Agricultural Chemigation System Safety

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Presentation and chemigation layout drawings available at:
http://ucanr.edu/schwankl

Chemigation

Chemigation is the application of a chemical through the irrigation system by mixing the chemical with the irrigation water.

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Chemigation of labeled chemicals

The label specifies the "Required System Safety Devices" in the "USE IN CHEMIGATION SYSTEMS" section.

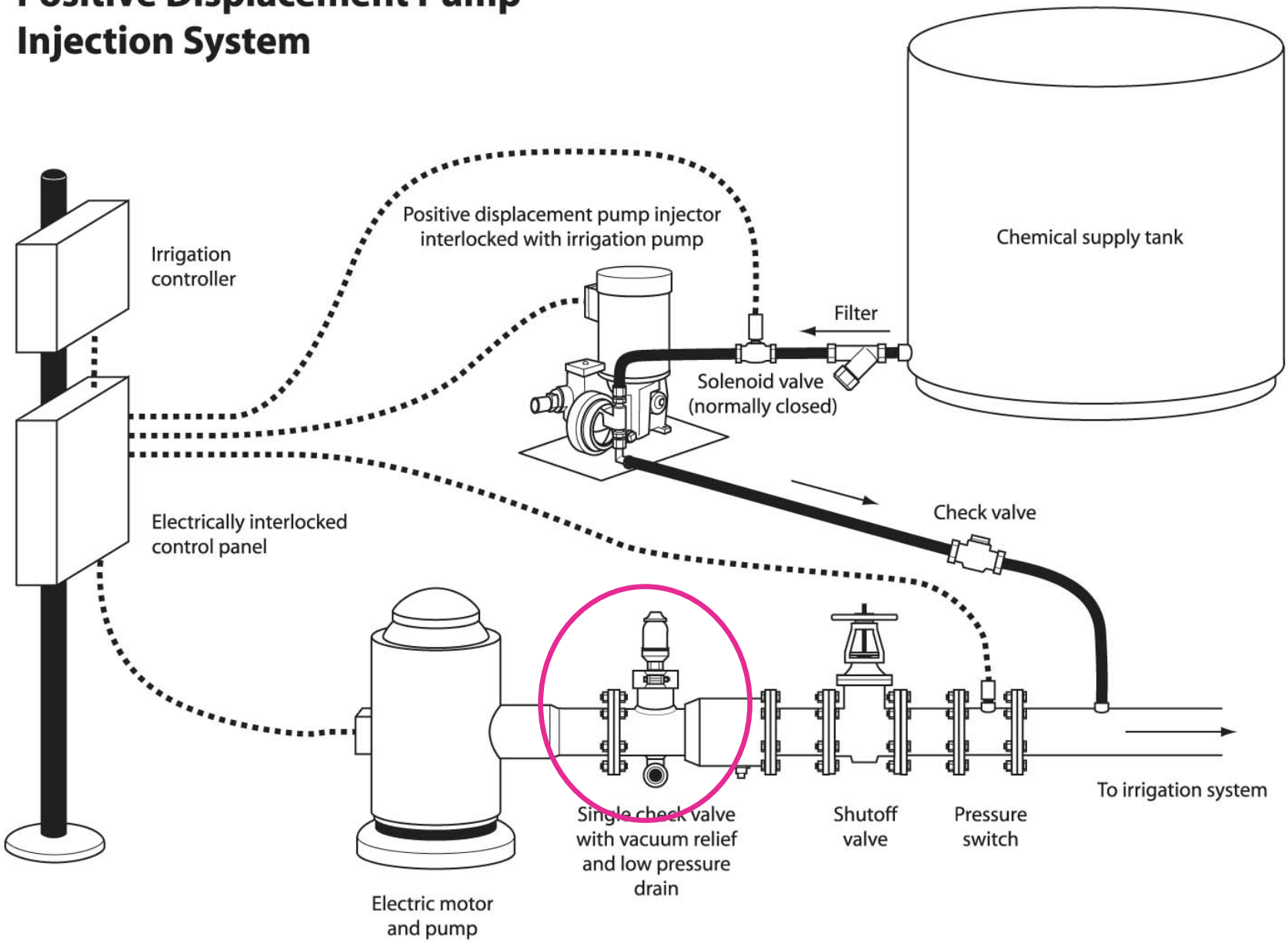
EPA, CA Dept. of Pesticide Regulation (DPR), and the County Ag Commissioners are all involved in setting and enforcing chemigation standards.

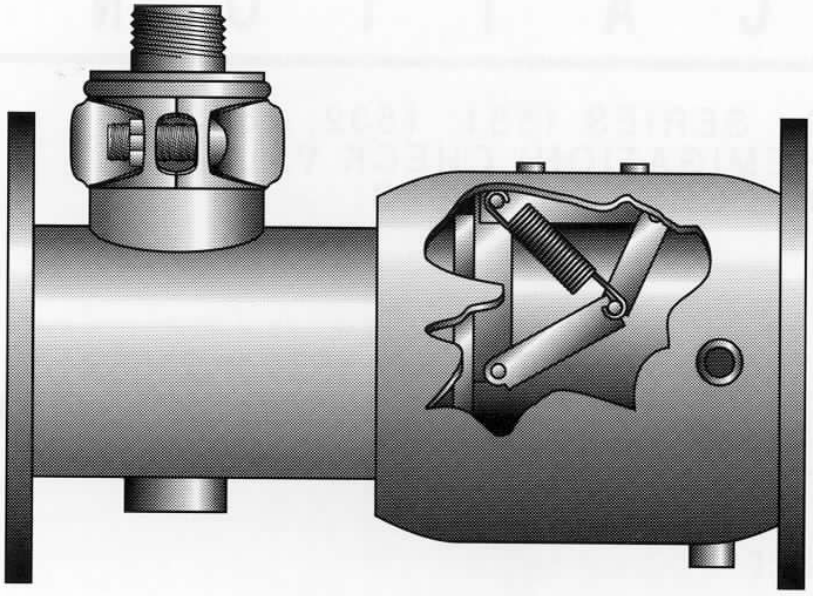
Chemigation Safety - Required Safety Devices

1. “A functional check valve, vacuum relief valve, and a low pressure drain”.

Purpose: No water movement back to the water source

Positive Displacement Pump Injection System





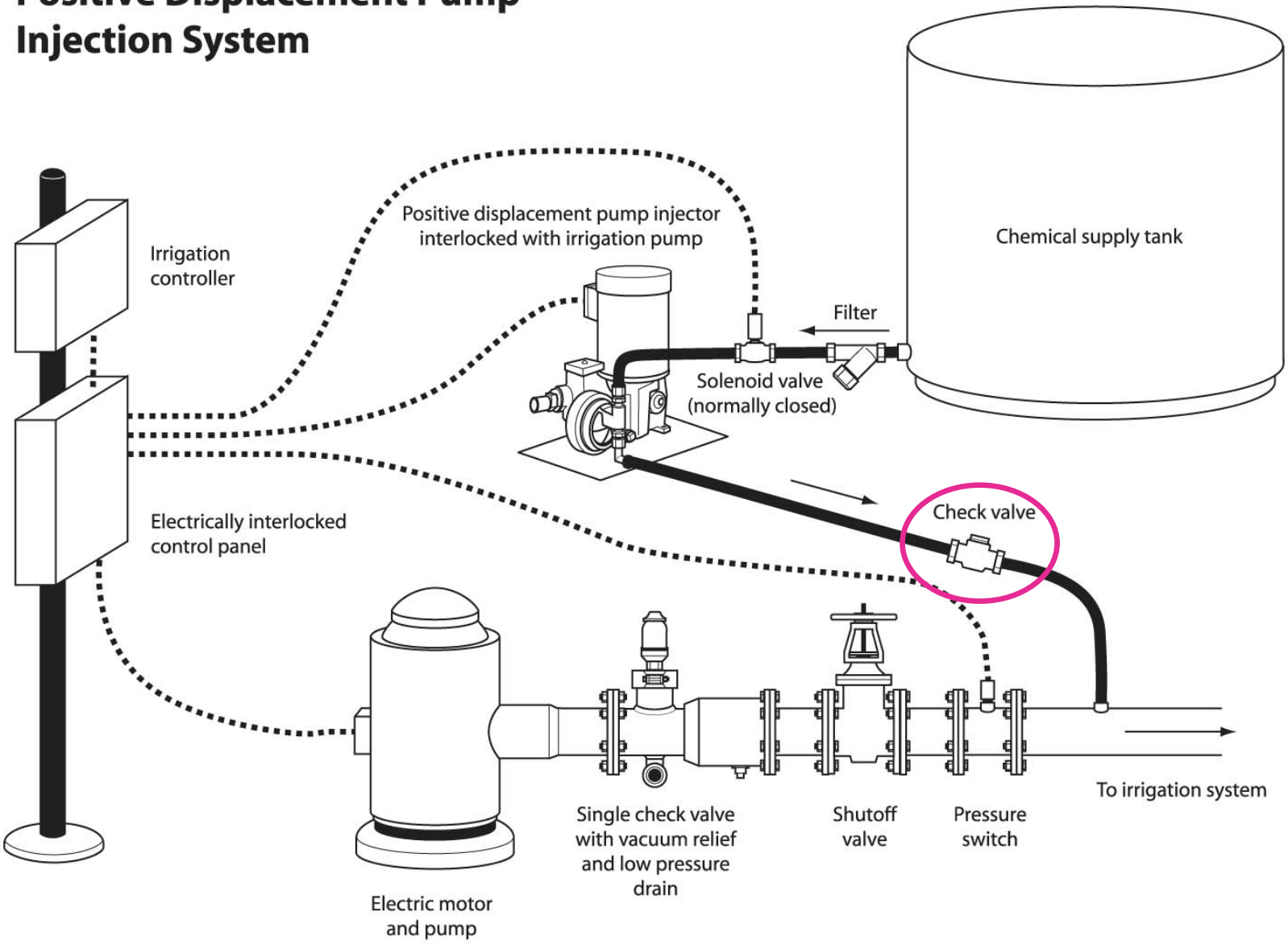
Chemigation Safety - Required Safety Devices

1. "A functional check valve, vacuum relief valve, and a low pressure drain". (No water movement back to the water source).

2. "Automatic, quick-closing check valve to prevent backflow toward the injection pump".

Purpose: prevent overflow of the storage tank

Positive Displacement Pump Injection System

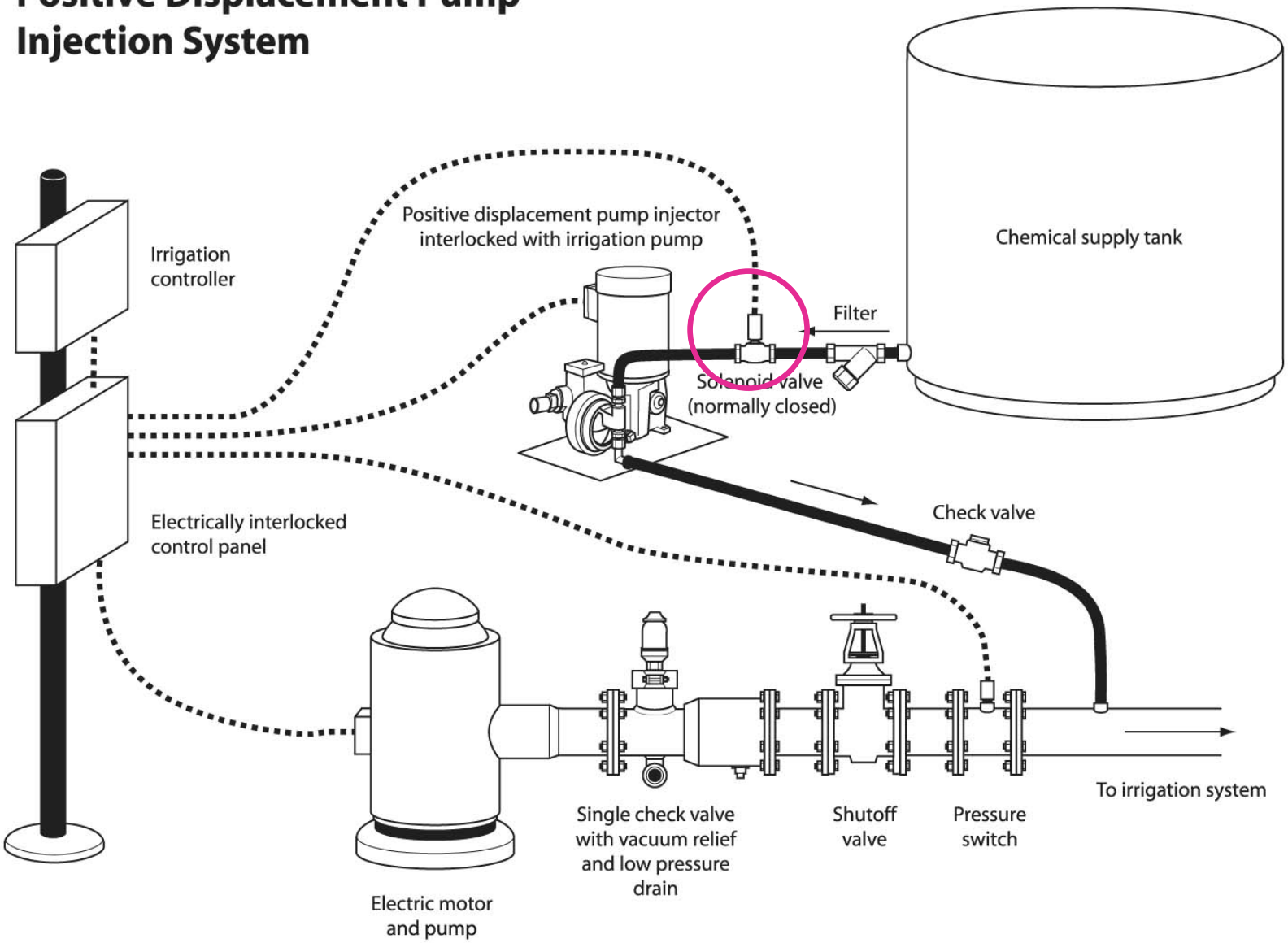


Chemigation Safety - Required Safety Devices

1. "A functional check valve, vacuum relief valve, and a low pressure drain". (No water movement back to the water source)
2. "Automatic, quick-closing check valve to prevent backflow toward the injection pump". (Do not want to overflow the storage tank)
3. " Normally-closed solenoid valve on intake side of injection pump, interlocked to pump".

Purpose: Prevent flow of chemical to the injector if the pump is shut down.

Positive Displacement Pump Injection System



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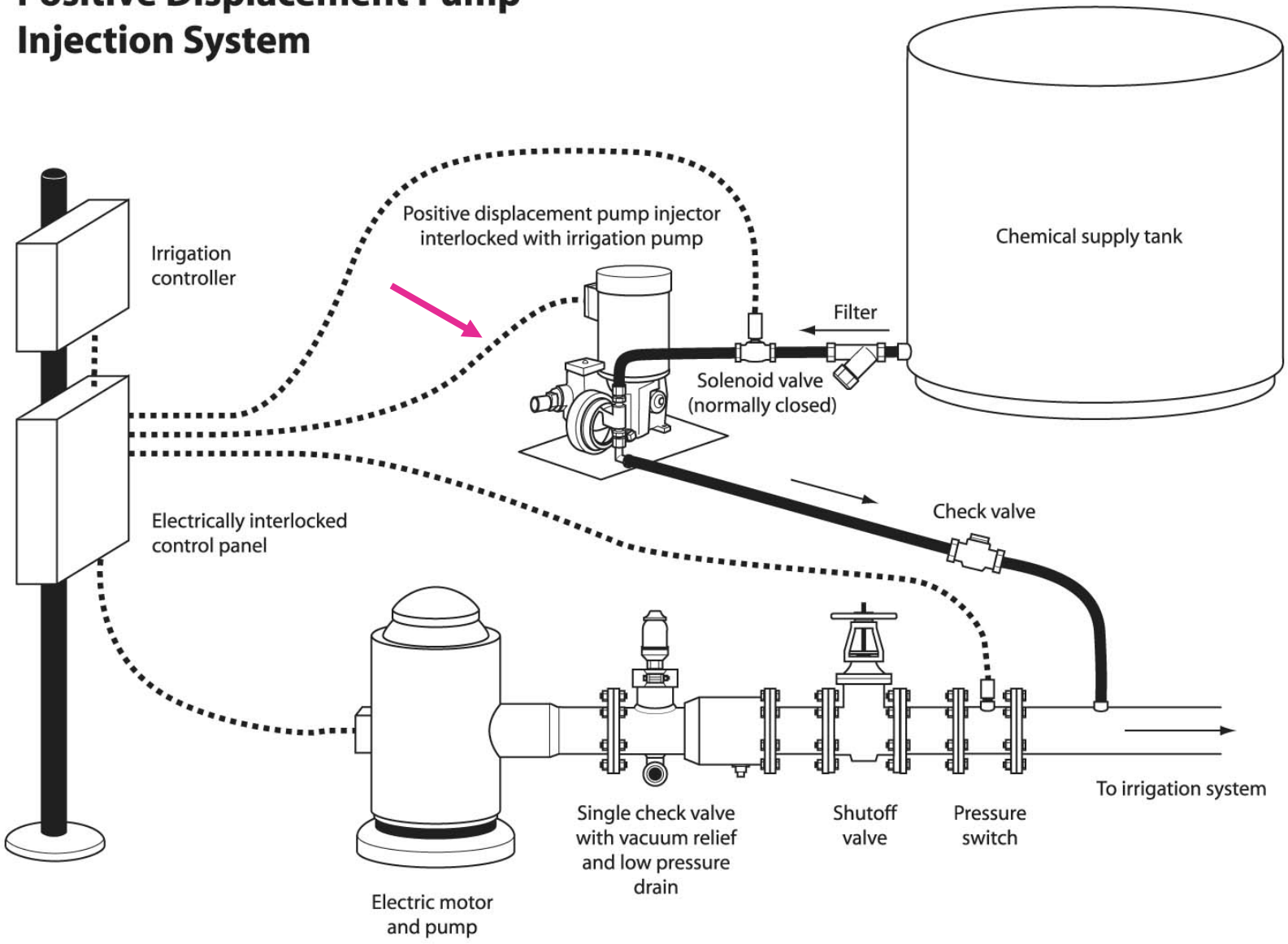
3. " Normally-closed solenoid valve on intake side of injection pump, interlocked to pump". (No flow of chemical to injector if the pump is shut down)
4. "The injection pump is interlocked to the irrigation pump".

Purpose: No injection will occur without water running.

