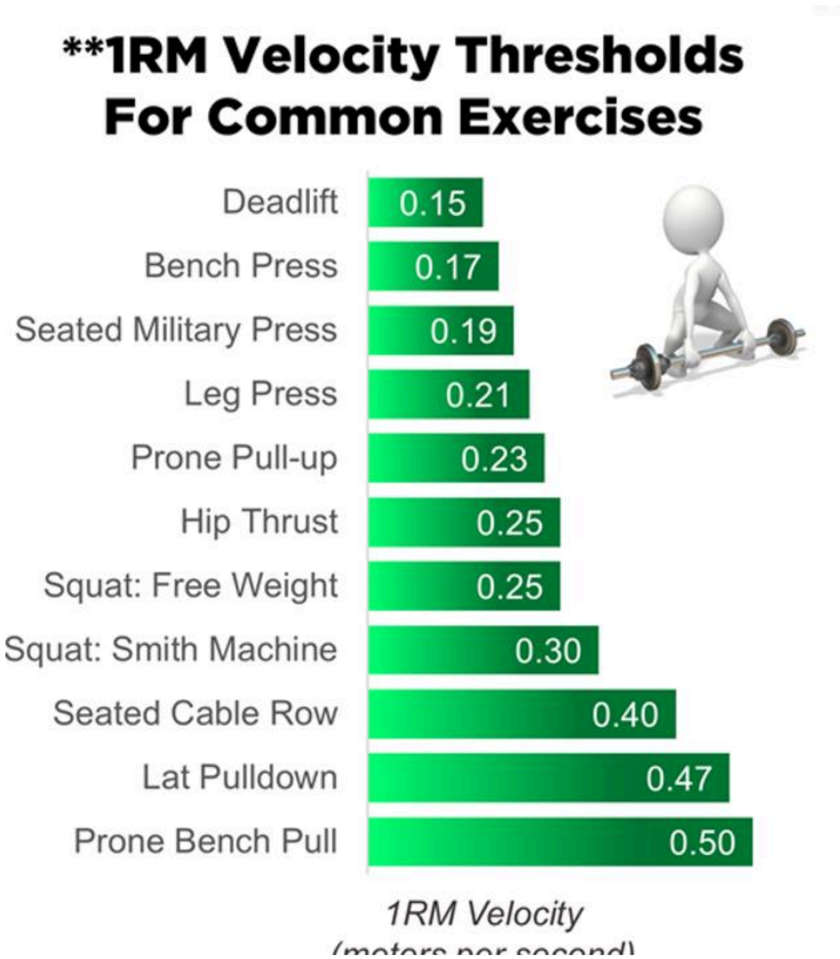
### 3.2 Using GymAware

GymAware is a linear position transducer used to measure barbell velocity and displacement in real time.

How to use GymAware:
1. Attach the GymAware tether to the end of the barbell.
2. Sync the GymAware unit to the iPad via Bluetooth.
3. Open the GymAware app and select the athlete and lift type.
4. Record sets; the system provides immediate velocity metrics (e.g., mean velocity, peak velocity).
5. Use live feedback to cue intent or adjust loads.
6. Export session data for long-term tracking or post-lift review.

Suggested VBT velocity zones:
• >1.3 m/s – Starting Strength
• 1.3–1.0 m/s – Speed-Strength
• 1.0–0.75 m/s – Strength-Speed
• 0.75–0.5 m/s – Accelerative Strength
• <0.5 m/s – Absolute Strength




**1RM Velocity Thresholds
For Common Exercises
Deadlift
0.15
Bench Press
0.17
Seated Military Press
0.19
Leg Press
0.21
Prone Pull-up
0.23
Hip Thrust
0.25
Squat: Free Weight
0.25
Squat: Smith Machine
0.30
Seated Cable Row
0.40
Lat Pulldown
0.47
Prone Bench Pull
0.50
1RM Velocity

# Section 4: References and Extra Resources

## 4.1 Hawkin Dynamic Force Plates


1. **Schuster, J., Bove, D., & Little, D. (2023).**
   *Jumping Towards Best-Practice: Recommendations for Effective Use of Force Plate Testing in the NBA*
   Science Performance & Science Reports (SPSR)
   **Link:**
2. **Eisenhower, H. (2023).**
   *Selecting Metrics That Matter: Comparing the Use of Force Plate Testing in Pro and Collegiate Settings*
   Journal of Strength and Conditioning Research
   **Link:** https://journals.lww.com/nsca-scj/abstract/2023/10000/selecting_metrics_that_matter__comparing_the_use.3.aspx.
3. **Hawkin Dynamics.**
   *Hawkin Metric Database*
   **Link:** https://www.hawkindynamics.com/hawkin-metric-database
4. **SimpliFaster.**
   *Force Plates and Countermovement Jump Guide*
   **Link:** https://simplifaster.com/articles/countermovement-jump-force-plates-guide/
5. **Bove, D. (2023).**
   *Takeoff: Jump Strategy & Neuromuscular Profiling in Basketball*

## 4.2 Catapult Sports


1. **Catapult Sports.** (n.d.). *The Key Principles of an Effective Training Program*.
   **Link:** https://support.catapultsports.com/hc/en-us/articles/360001415776-The-Key-Principles-of-an-Effective-Training-Program
2. **Gabbett, T. J.** (2020). *Load Management in Basketball: Don't Forget the Game*.
   **Link:**https://www.researchgate.net/publication/346091602_Load_Management_in_Basketball
3. **Catapult Sports.** (n.d.). *Catapult Glossary: Definitions and Metric Descriptions*.
   **Link:** https://support.catapultsports.com/hc/en-us/articles/360001235575-Catapult-Glossary
4. **Troester, J.** (2023). *Integrated Sports Science Framework – Bridge Athletic Presentation & Supporting Work.*
   **Material referenced from:**
   - Bridge Athletic Conference, 2025
   - https://www.linkedin.com/in/jordan-troester-phd-73597b19/


## 4.3 Gymaware

**1. Adam Virgile – Velocity-Based Training Articles**
**Link**:https://adamvirgile.com/tag/vbt/
A collection of applied sport science articles authored by Adam Virgile, offering detailed analysis on VBT implementation, athlete monitoring, and performance optimization. These articles are especially useful for practitioners seeking real-world examples and breakdowns of VBT data interpretation.

**2. GymAware – Velocity-Based Training Technology**
**Link:** https://gymaware.com/
This is the official website for GymAware, a leading VBT technology provider. The site offers device specs, metric definitions, practical guides, case studies, and educational content for coaches and sports scientists who use velocity-based methods to enhance athlete performance.