Welcome!

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Assessing the Risk of Squeezing Activities and Reviewing the Impact of Squeezing PE Pipe

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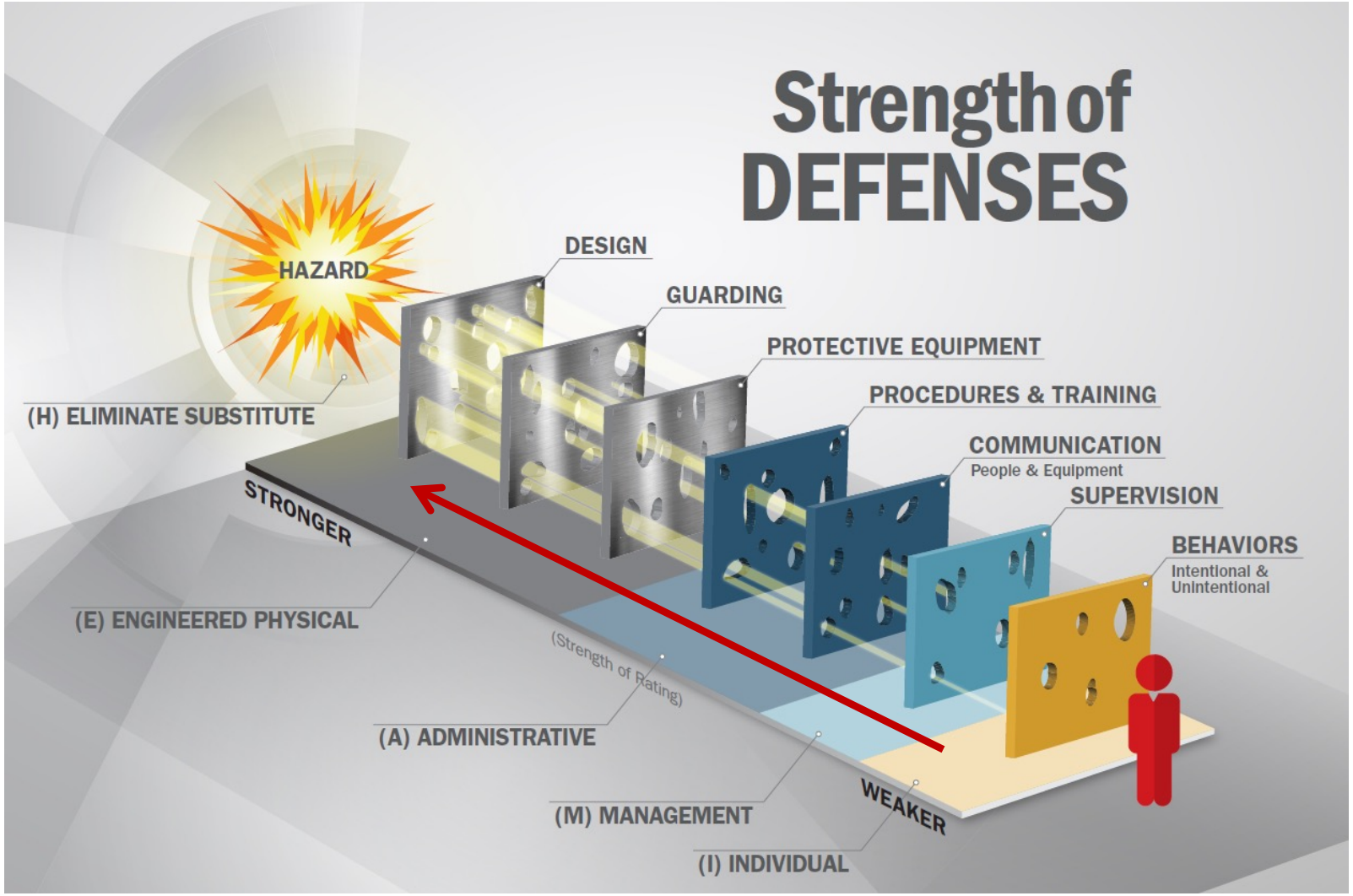
In This Presentation We Will

- See the results of integrity testing of squeeze points on a PE pipe using microscopy.
- Compare the impact of properly squeezing PE pipe vs. improperly squeezing PE pipe.
- Examine the squeezing procedure and perform a risk assessment using the “Strength of Defenses” model.
- Perform and compare a risk assessment of other methods of isolation using “Strength of Defenses” model.

What is a Risk Assessment?



Squeezing Old Generation Pipe

Commonly accepted within the industry that squeezing early generation pipe increases the risk of slow crack growth propagation and decreases the life expectancy of the pipeline

- DOT safety advisory referencing pipes manufactured in 1960s-1983.
- Advisory Bulletin ADB-99-01, ADB-99-02, ADB-02-07
  - Century Utilities Pipe 1970-1973
  - Low-ductile inner wall Aldyl A, by Dupont
  - Pipe designated “PE 3306”
- Susceptivity to brittle-like cracking or slow crack growth propagation.

What About New PE Pipe?

For the remainder of this presentation, assume we are talking about modern PE pipe.

- Newer generations of PE pipes are stronger and more durable.
- Controlled polymer branching generates higher density pipe with longer Pennsylvania Edge Notch Tensile (PENT) test results, most common today.

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What is the Procedure?

ASTM F 1041, For temperatures over 32°F:

- Squeeze at 2-inches per minute.
- Release at ½-inch per minute.
- Use correct stops to avoid over squeezing.

Use squeeze tools compliant with ASTM F 1563.

Procedure is the Key

Most pipe manufacturers and squeeze tool manufacturers warn against deviation from procedure.

- Citing test results, they recommend adhering to ASTM F 1563 and ASTM F 1041.
- Focus on compression rate, release rate, using correct stops, and ambient temperature.

The notice below is shown on multiple PE pipe manufacturing operating manuals and websites.