Positive Displacement Pump Injection System



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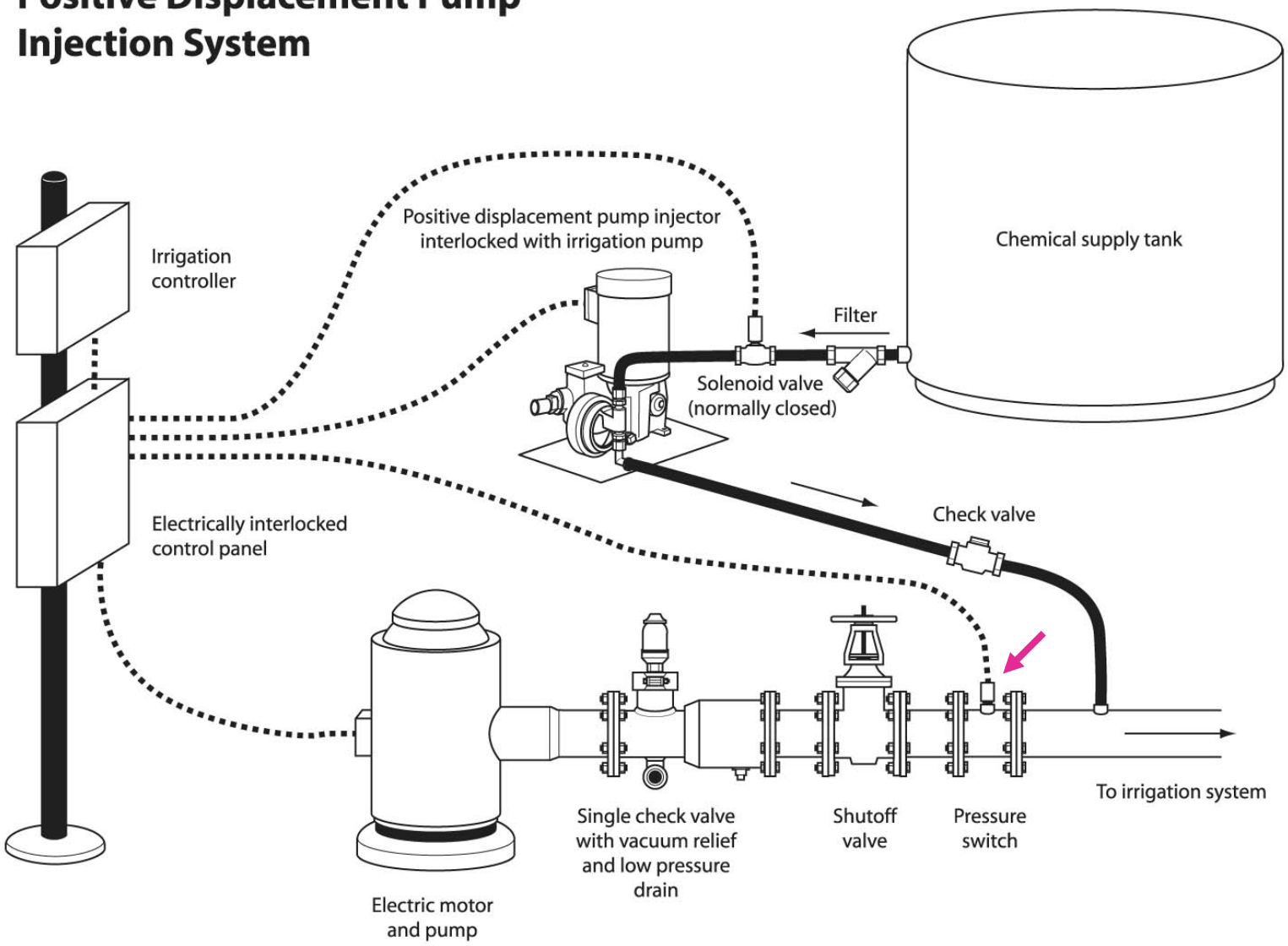
5. **"Pressure switch in the irrigation line which will stop the irrigation pump".**

Purpose: Stops irrigation and injection if there is a break in the irrigation line.

Positive Displacement Pump Injection System



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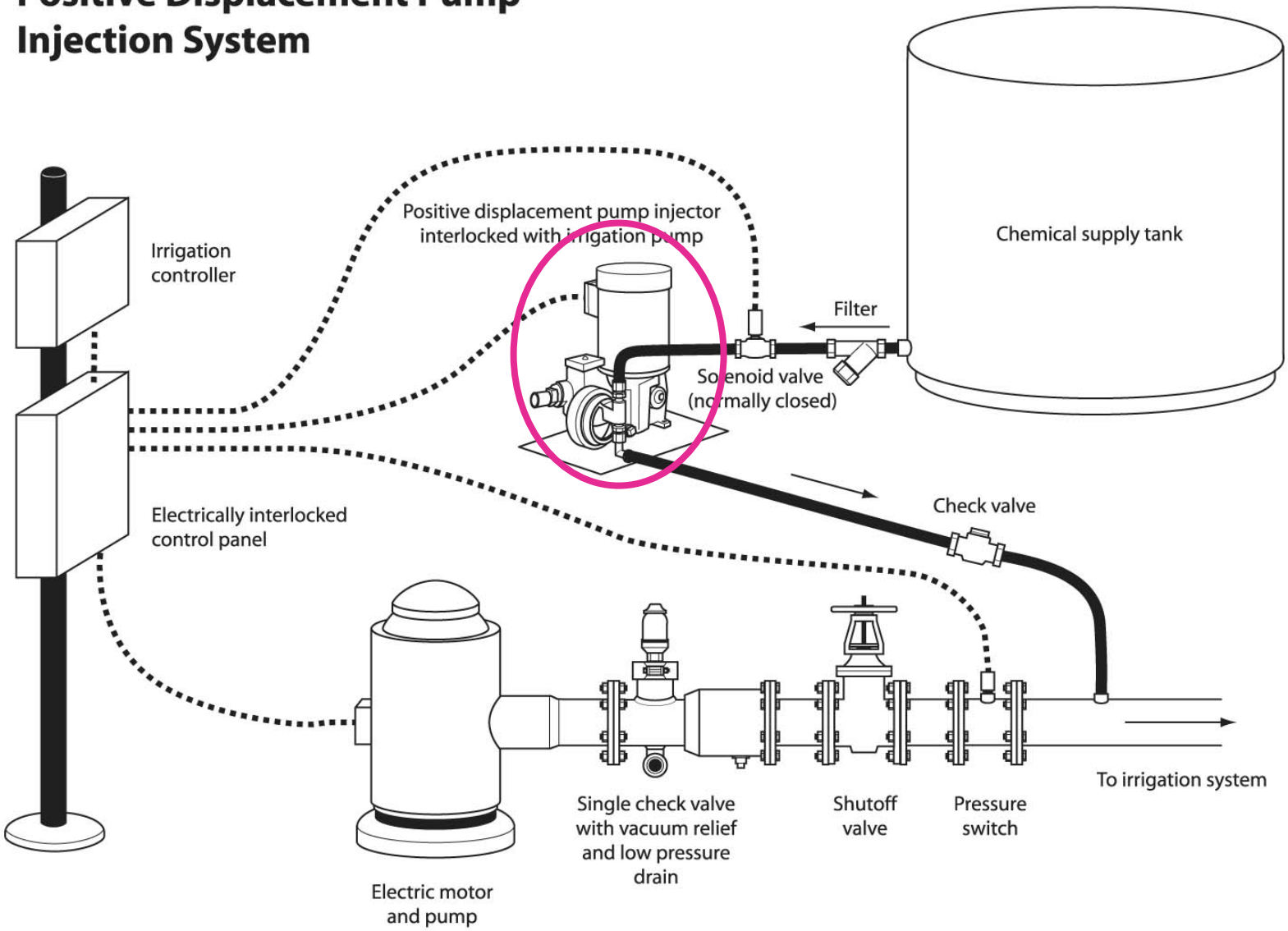
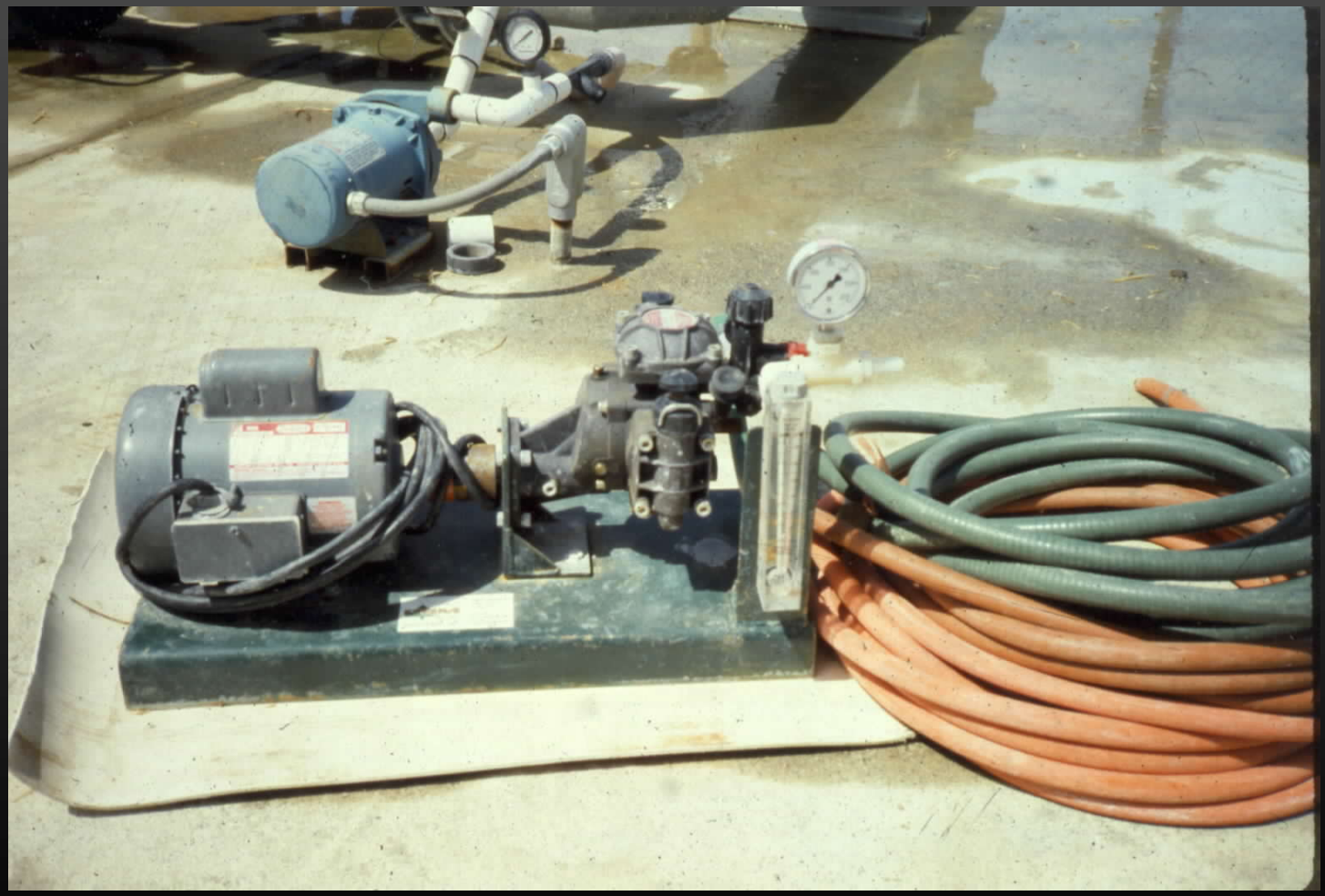
4. " The injection pump is interlocked to the irrigation pump". (No injection will occur without water running)
5. "Pressure switch in the irrigation line which will stop the irrigation pump". (Stops irrigation and injection if there is a break in the irrigation line)
6. **"Use a metering pump (positive displacement pump) for injection. Positive displacement pumps include piston/cylinder pumps and diaphragm pumps".**

Positive Displacement Pump Injection System



Positive Displacement Pump - Piston / Cylinder

Positive Displacement Pump - Diaphragm Pump



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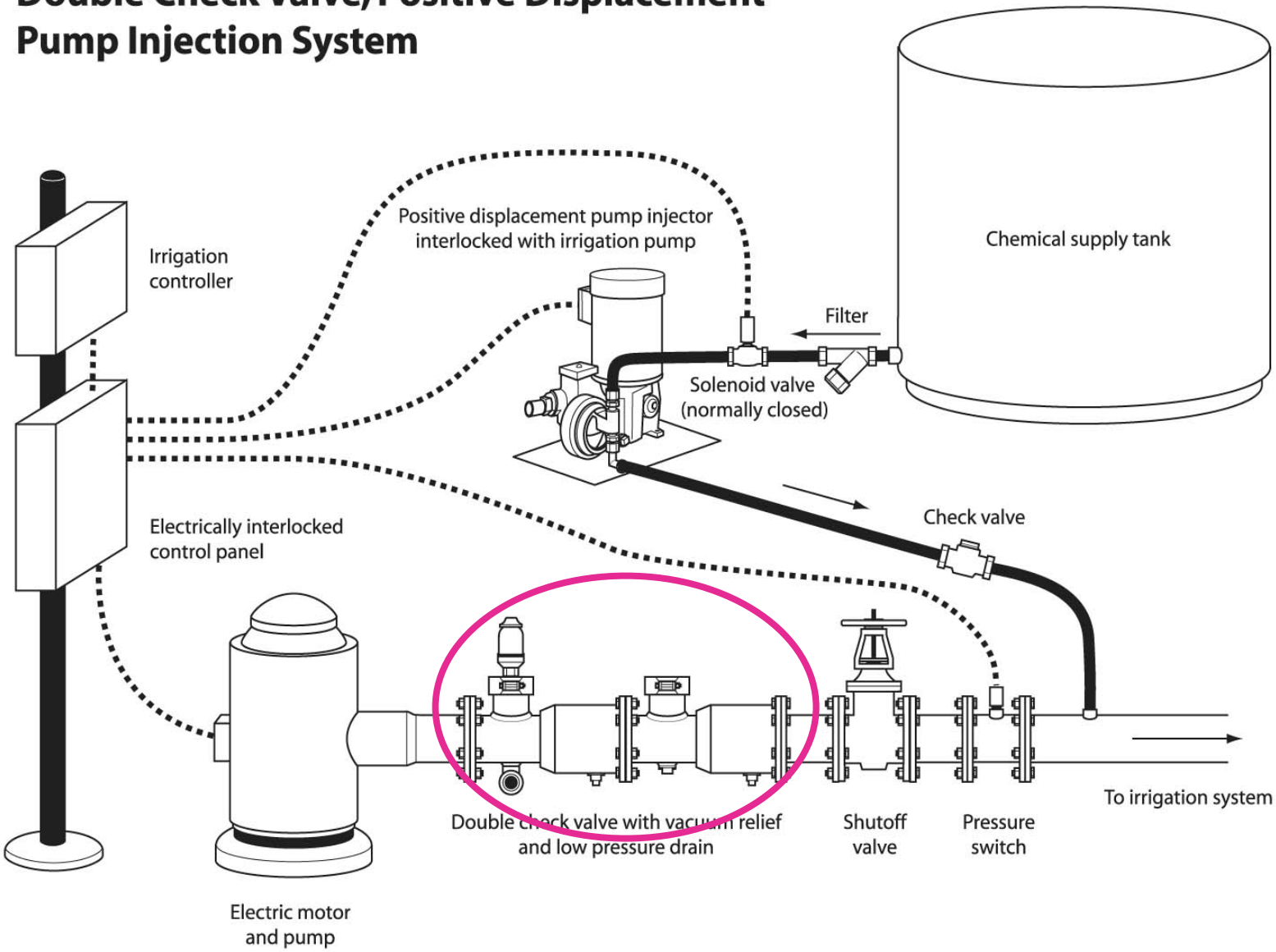
- Some regulations require a double check valve system to provide safety redundancy.

Double Check Valve, Positive Displacement Pump Injection System



Double Check Valve

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Some locales even require a ***Pressure Reducing Backflow Prevention Valve***. These are the backflow prevention valves used on urban water systems and they are extremely expensive.

Pressure Reducing Backflow Prevention Valve

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There are also approved alternatives to the label's list of Required System Safety Devices. They include:

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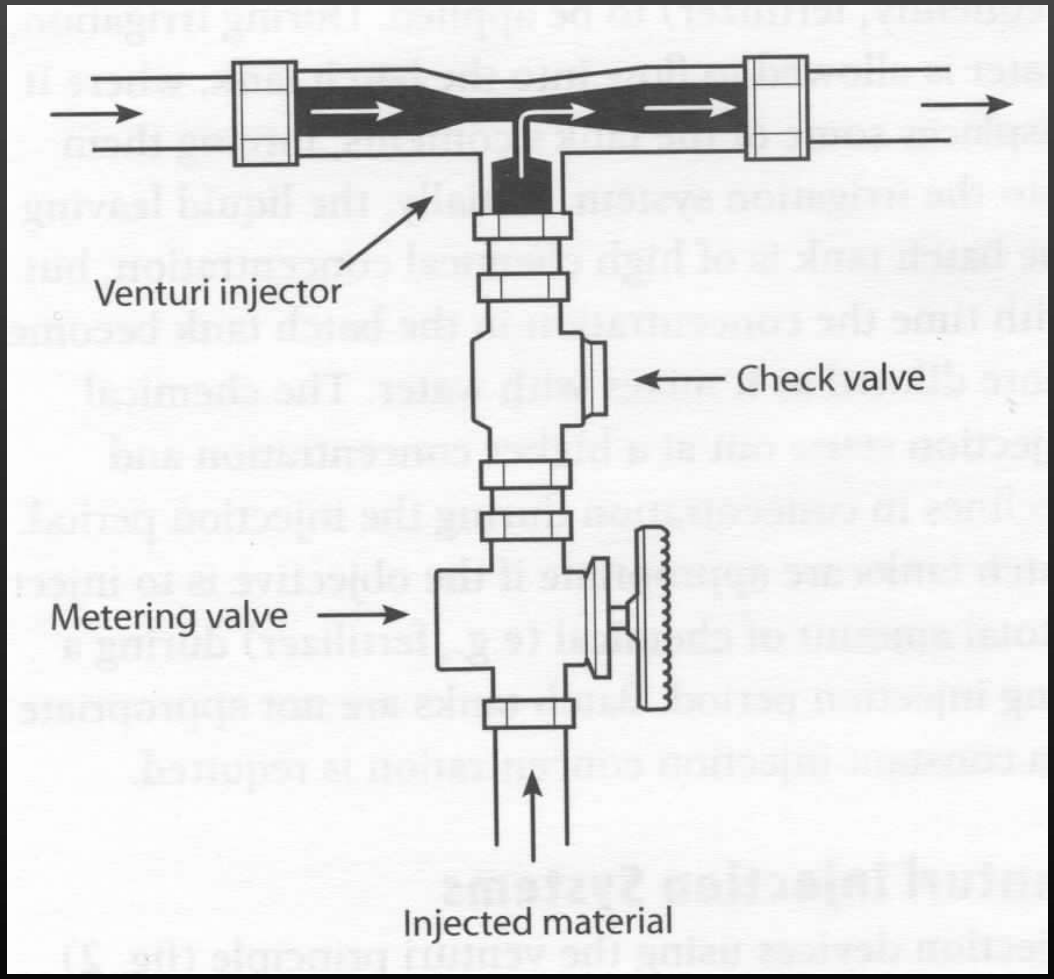
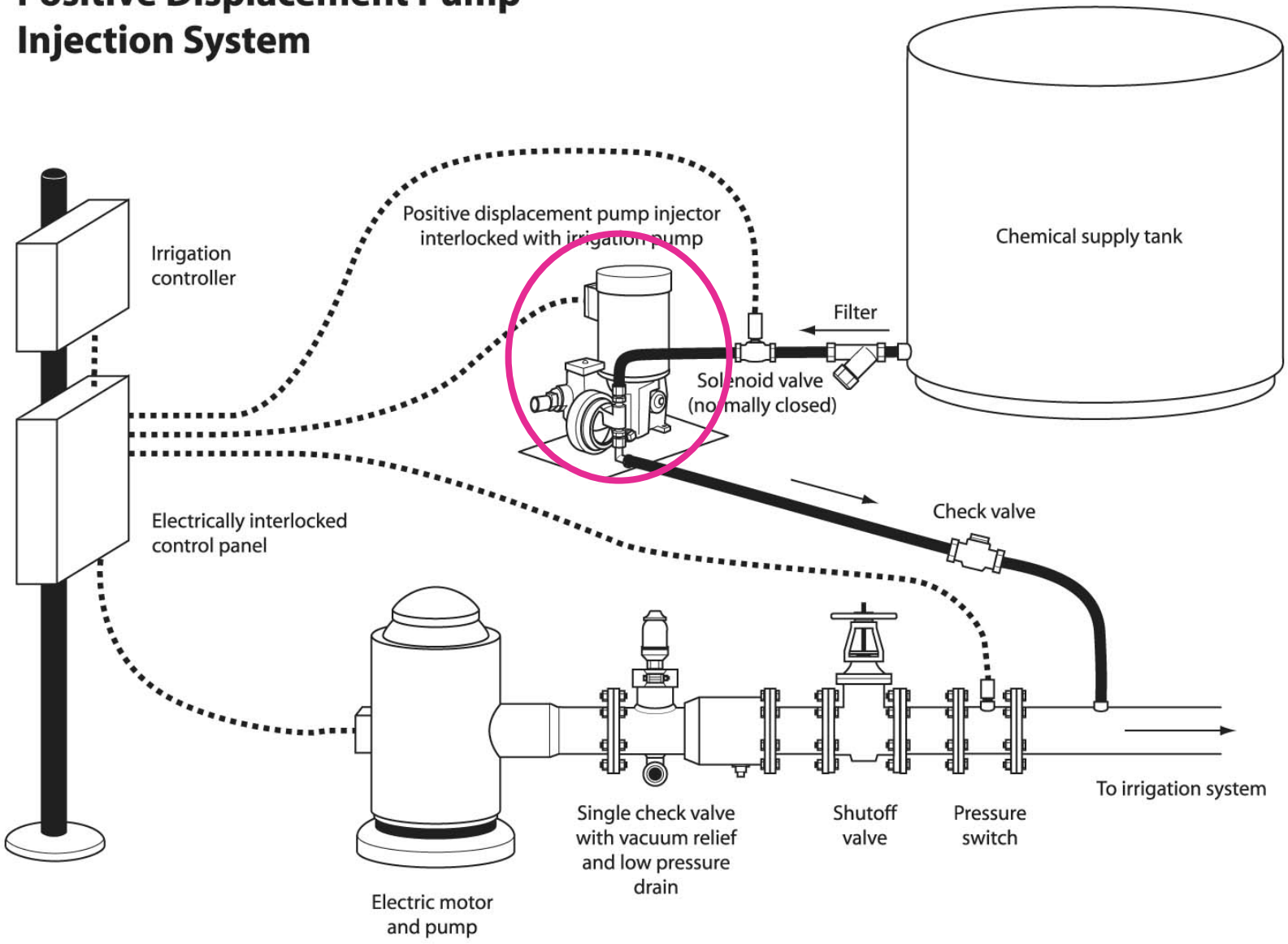
Alternative devices:

Replacing the positive displacement injection pump with *"a venturi system inserted directly into the main water line. The line from the pesticide supply tank to the venturi must contain a quick-closing check valve. This supply line must also contain either a (1) normally-closed, hydraulically operated valve, or (2) a normally-closed solenoid valve, interlocked to the irrigation pump".*

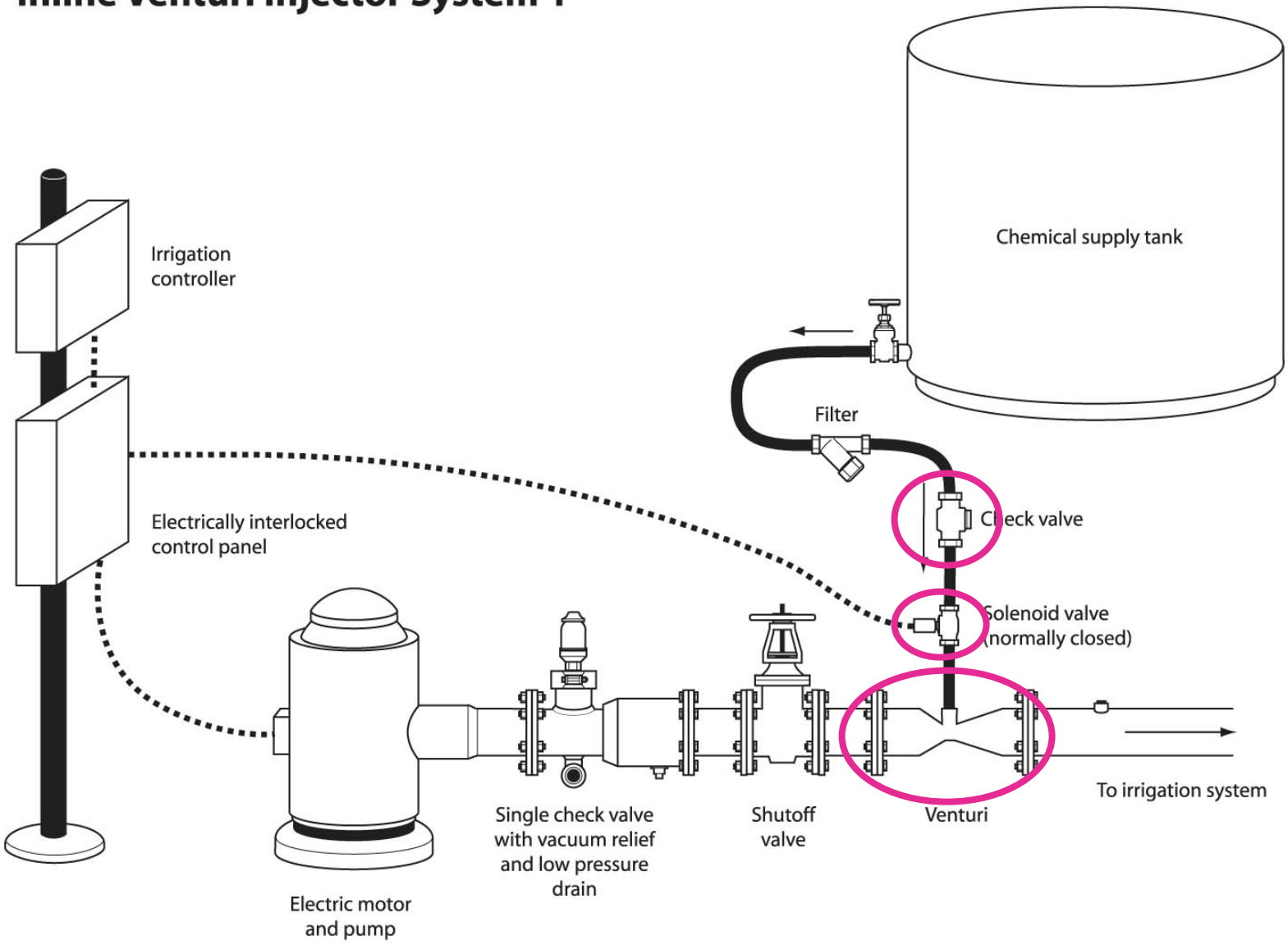
Venturi Injector:



Positive Displacement Pump Injection System



Inline Venturi Injector System 1



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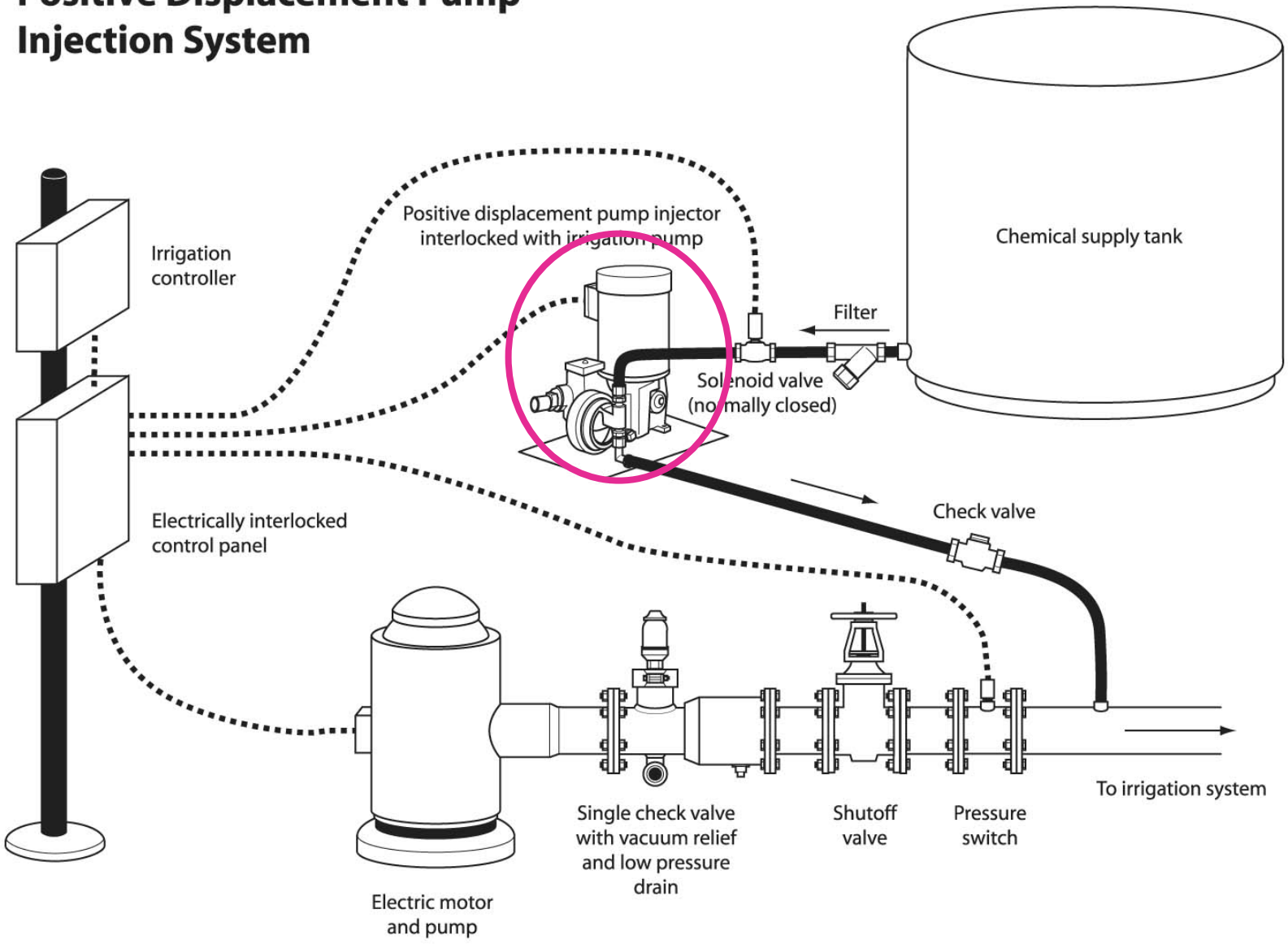
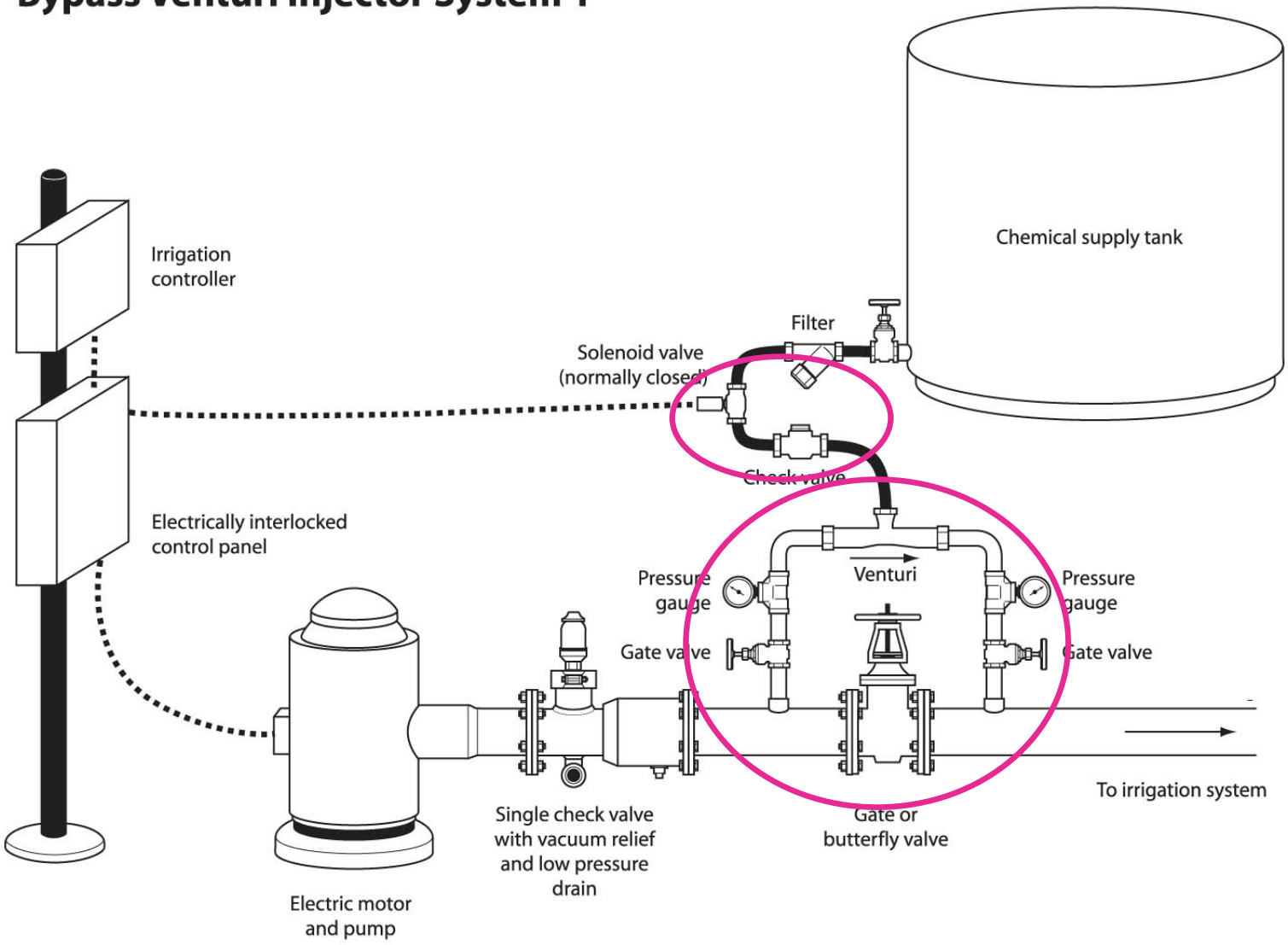
Alternative devices:

Replacing the positive displacement injection pump with "*a bypass venturi injector*". The same requirements for valves on the intake line to the venturi injector hold for both the inline venturi injector system and for the bypass venturi injector system.

Positive Displacement Pump Injection System



Bypass Venturi Injector System 1



Venturi Injector - Bypass Across a Pressure Drop

Venturi Injector

- The bypass venturi injector must be plumbed across a pressure drop in order to work.
- There is approximately a 20% pressure loss across the venturi.
- The venturi injector can sometimes be difficult to adjust for a constant injection rate, especially if the irrigation system pressure is fluctuating or changes (different irrigation blocks being irrigated).

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Alternative devices:

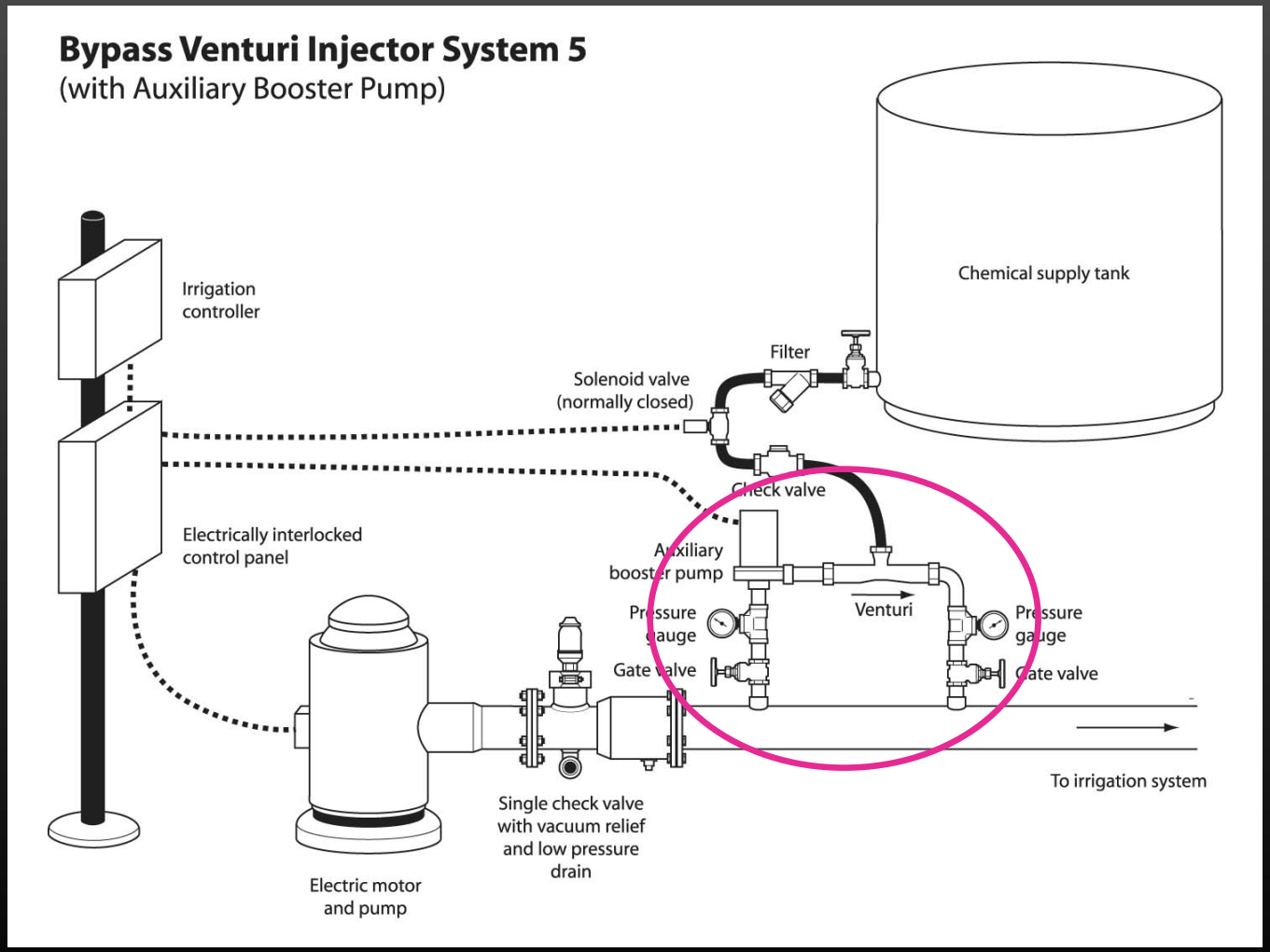
The bypass venturi system can also be installed using a *booster pump*.