“If the installer or operator does not follow the approved procedure during a squeeze-off, such as what might occur in an emergency, presume the pipe damaged and replace or remove from service.”

So, Let’s Pause for a Second

With that information in mind, should you be worried that you are damaging the pipe during a properly executed squeeze off?

Absolutely not

There is no data suggesting that, when done properly, squeezing increases the risk of an incident or decreases the life of your pipeline.

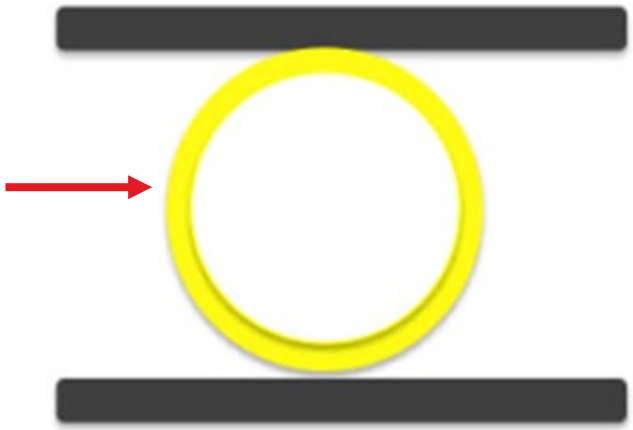
You simply must follow procedure per ASTM F 1041 and use tools compliant with ASTM F 1563.

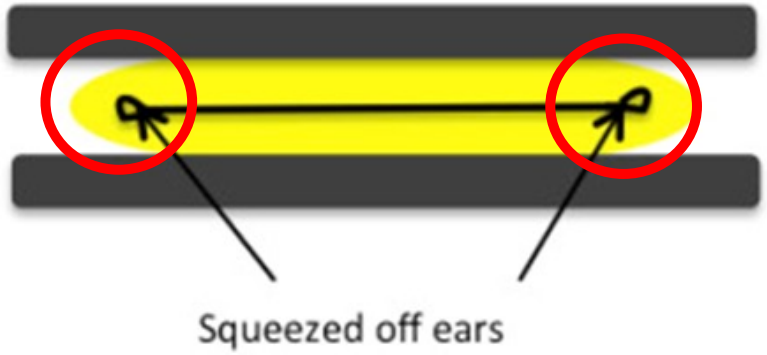
Tests and Results

We performed various squeezing activities. Using microscopy, we were able to see what the pipe looked like afterwards:

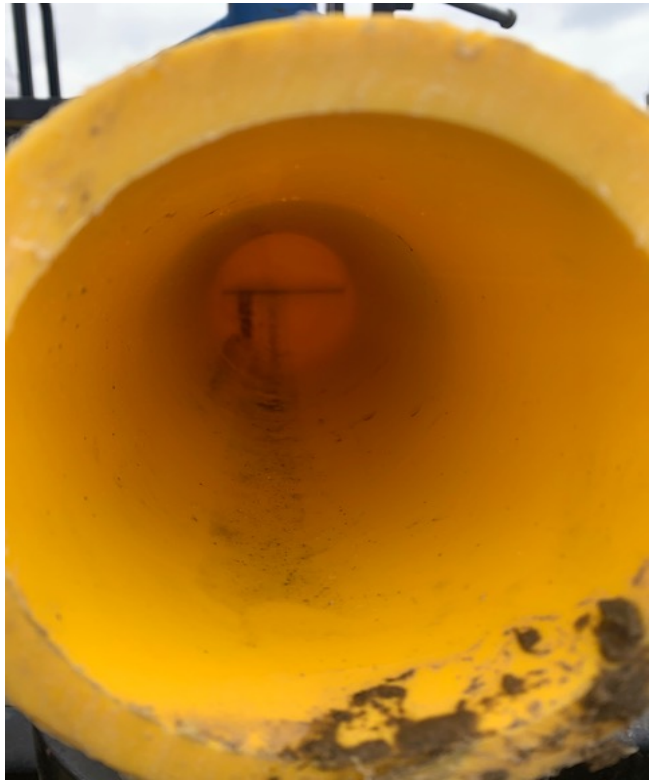
- A pipe that has not been squeezed.
- Proper squeeze, proper release.
- 2x proper squeeze rate, 2x proper release rate.

What You Will See





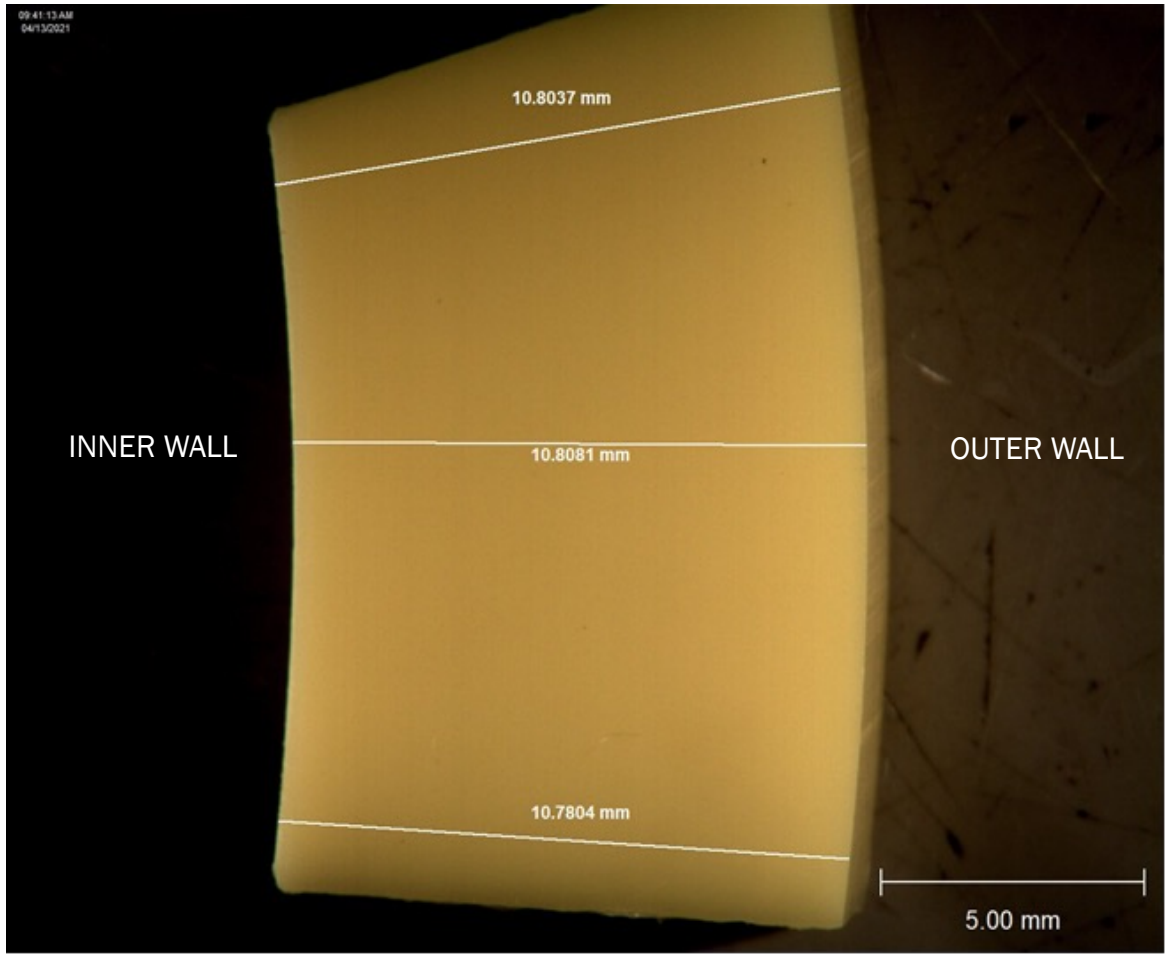
The pictures you will see will show a cross section of the pipe, like the picture to the right. You will be looking down the pipe, seeing both the inner wall and outer wall of the pipe.



4” Medium Density Pipe

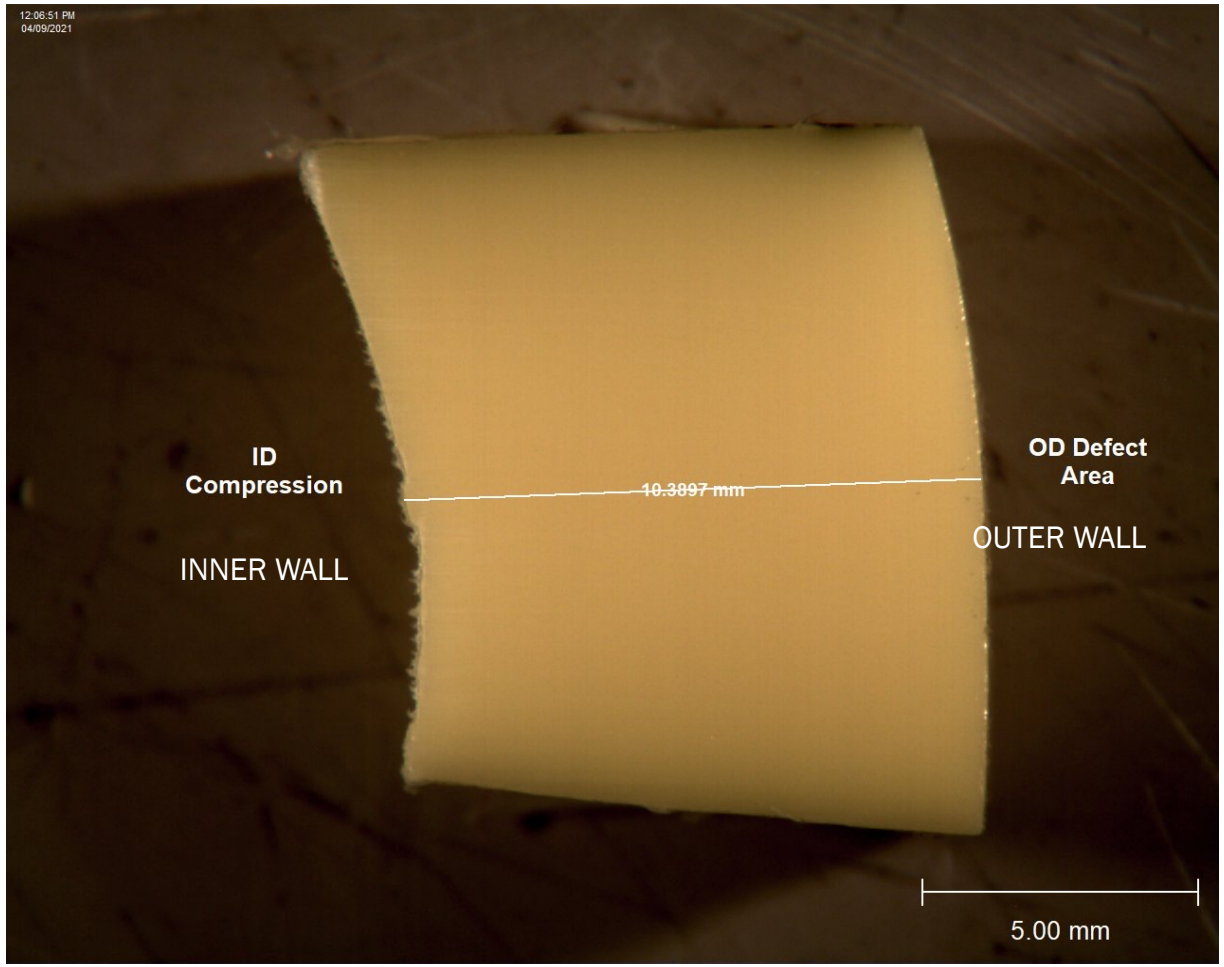
What Does a Squeezed Pipe Look Like?