With a booster pump venturi system, the venturi does not need to be installed across a pressure drop.

With a booster pump system, the venturi system is more easily controlled and not as sensitive to changes in the irrigation system pressure.

Venturi Injector - Bypass with a Booster Pump

Venturi Booster Pump Injection System



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Summary:

- **Proper injection equipment is the first step in complying with injection safety requirements.**
- **It is effective in protecting the water supply, preventing chemical spills, and ensuring that injections occur when the irrigation system is operating properly.**
- **Check local regulations, especially for backflow prevention, to see if they exceed the label requirements.**

Presentation and drawings at: http:/ucanr.edu/schwankl

Questions?

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For Powerpoint presentation, go to:

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Chemigation Uniformity in Drip Irrigation Systems

Uniform Chemigation

We want to have the material injected into the drip system to be applied as evenly (uniformly) as the water applied by the drip irrigation system.

Uniform Chemigation

A well-designed, well-maintained drip system which applies water uniformly will apply injected chemicals uniformly if the injection is done properly.

Uniform Chemigation

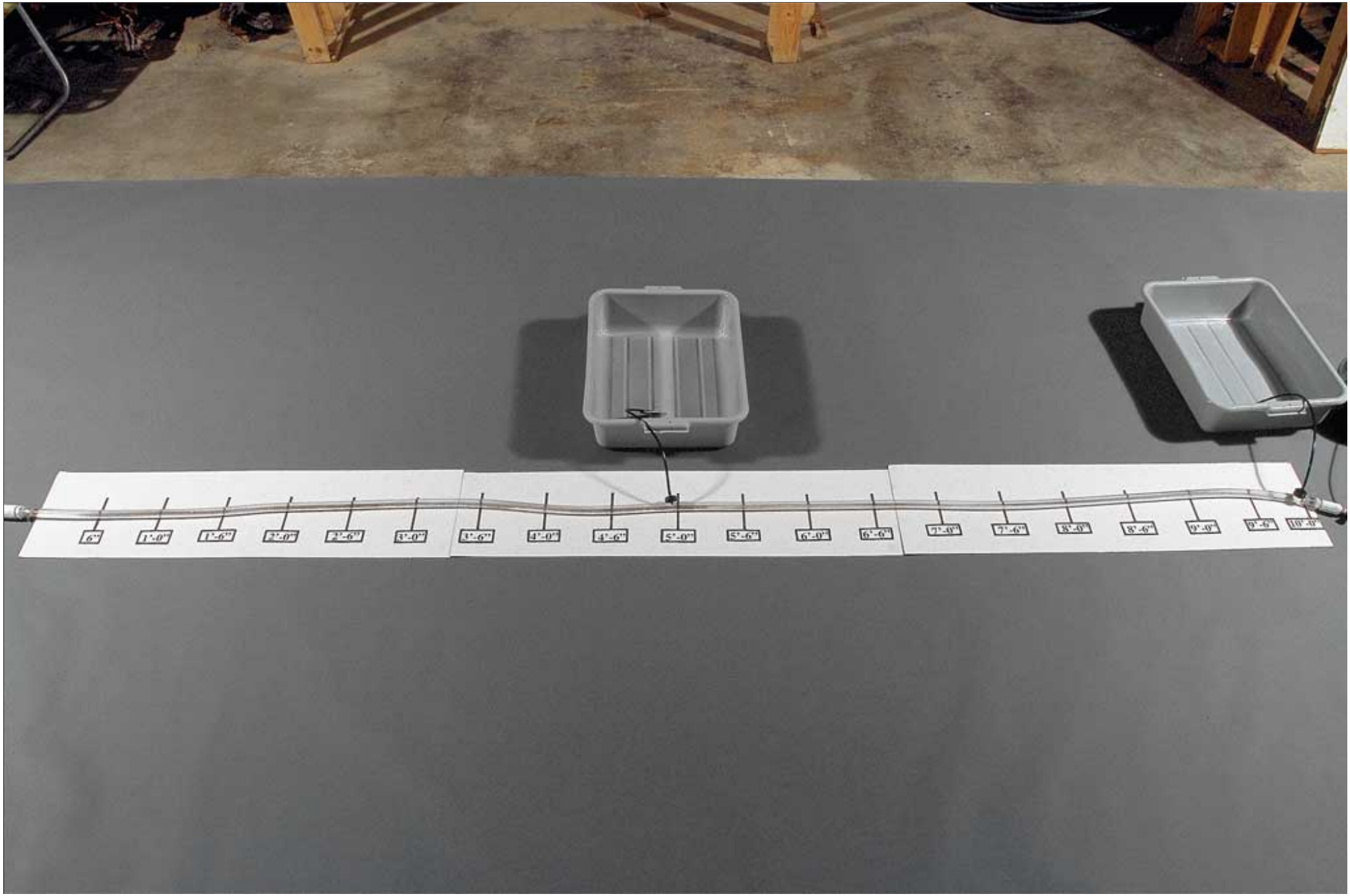
First, it is important to remember that once injection starts, the injected material doesn't immediately start coming out of all the drip emitters.

- It takes time for the injected material (and the water) to travel through the drip irrigation system.

Uniform Chemigation

First, it is important to remember that once injection starts, the injected material doesn't immediately start coming out of all the drip emitters.