Pipe that has **not** been squeezed,



Calibration 5x with 0.5x auxiliary lens.

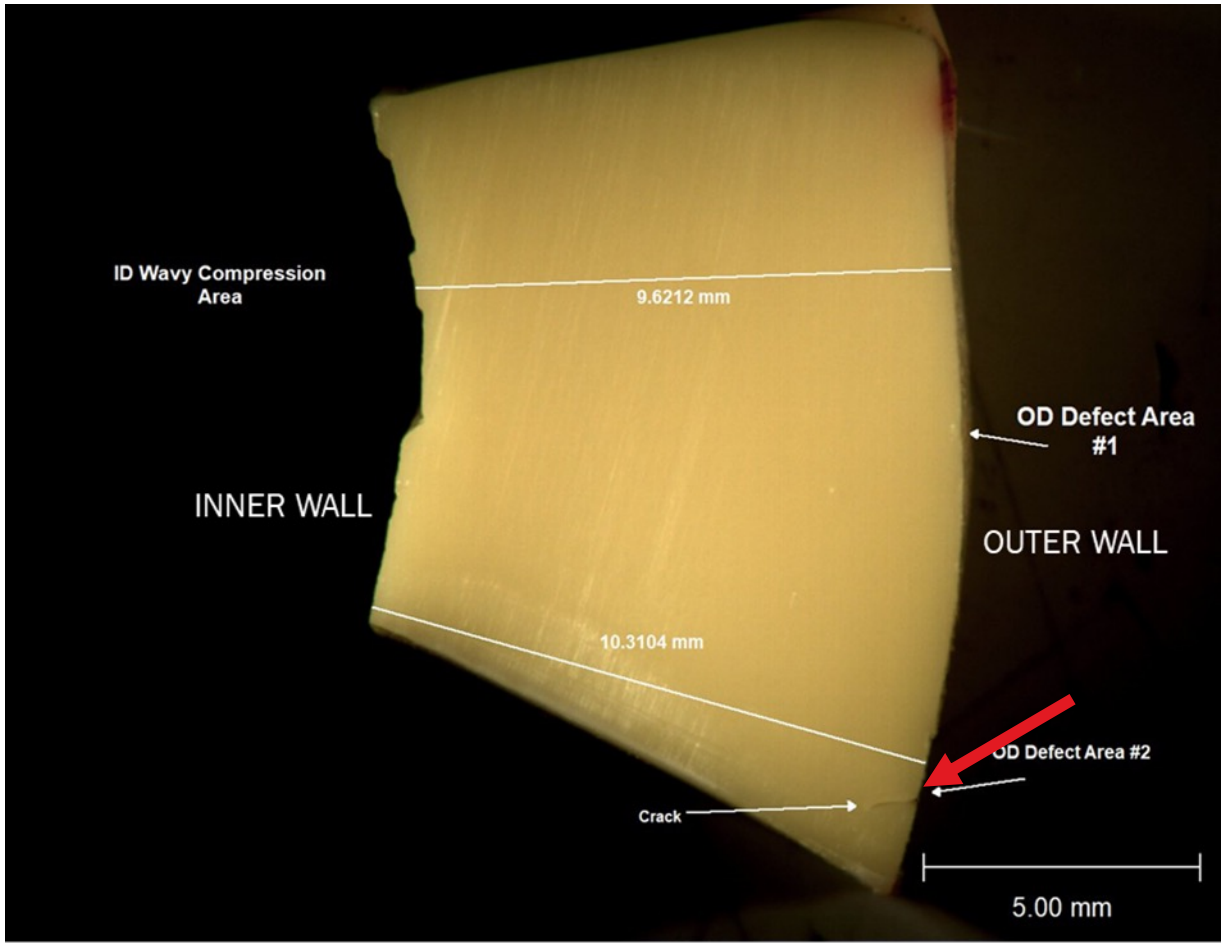
Pipe that has been squeezed properly,



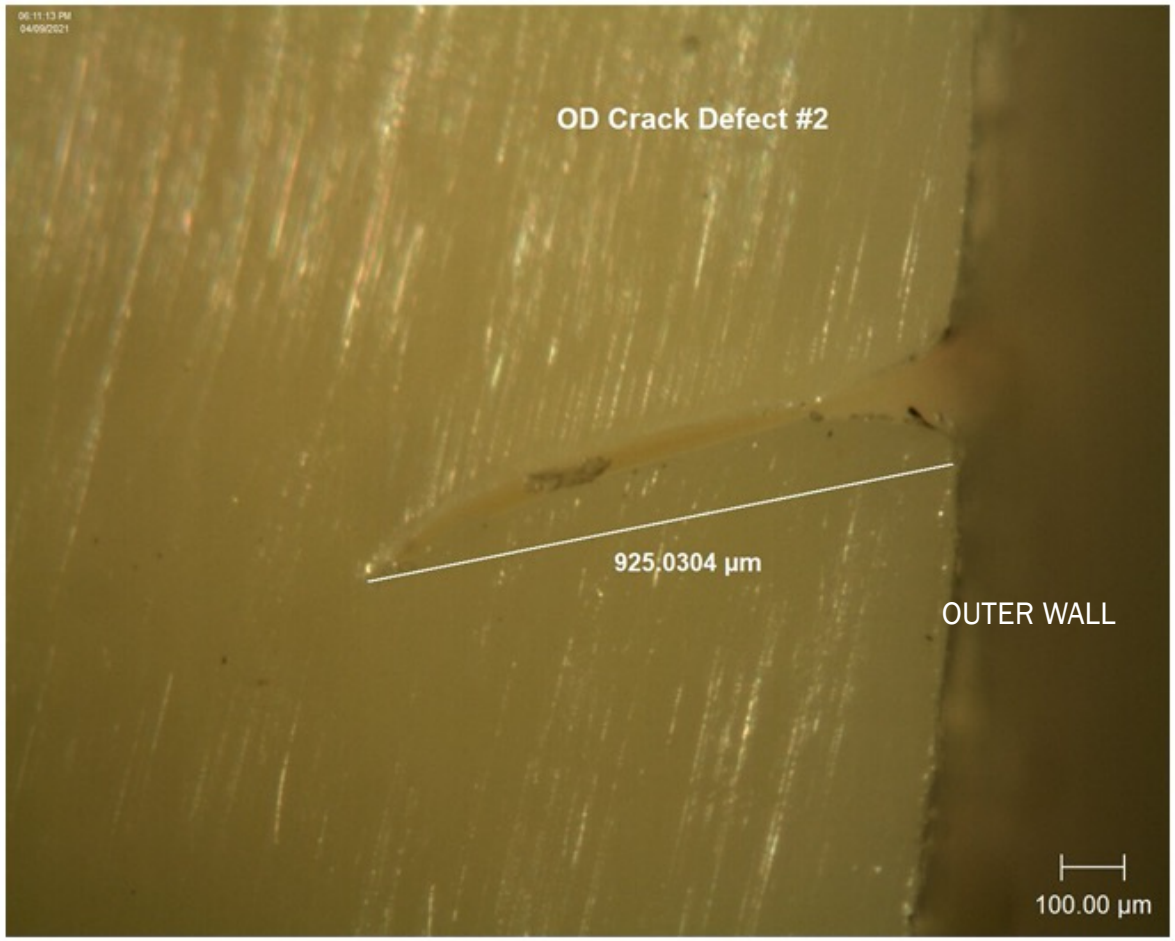
Calibration 5x with 0.5x auxiliary lens.

What Does an Improper Squeeze Look Like?