- It takes time for the injected material (and the water) to travel through the drip irrigation system.
  - **Travel time issue is not as important in microsprinkler systems due to higher flow velocities at ends of lateral lines.**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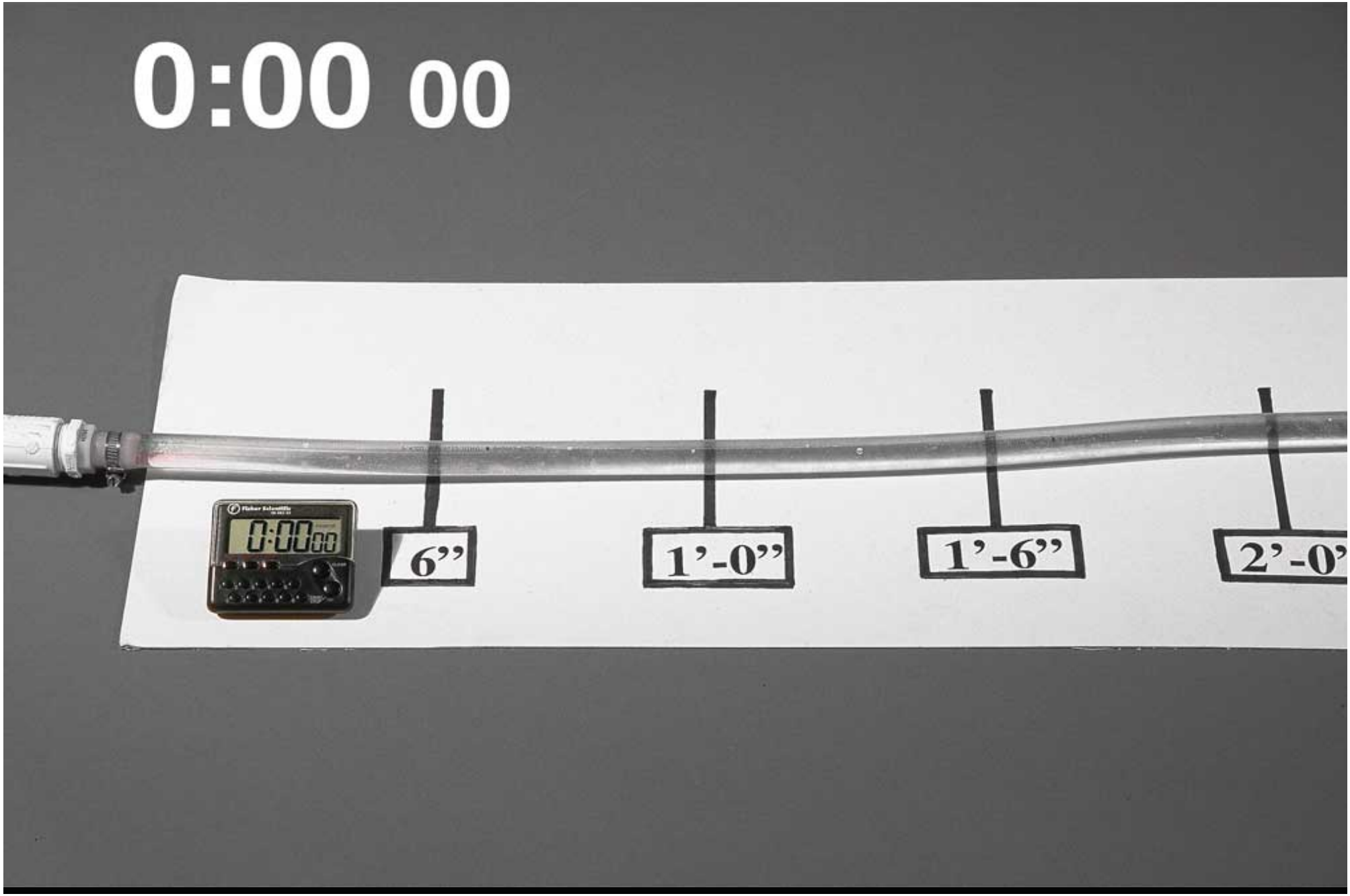
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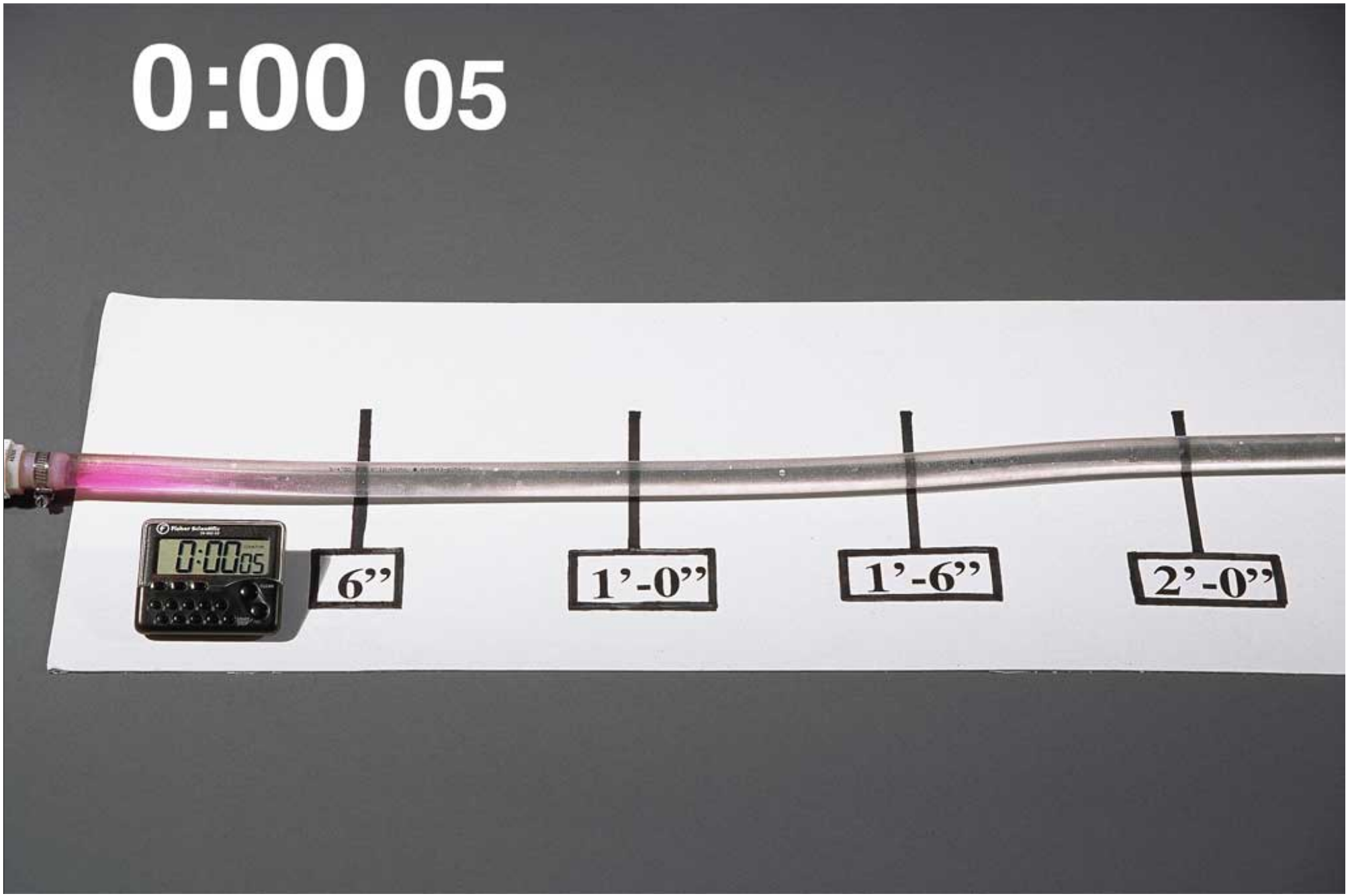
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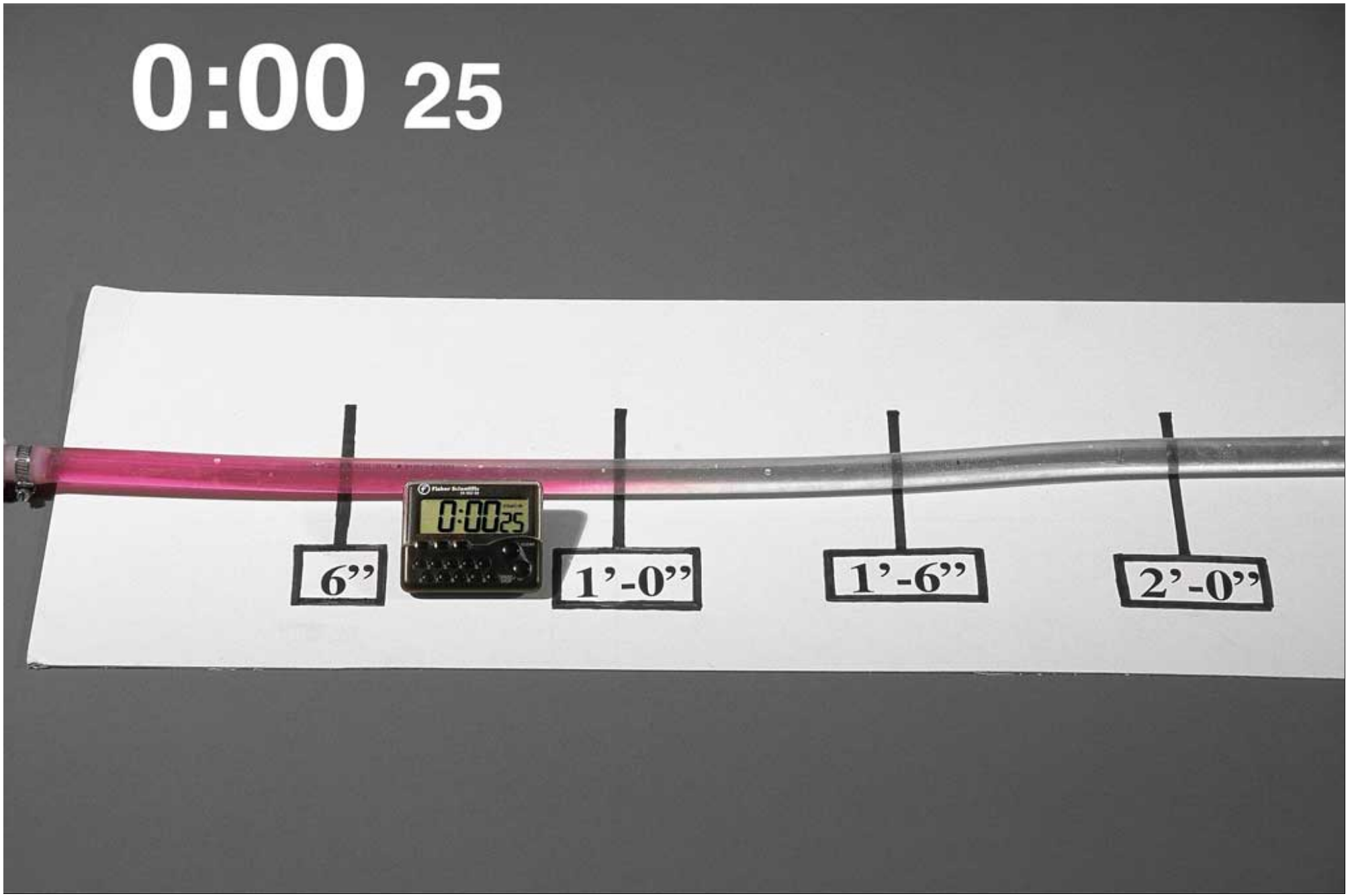
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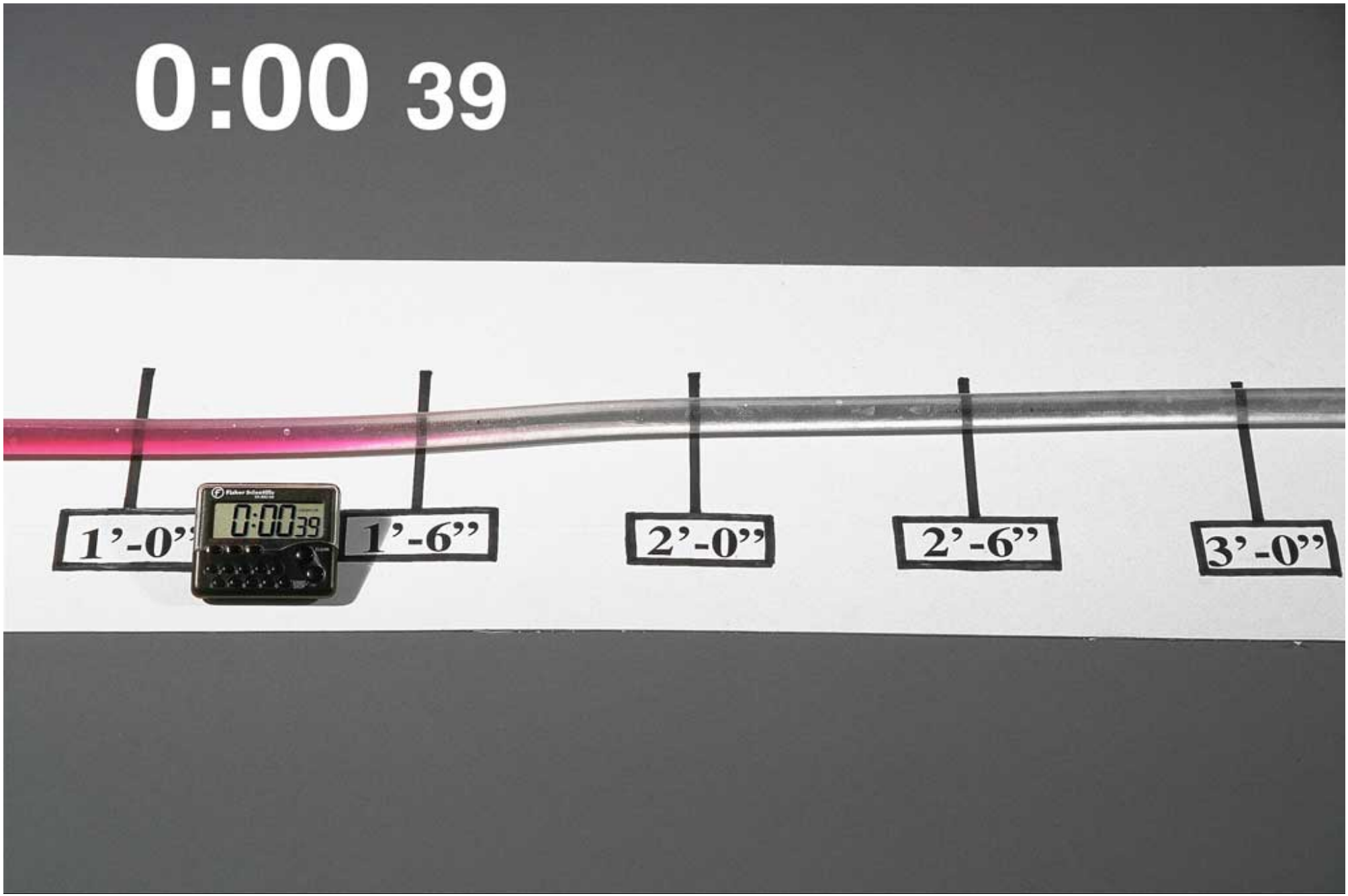
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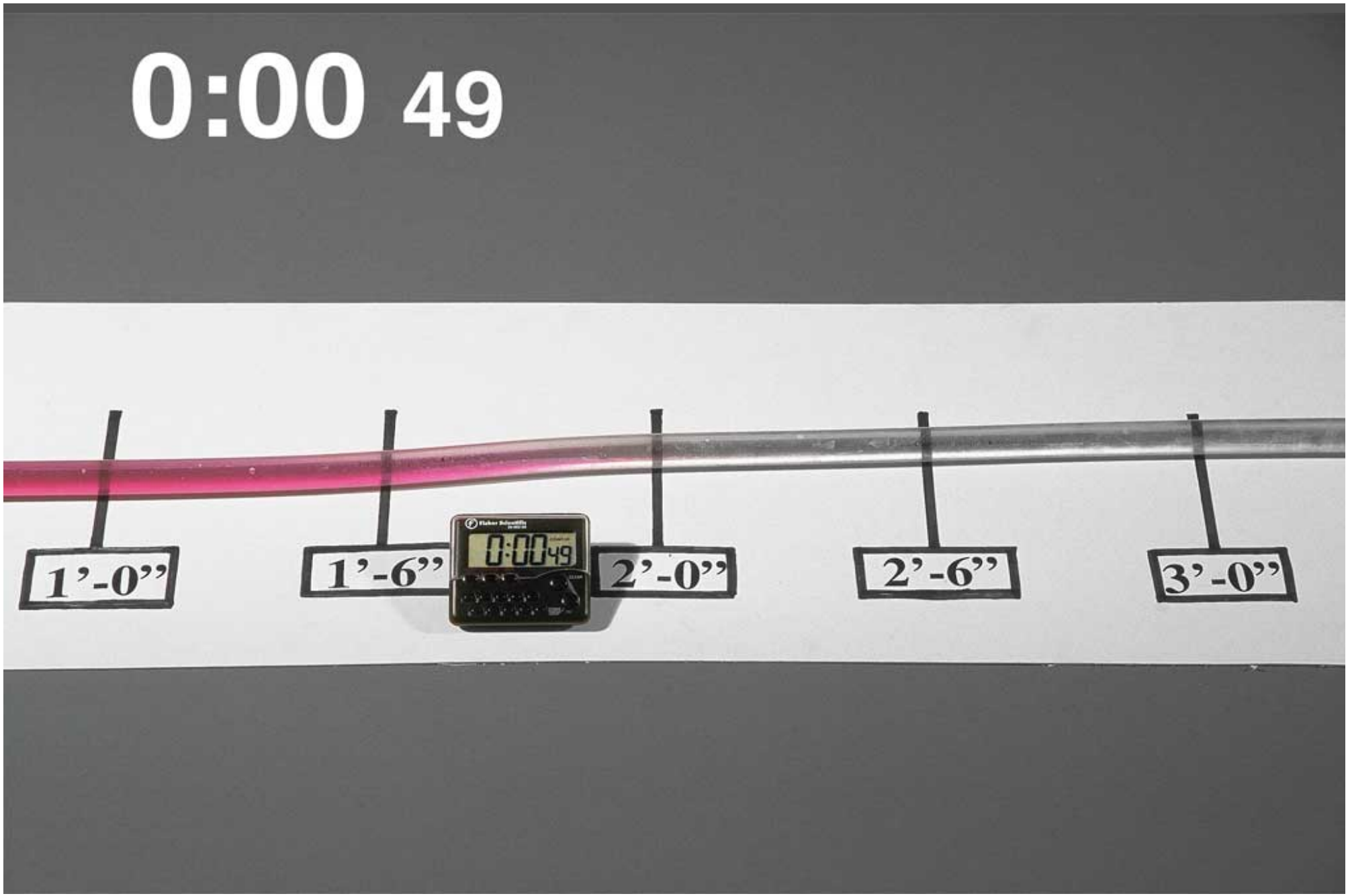
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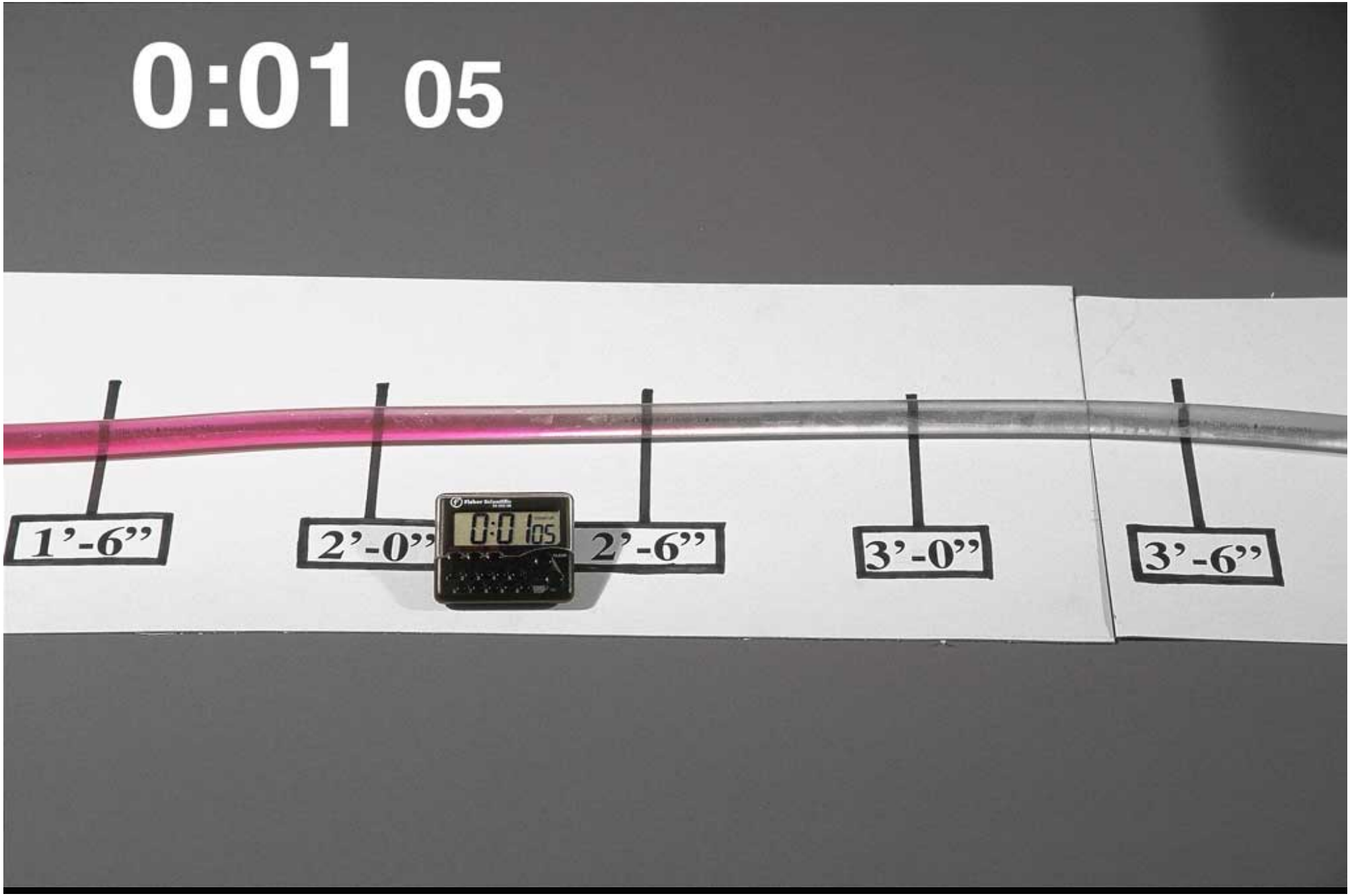