Pipe that has been squeezed/released twice as fast as ASTM F 1041, squeezed at 4-inches/minute, released at 1-inch per minute.



Calibration 5x with 0.5x auxiliary lens

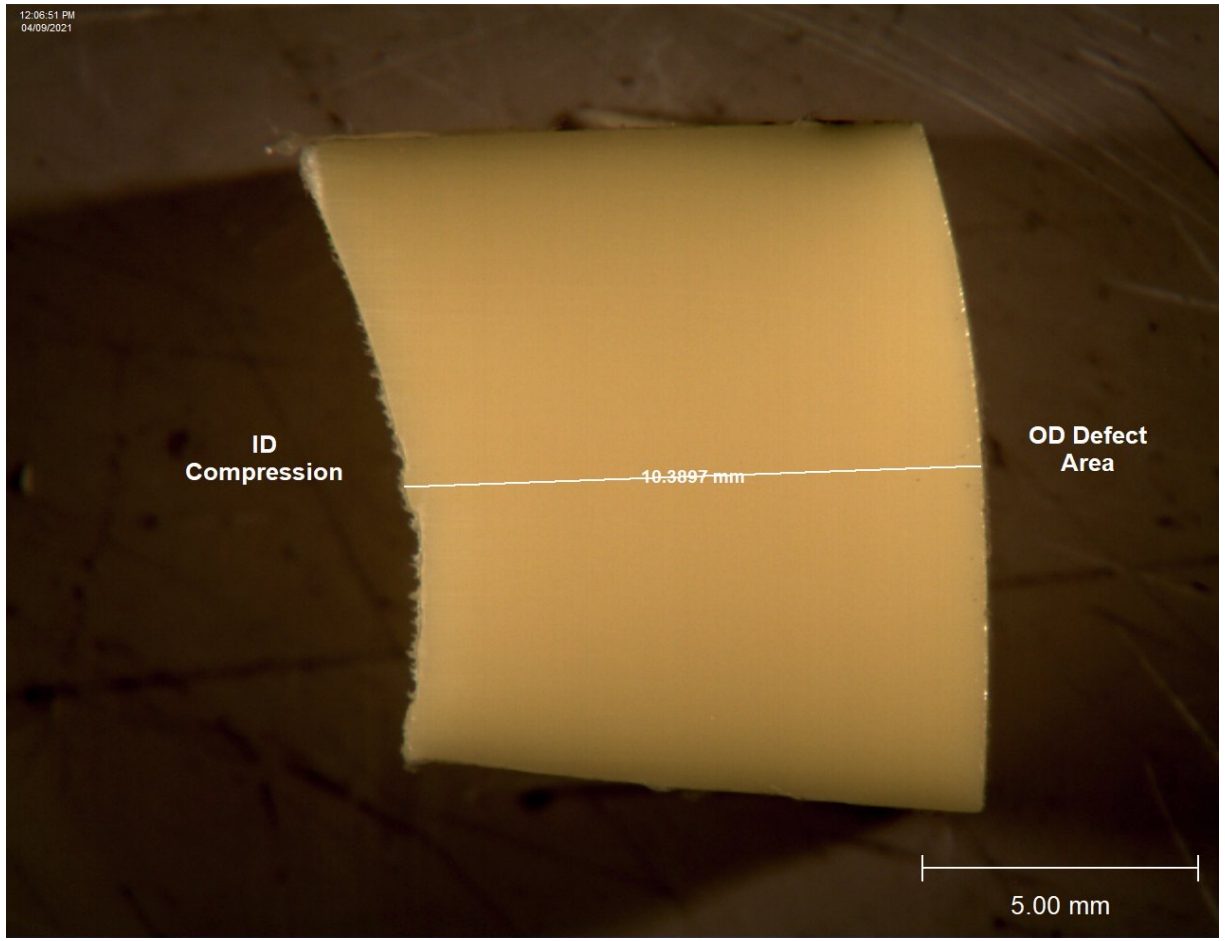


Calibration 63x with no additional lens

Length of crack was approximate 1.5-inches lengthwise down the outside wall of the pipe