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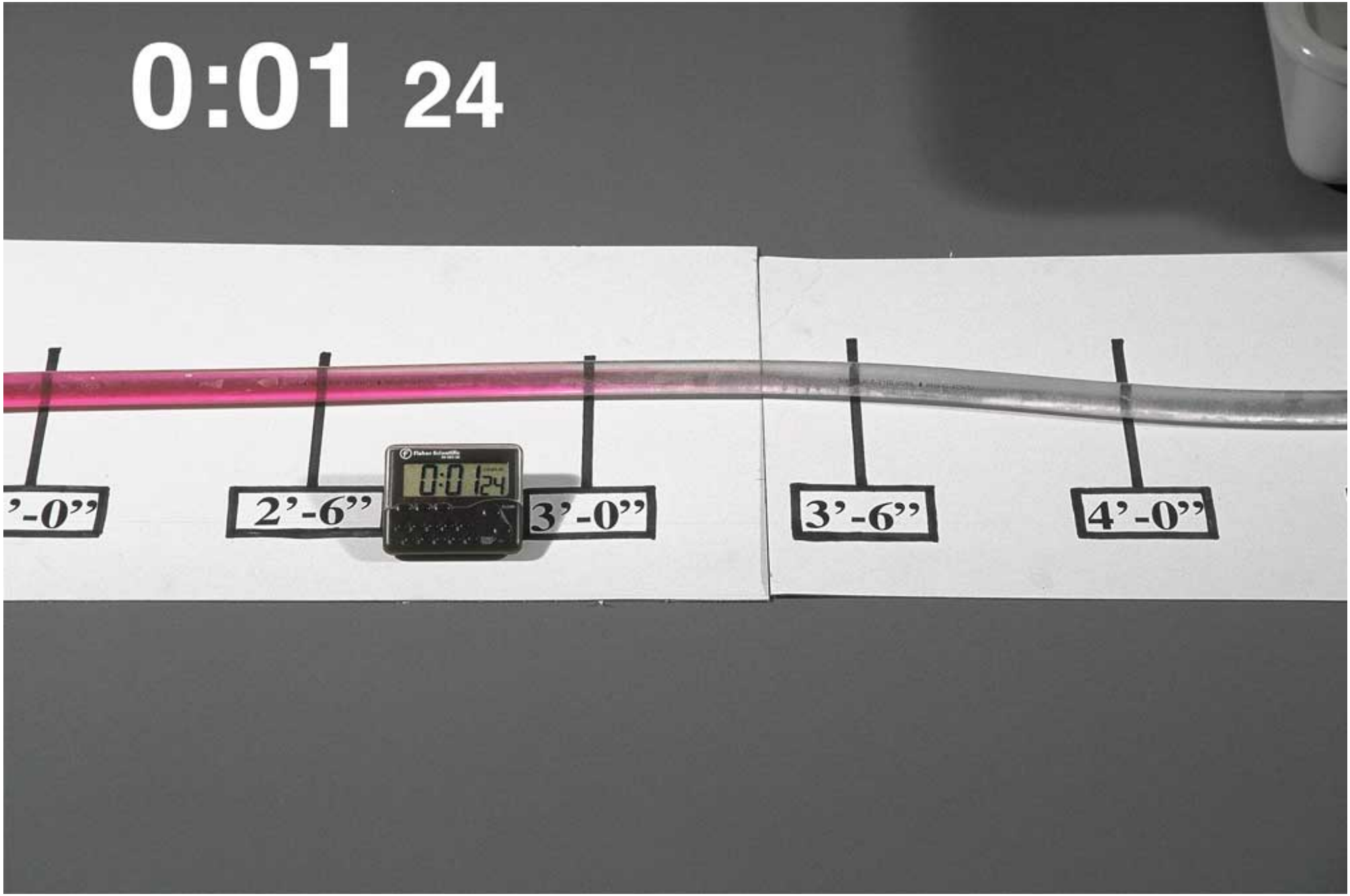
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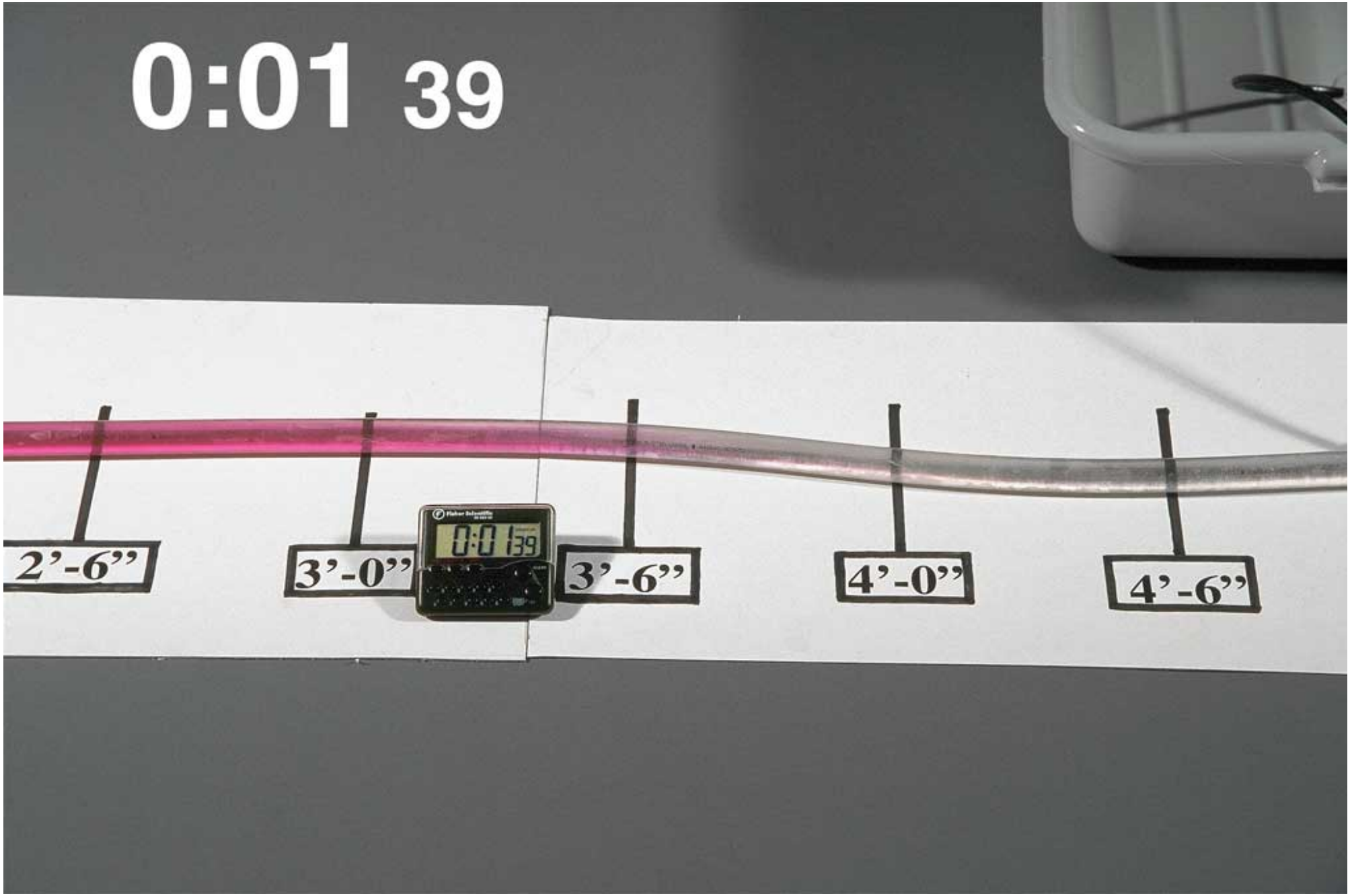
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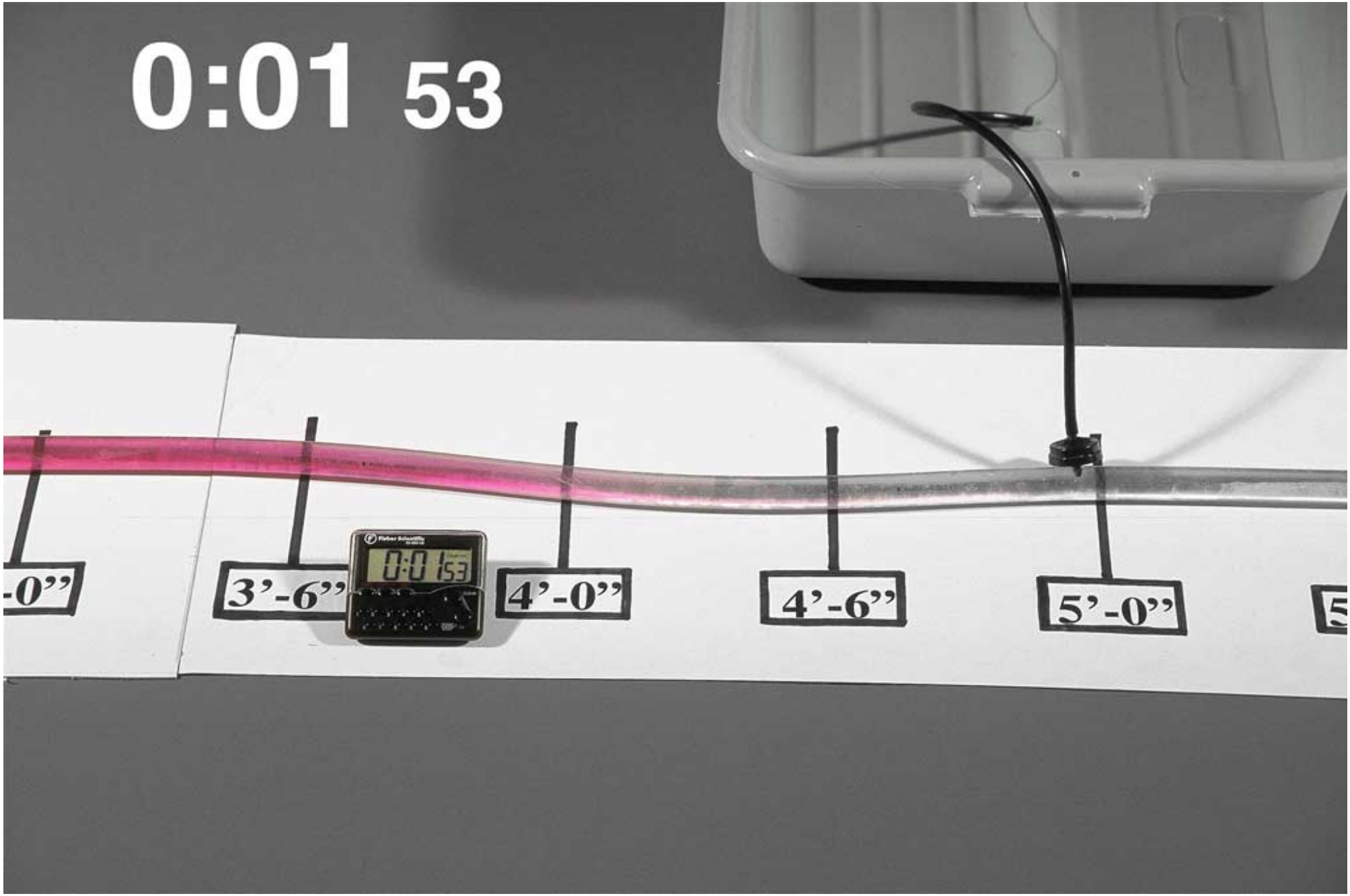
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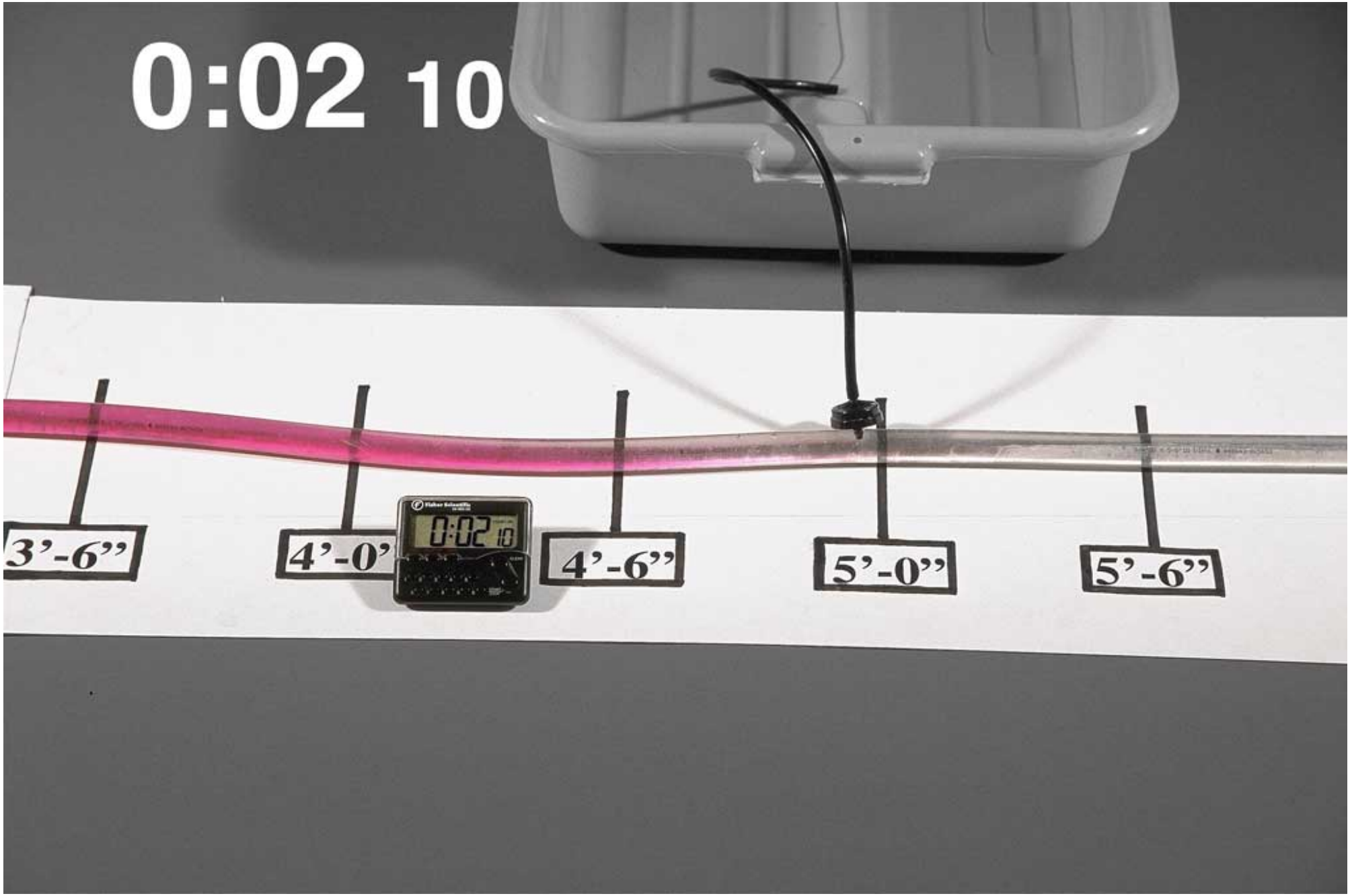
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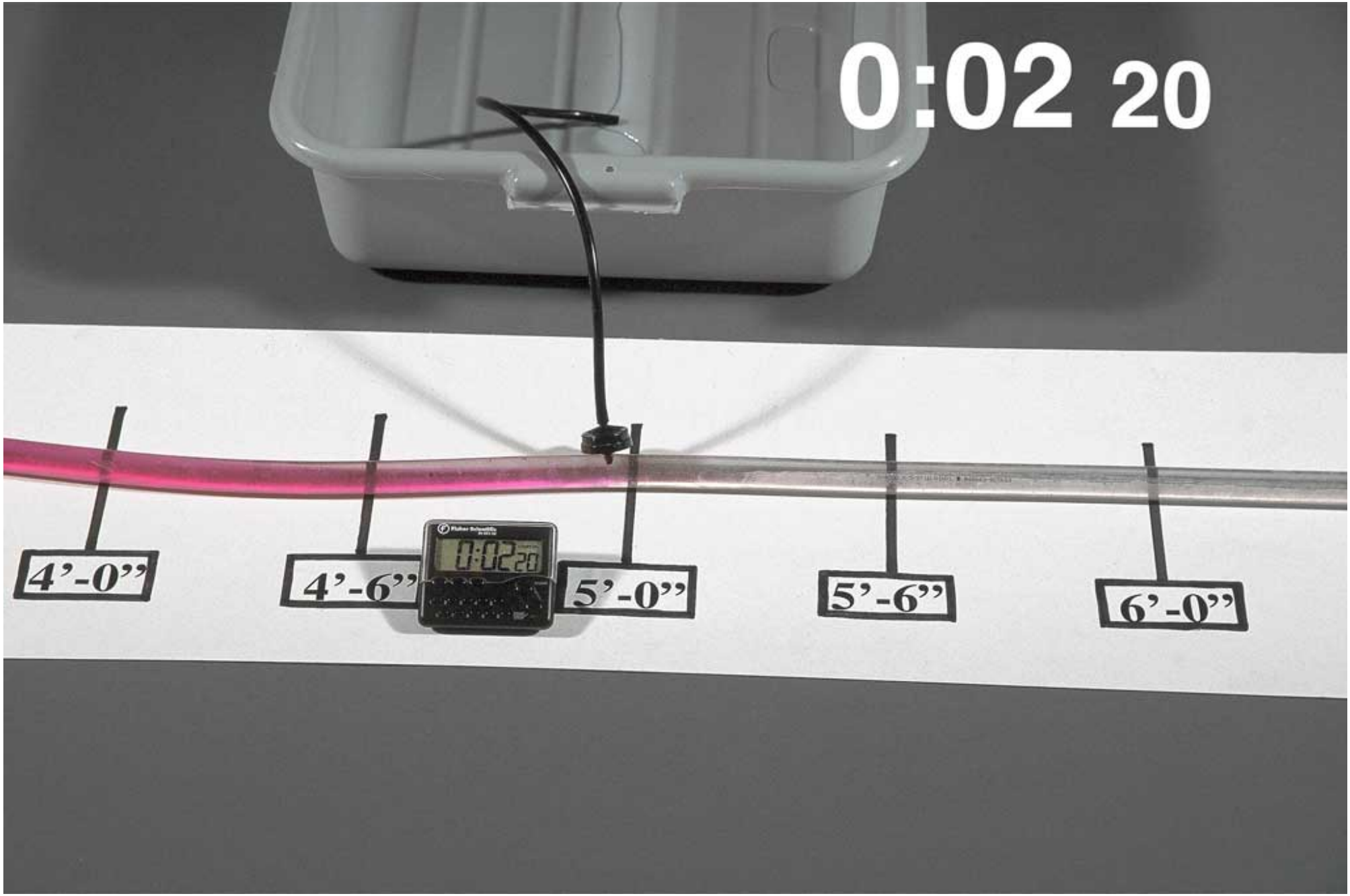
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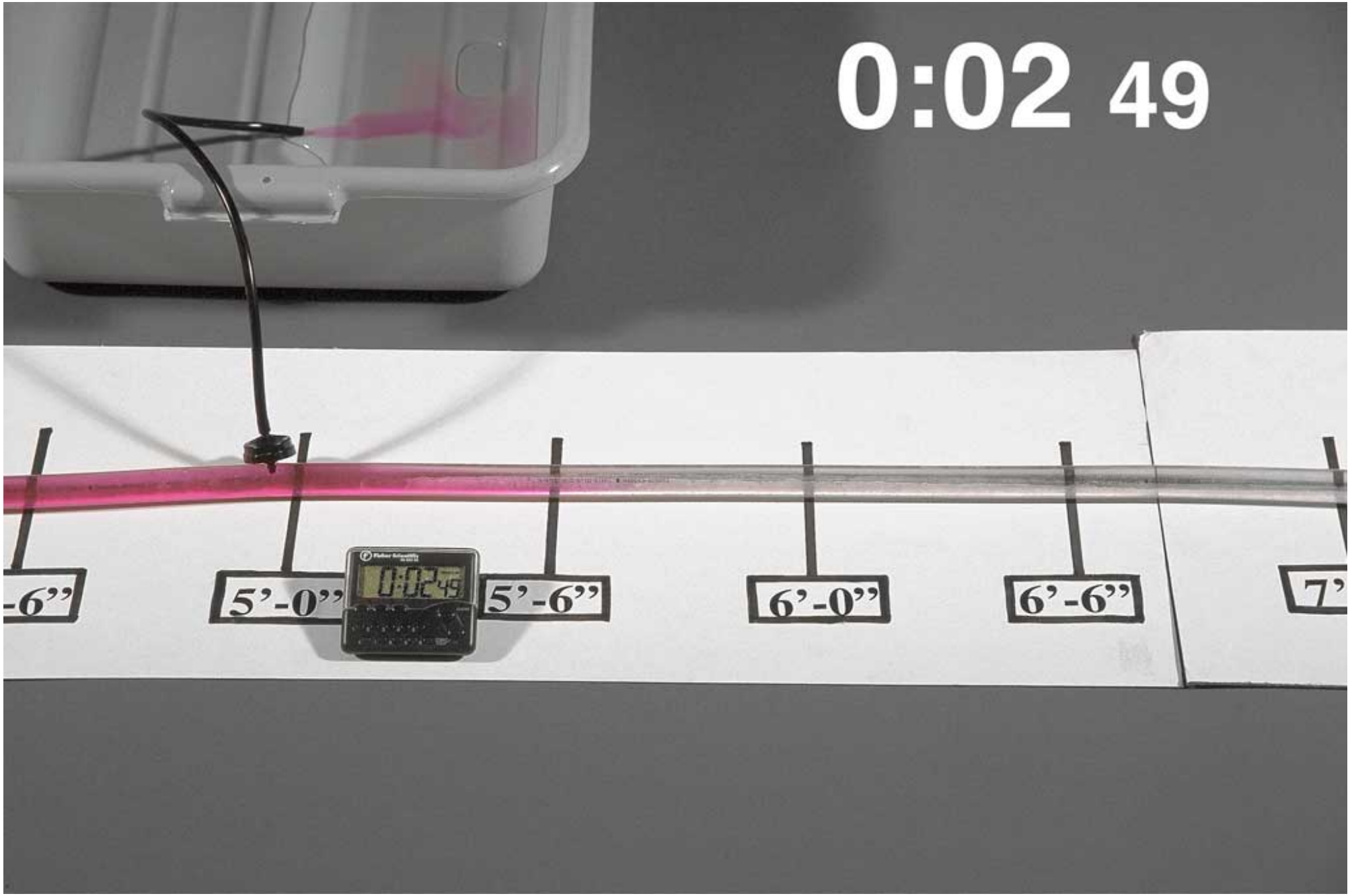
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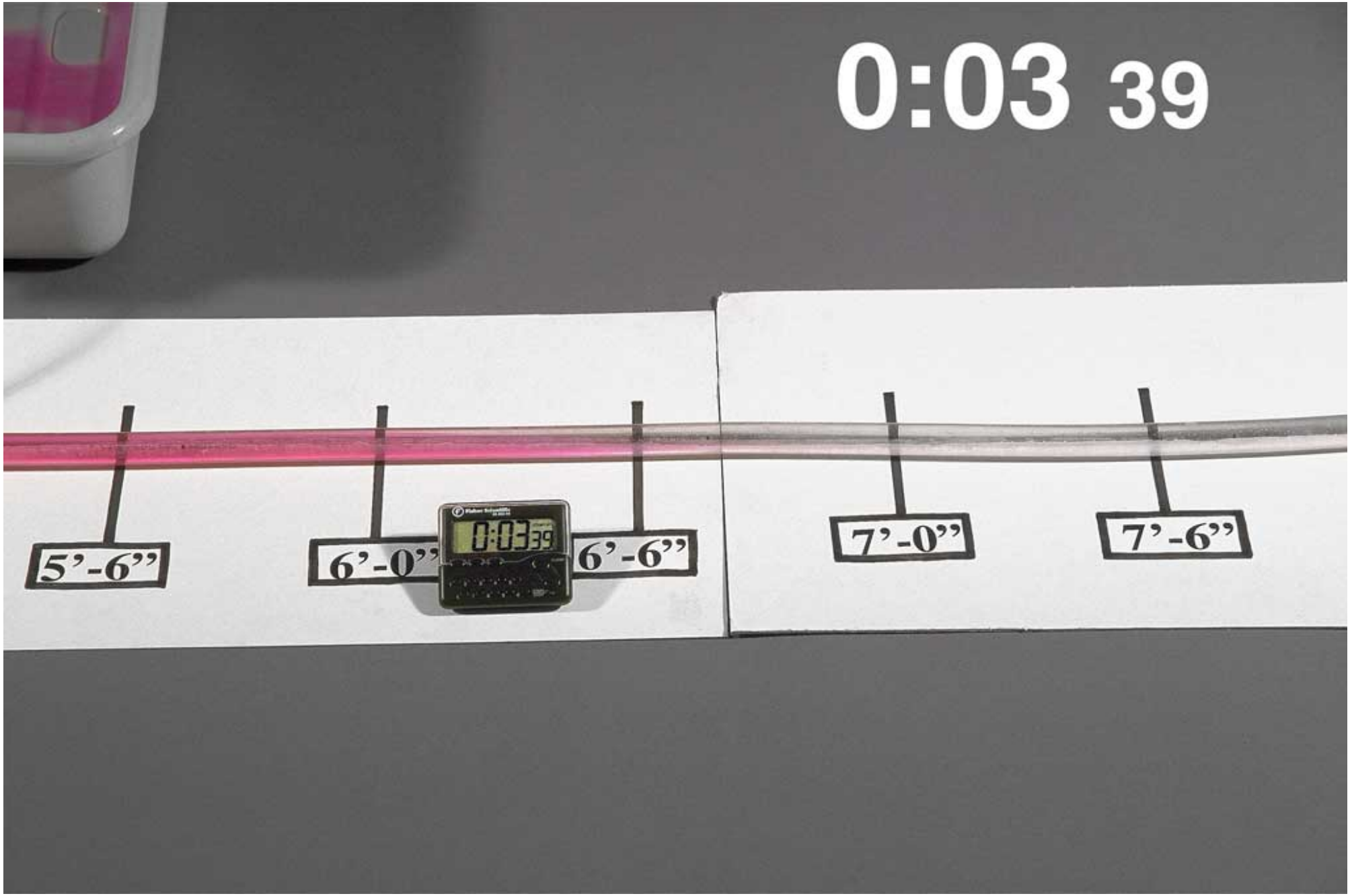
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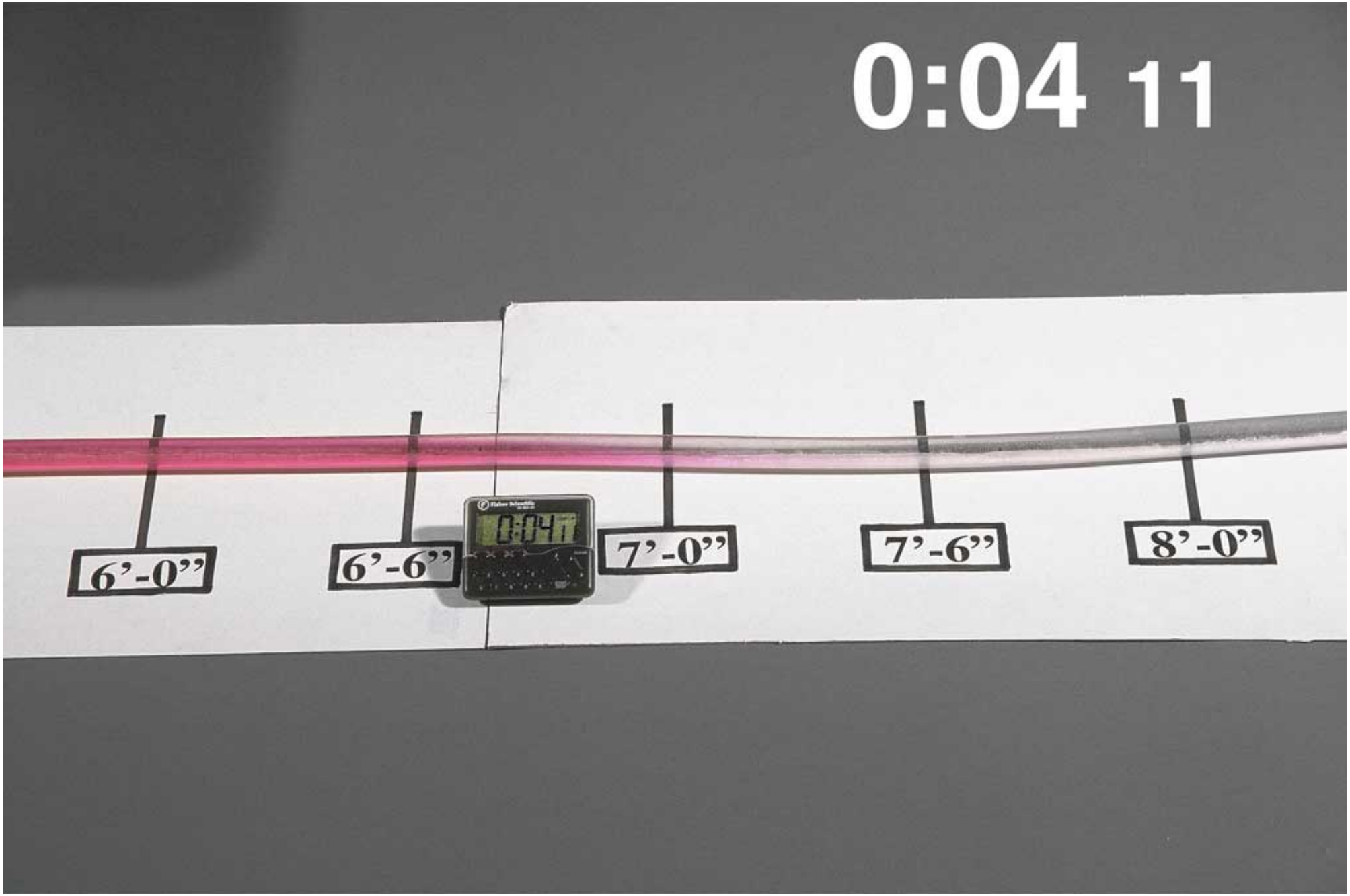