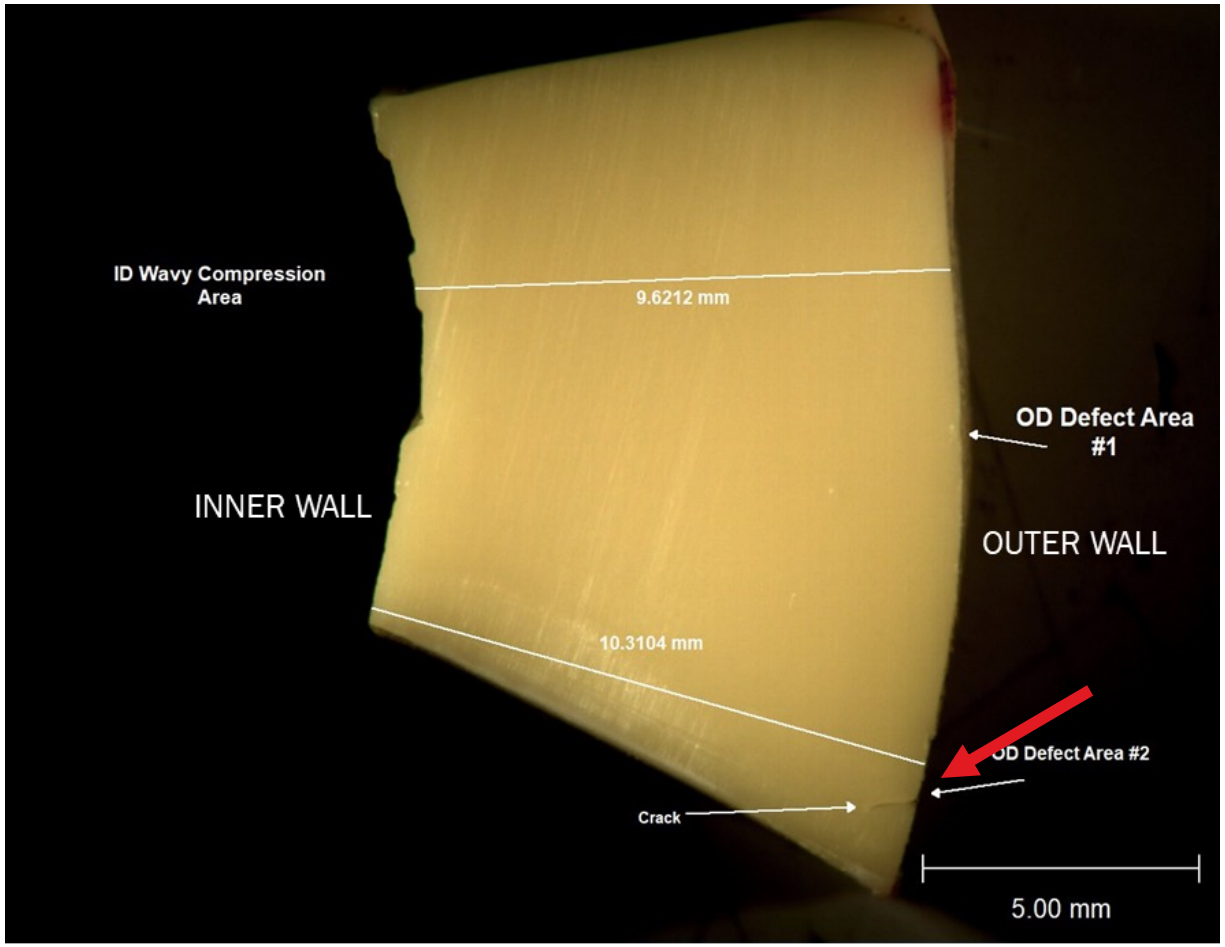
Side by Side

Proper Squeeze



Calibration 5x with 0.5x auxiliary lens

Improper Squeeze



Calibration 5x with 0.5x auxiliary lens

Length of crack was approximate 1.5-in. lengthwise down the outside wall of the pipe .

Using Microscopy, What Did We See?

Proper squeeze, proper release:

- Slight deformation on inner wall of the pipe, about a 3.7% decrease in wall thickness.
- No significant damage was visible.

2x Proper squeeze rate, 2x proper release rate:

- Significant deformation on inner wall of the pipe, roughly 11% decrease in wall thickness.
- Significant crack, 1.5-inch along the run of the pipe, just under 1-mm deep, or about 8.5% of the wall thickness.

Based on Test Results

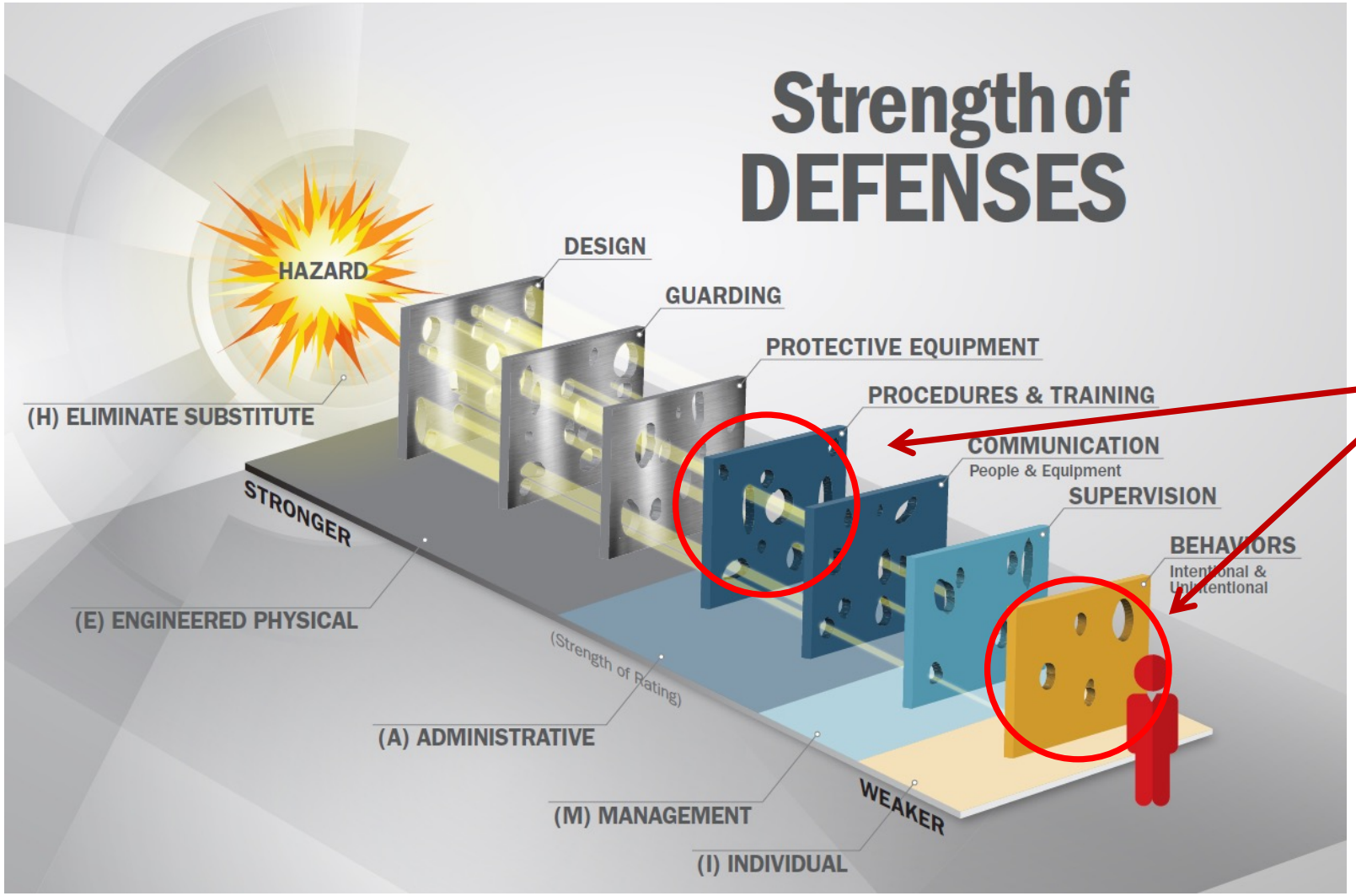
Should squeezing be considered and unsafe practice?

Absolutely not

There is no data suggesting that, when done properly, squeezing increases the risk of an incident or decreases the life of your pipeline.

You simply must follow procedure per ASTM F 1041 and use tools compliant with ASTM F 1563.

Risk Assessment of Proper Squeezing



Application of proper squeezing procedures.

Risk Assessment of Proper Squeezing

What are the key risks associated with squeezing?

1. The safety and integrity of your pipeline is dependent on people, their behaviors and the application of proper procedures.
2. Squeezing procedure can be cumbersome and tedious — requires time and diligence.
3. There is no way to test during or after a squeeze whether the pipe has been damaged — the integrity of your pipe is unknown.

So, What Does This Mean?

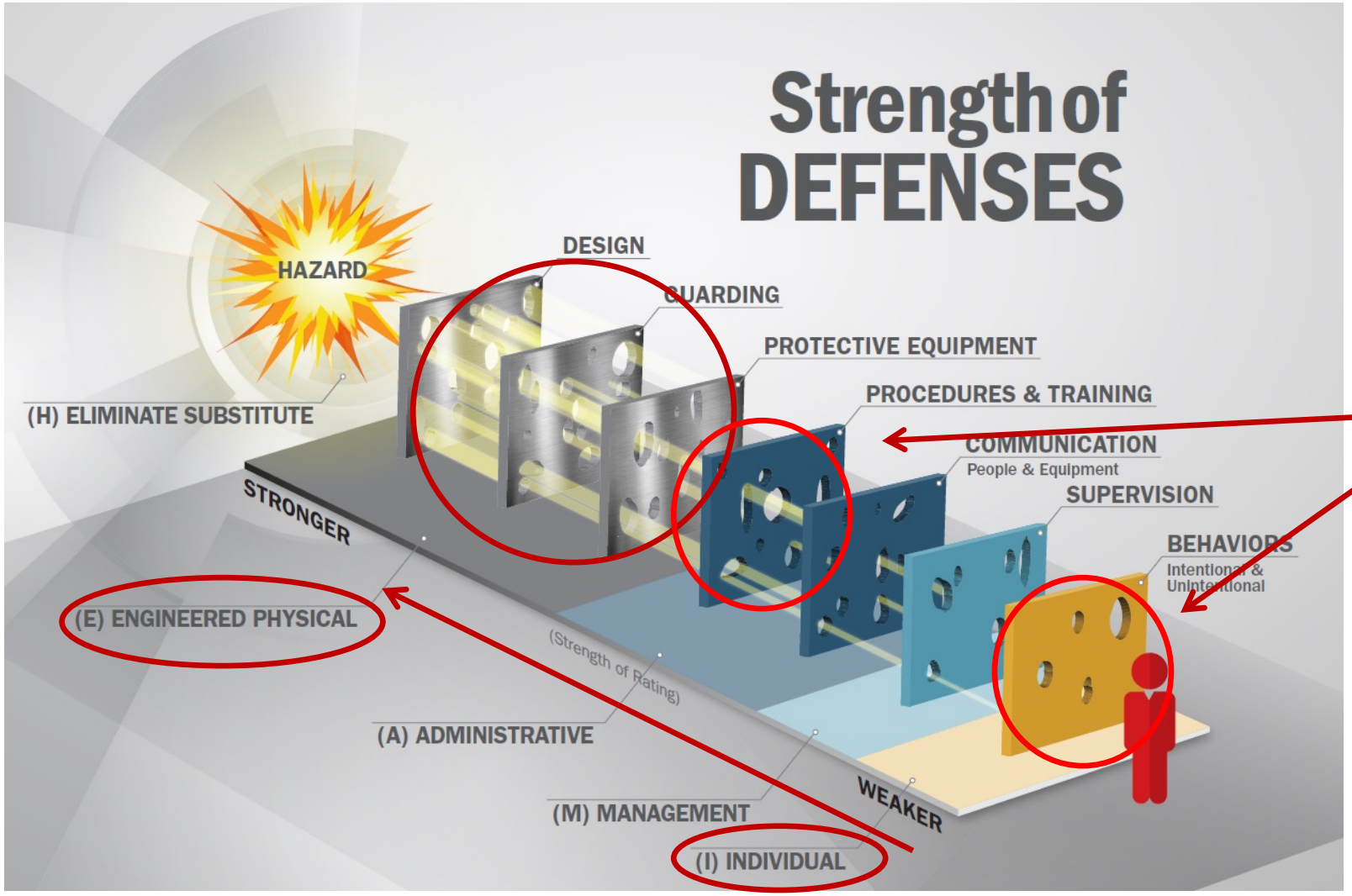
- It’s all about risk appetite.
- Using the Strength of Defenses model, we show that following the proper squeeze procedures reduces the risk of an incident.
- We also show this is the last line of defense from the risk being recognized as an incident.
- It’s up to the operator to decide if this falls within the scope of their risk tolerance