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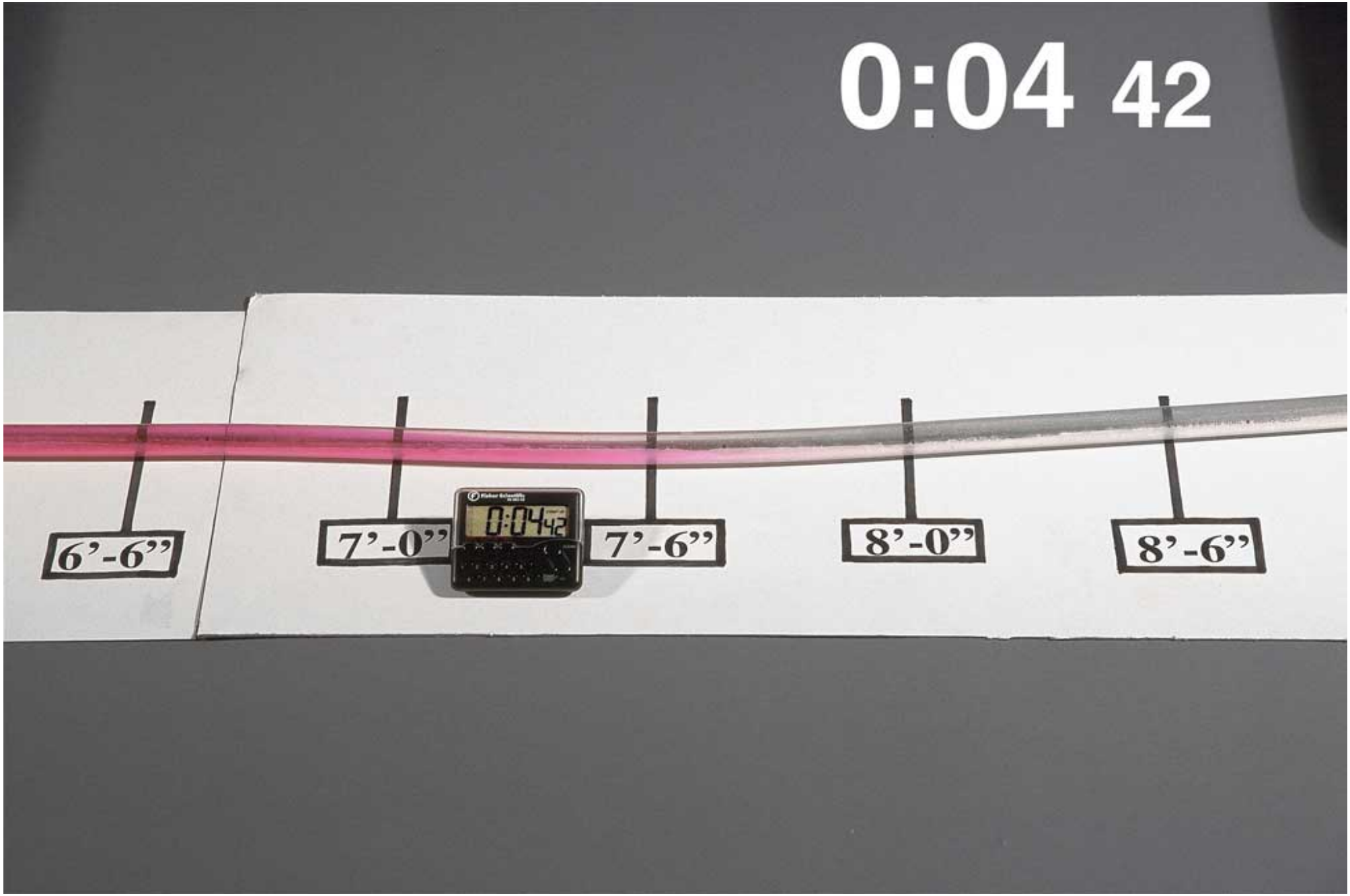
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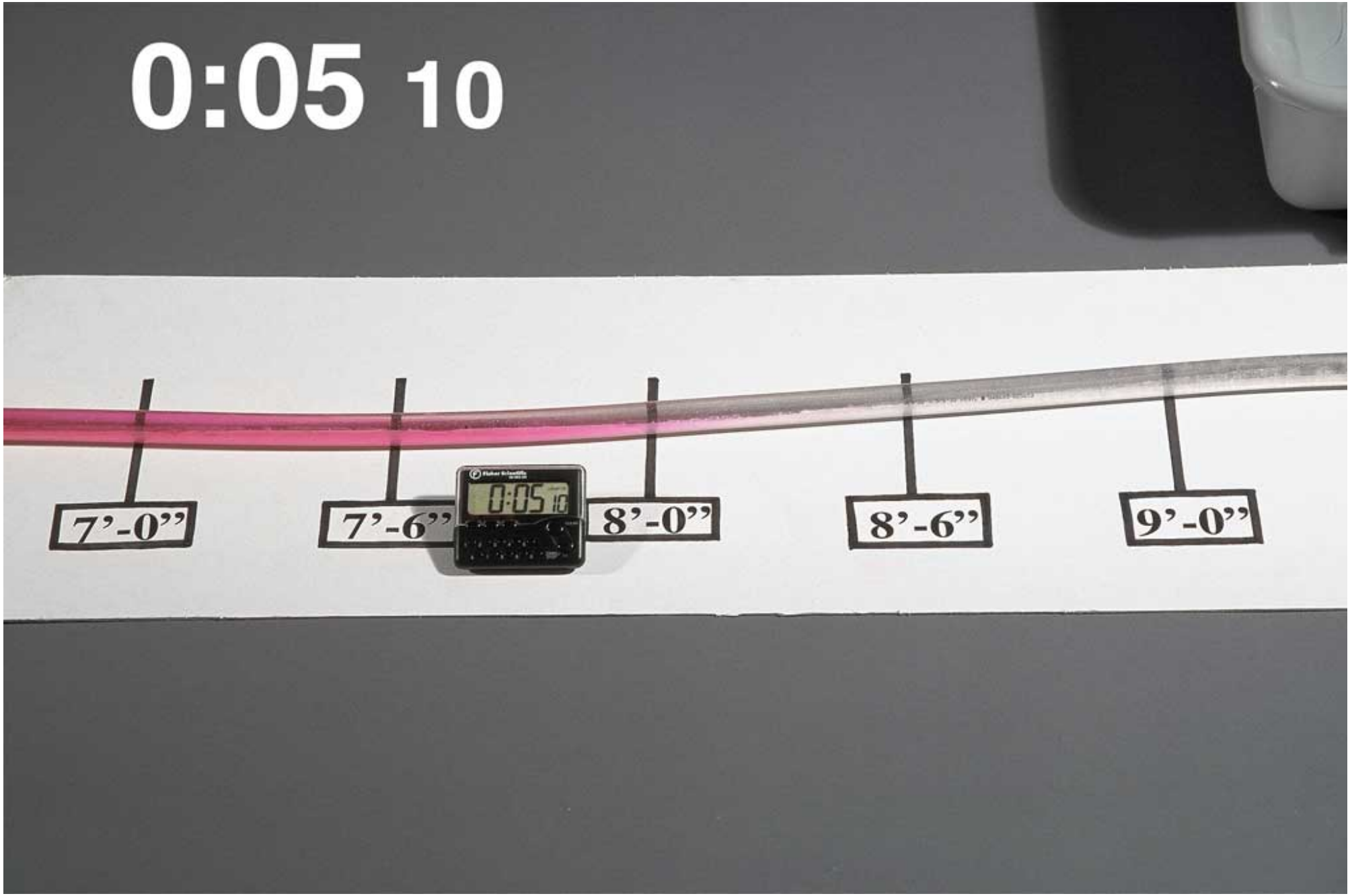
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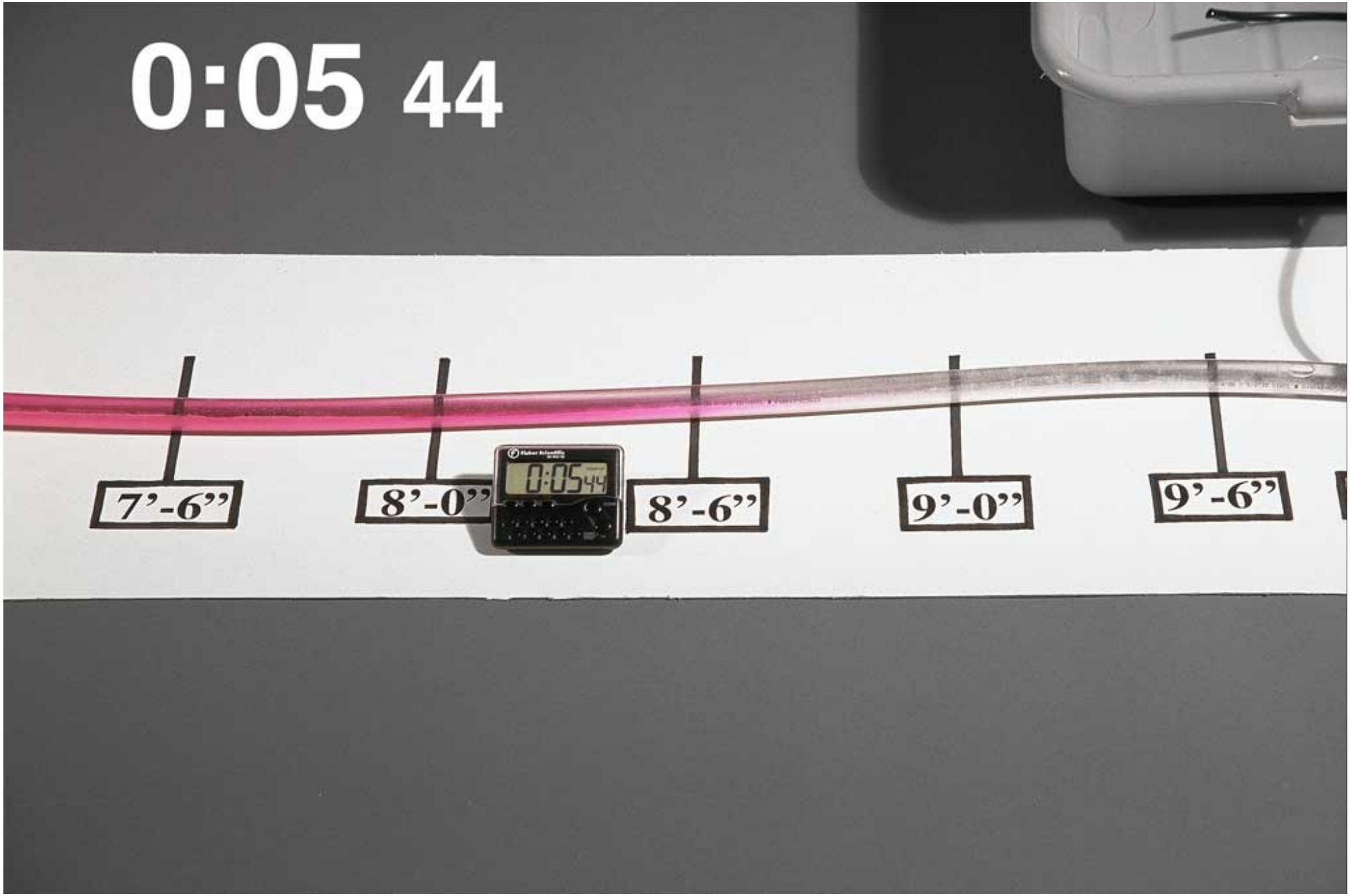
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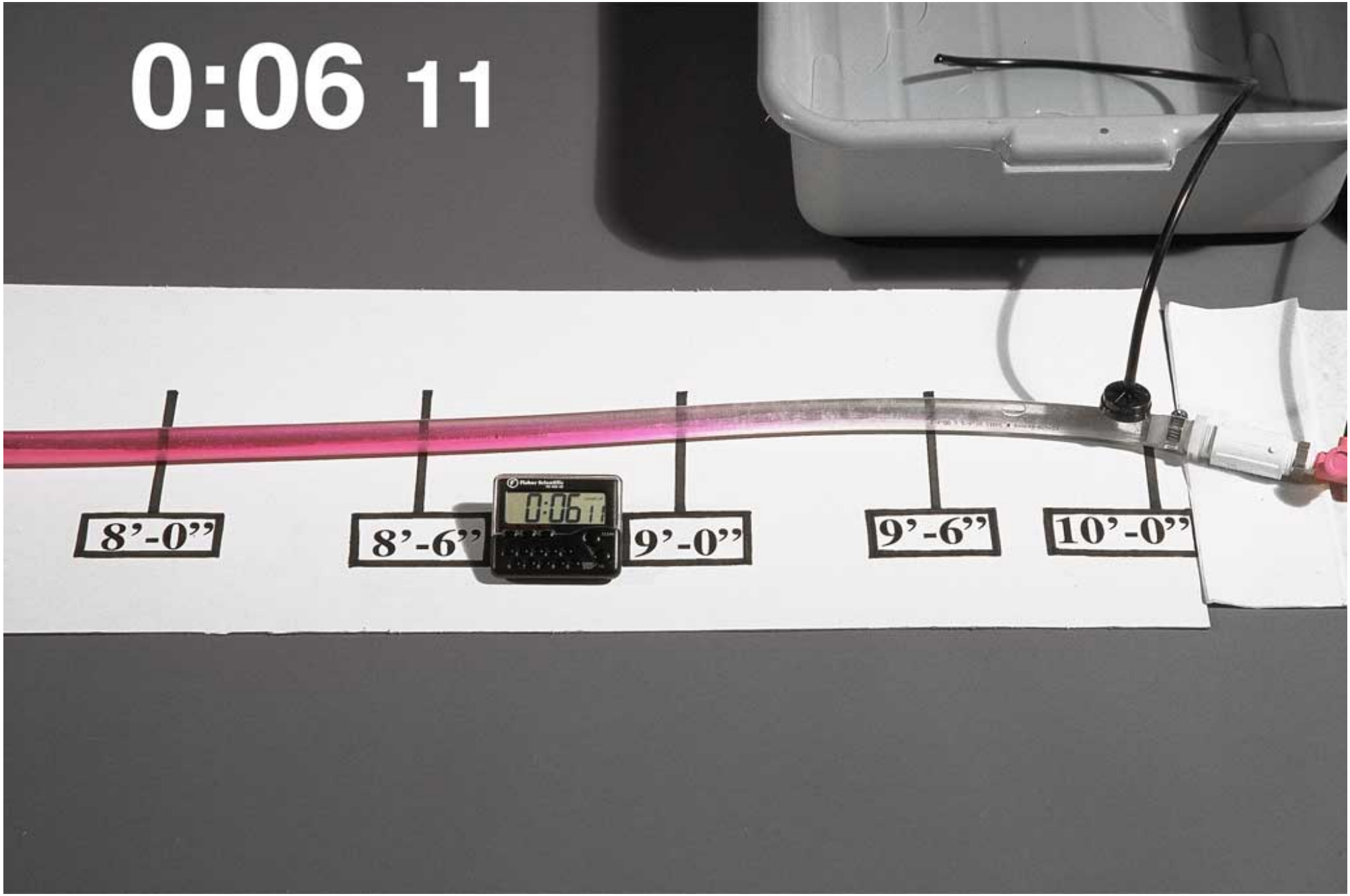
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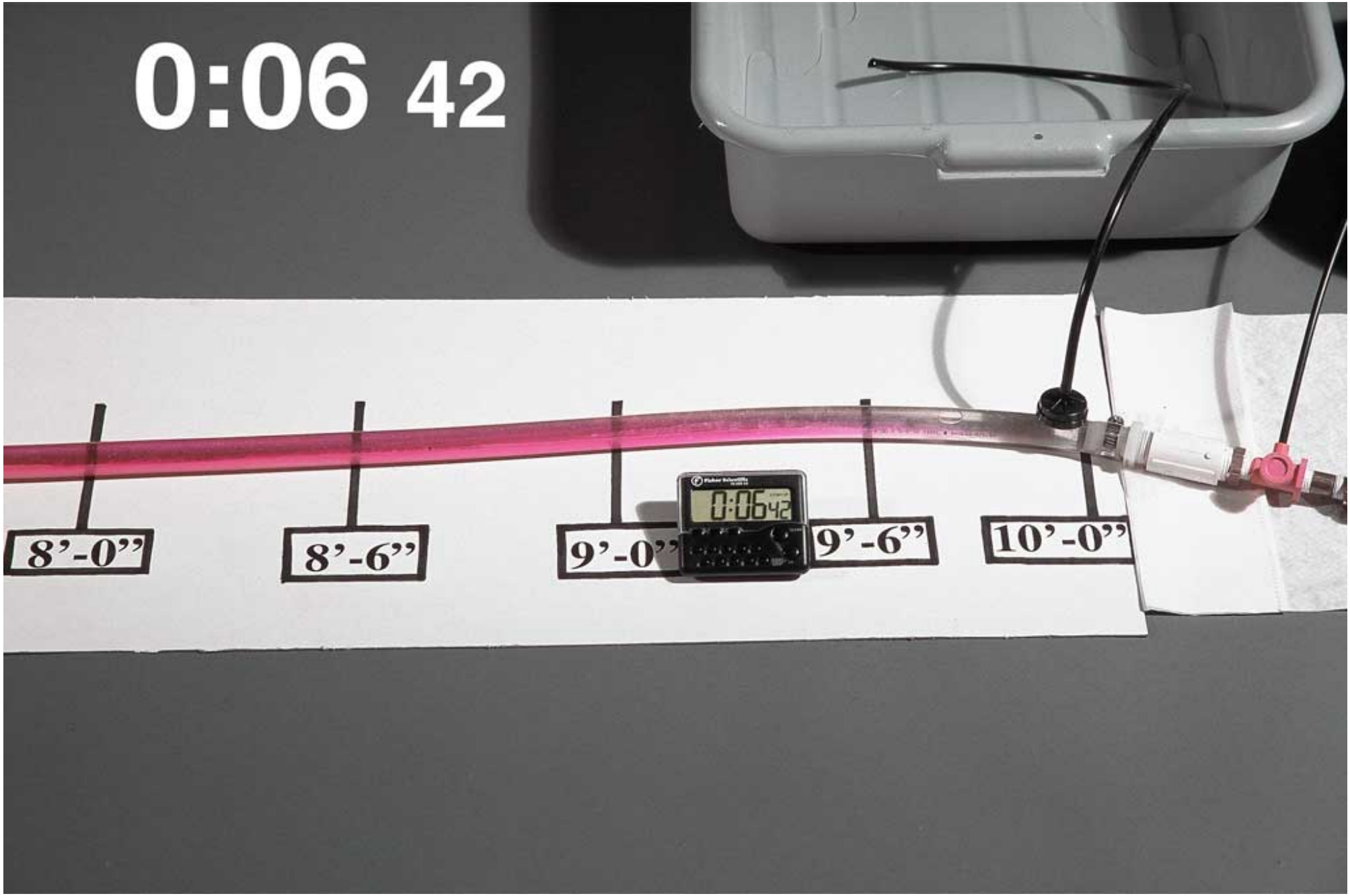
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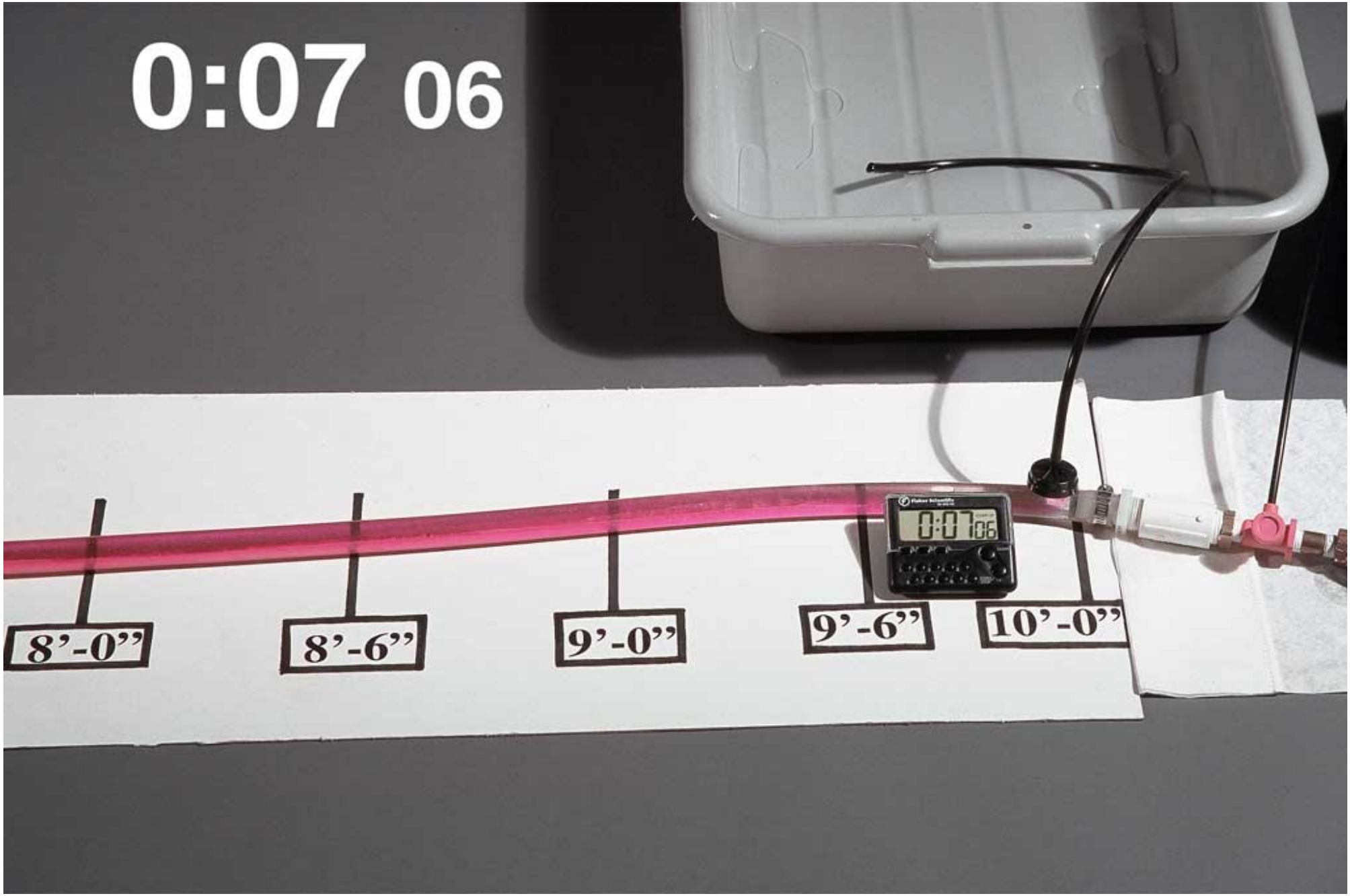
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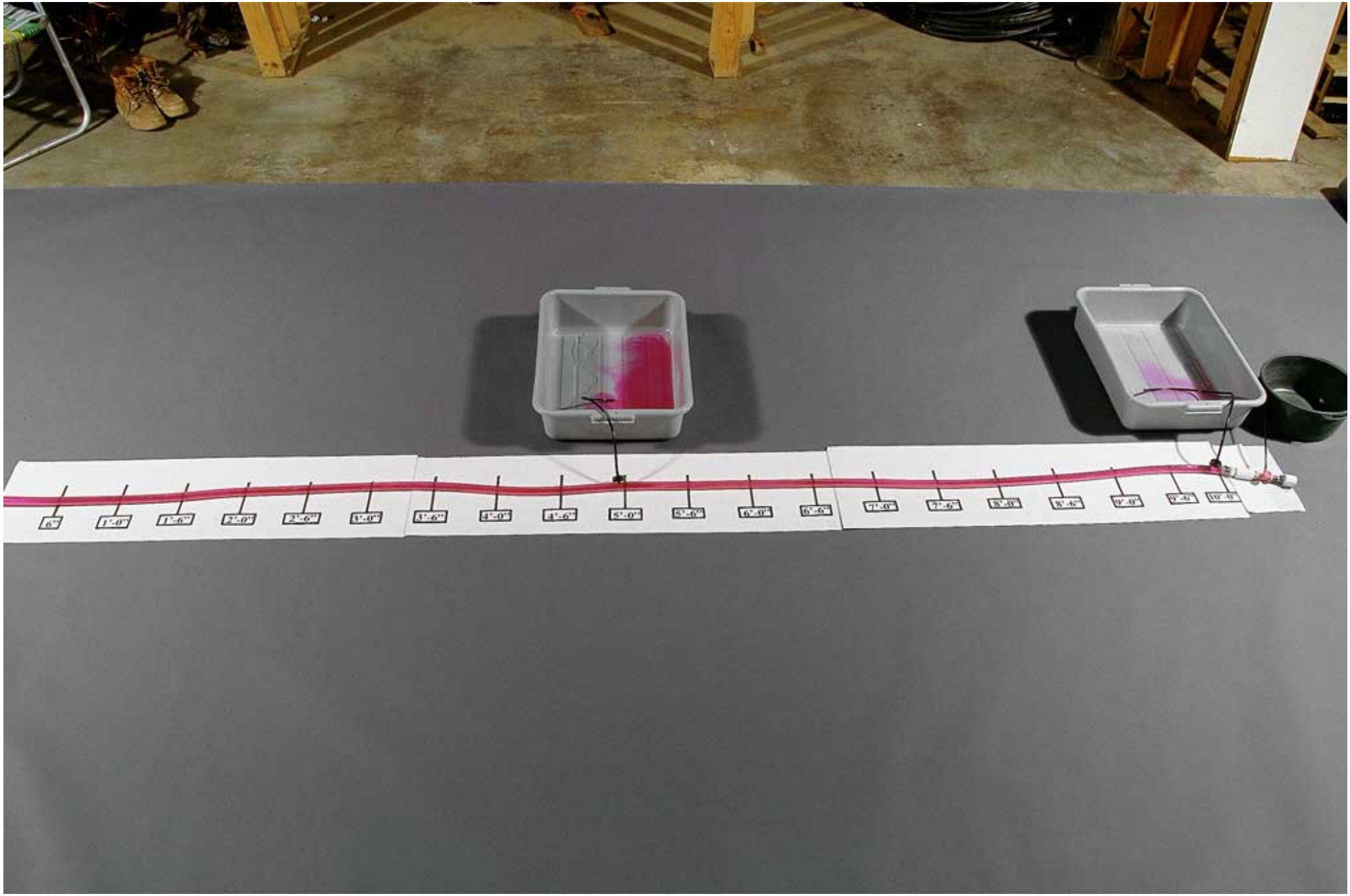
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Uniform Chemigation

This simulates the last sections of a drip lateral. The flow velocity is SLOW.

Luckily, at the head of the drip lateral, the flow rate is higher and the flow velocity is faster.

Uniform Chemigation

What happens when we stop the injection?

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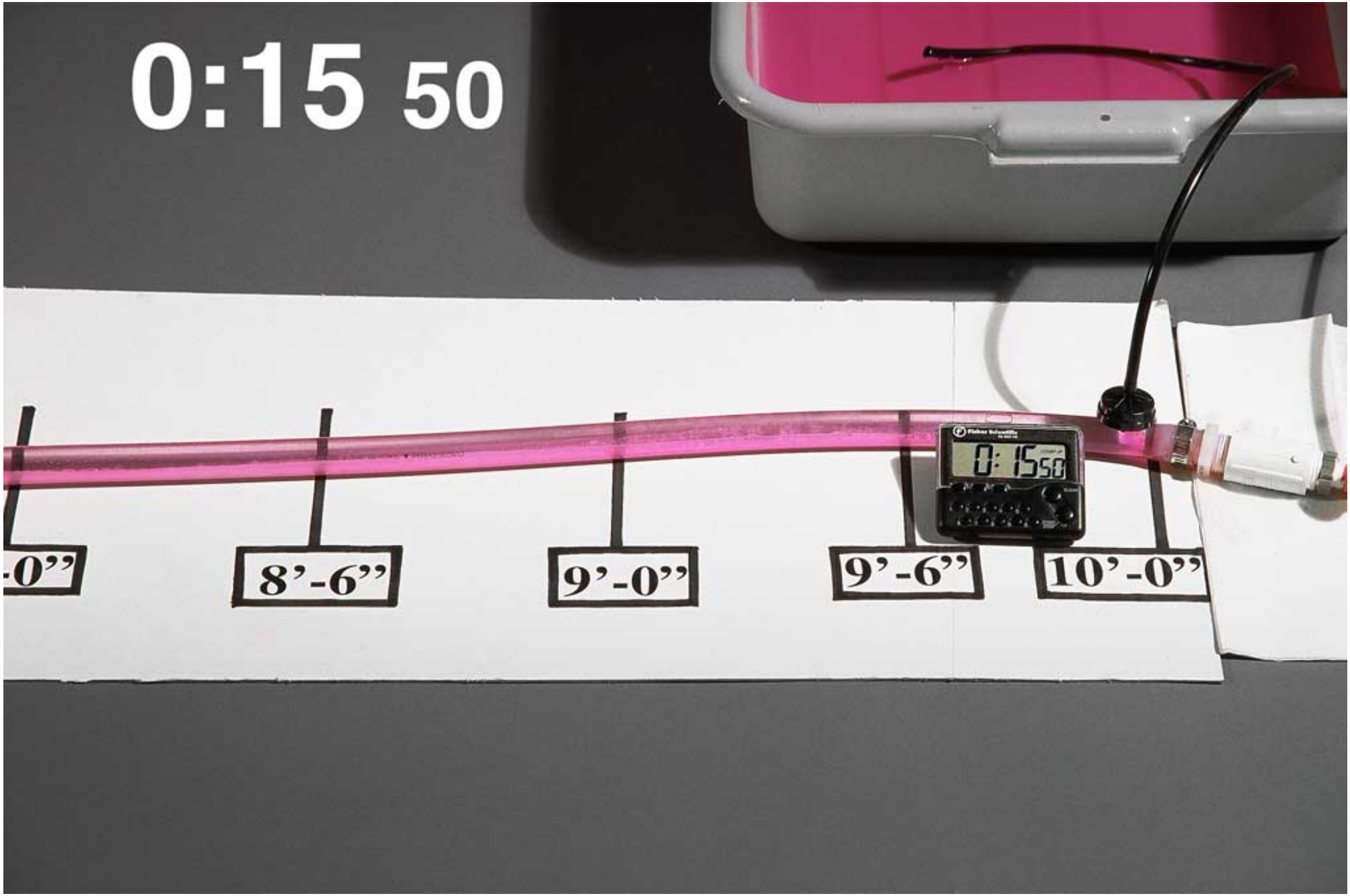
Uniform Chemigation

It takes at least as long for most of the chemical to clear from the drip lateral as it took it to initially move through the lateral.

To takes a long time for all the chemical to clear out of the drip lateral.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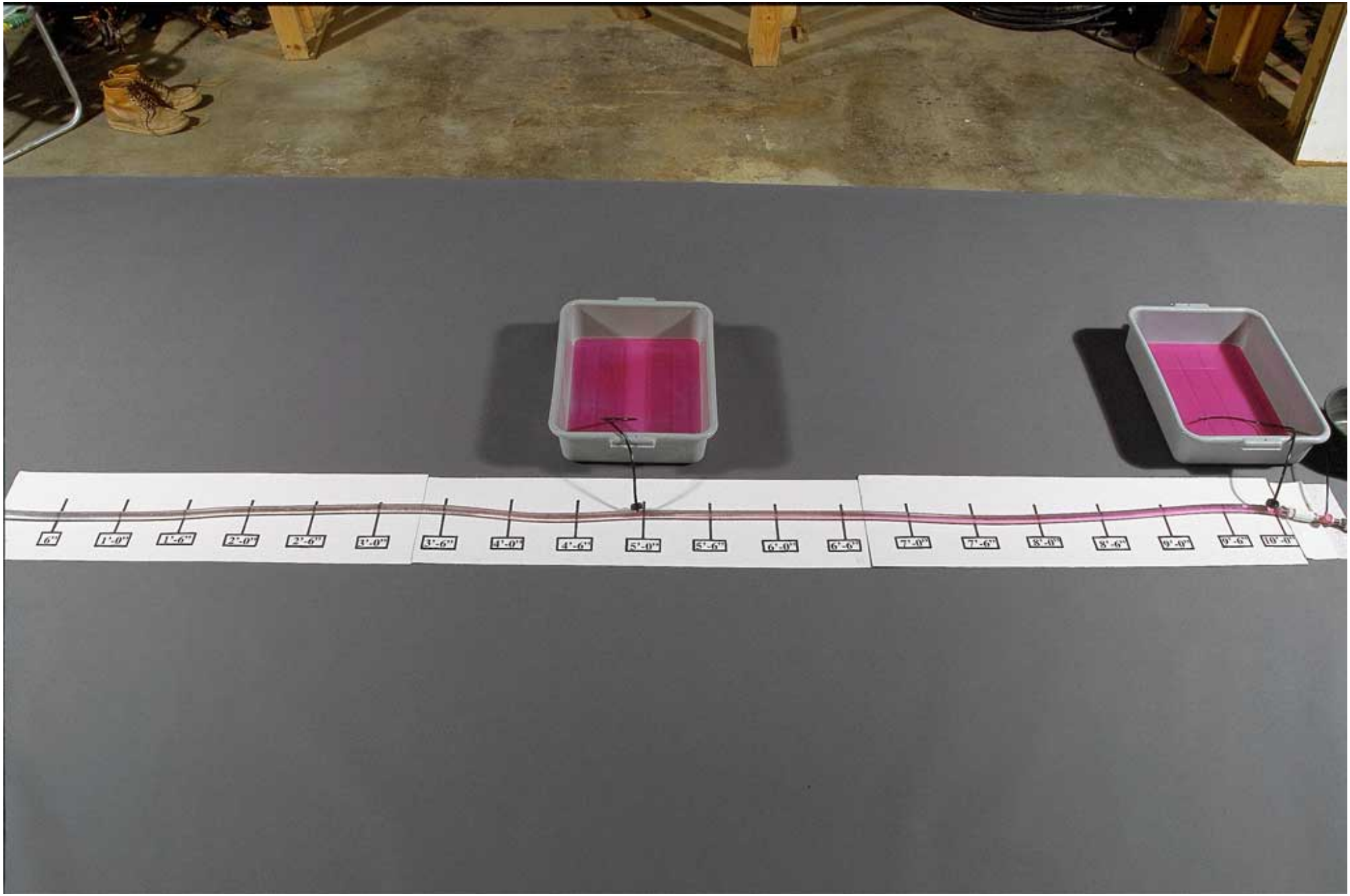
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Uniform Chemigation

We also need to account for the time it takes for the injected chemical to move through the underground pipelines.

How do we do this?

Uniform Chemigation

The easiest way to determine travel times of chemicals (and water) through a drip system:

- Inject chlorine (at about 10 - 20 ppm) into the drip system and follow its movement through the drip system.
- It is easy to spot when chlorine reaches any point by testing the water with a pool/spa test kit.

Uniform Chemigation

What if you don't have the post-injection period of clean water irrigation?

Chemigation uniformity in a drip lateral (500-feet long with 1-gallon per hour drip emitters installed at 5-foot intervals) for various injection time periods and various post-injection clean water irrigations. The water / chemical travel time to reach the end of the drip lateral was 25 minutes.

Injection Time (min)	Post-Injection Irrigation Time (min)	Relative Uniformity
50	50	100
50	0	25
25	25	95
25	0	11

Uniform Chemigation

What happens during chemigation in a commercial scale vineyard or orchard?

The following table shows the characteristics (pipeline length and drip lateral lengths) and water/chemical travel times for 6 commercial systems.

Water / chemical travel times through the pipelines and drip lateral lines for the vineyard and orchard field sites evaluated.

Site	Mainline and Submain		Lateral Line		Total Travel
	Travel Time (min.)	Length (ft)	Travel Time (min.)	Length (ft)	Time (min)
1	22	1000	10	175	32
2	30	1500	10	340	40
3	65	5000	10	340	75
4	15	1400	30	630	45
5	8	700	25	625	33
6	17	800	28	600	45

Chemigation Uniformity in Drip Irrigation Systems

- **Trees & vines** - injections should last at least 1 hour, and at least 1 hour of clean water irrigation should follow it.

- **Row crop drip** - injections should be at least 2 hours in length, and there should be at least 2 hours of clean water irrigation following injection.

Chemigation Uniformity in Drip Irrigation Systems

- When during the irrigation should the injection occur?

Chemigation Uniformity in Drip Irrigation Systems

- When during the irrigation should the injection occur?
  - What are you trying to accomplish and how does the chemical move?

Questions?

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For Powerpoint presentation, go to:

http://ucanr.edu/schwankl