- Is there another risk we should identify?

Workers and Tribal Knowledge

- Your workers, our workers are the best in the world.
- They've been doing this safely for 40 years.
- The Great Crew Change.
- The Great Resignation.

Can You Reduce Risk?

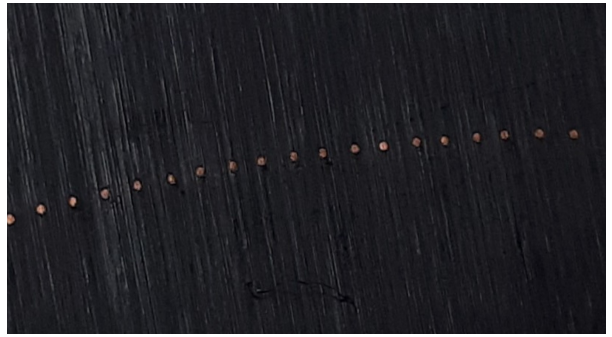


Application of proper squeezing procedures.

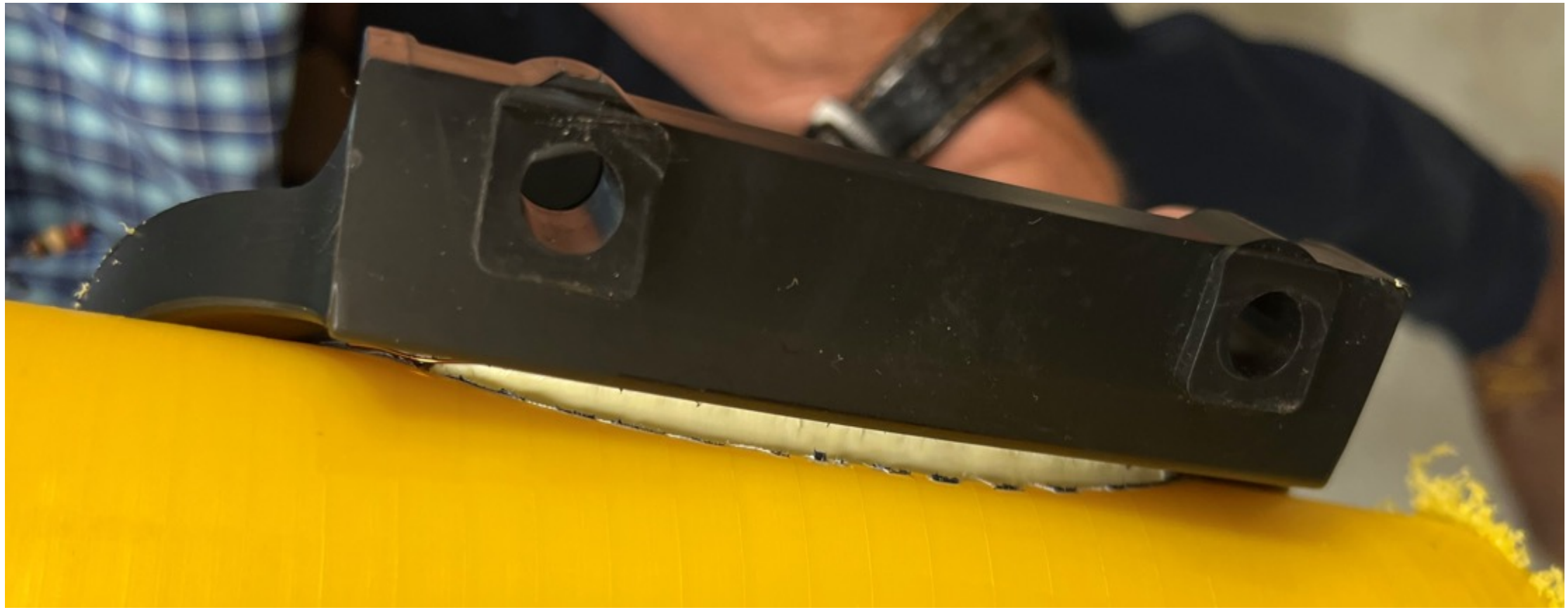
Comparing Against Other Methods

Hot Tapping and Plugging — Line Stop Fittings

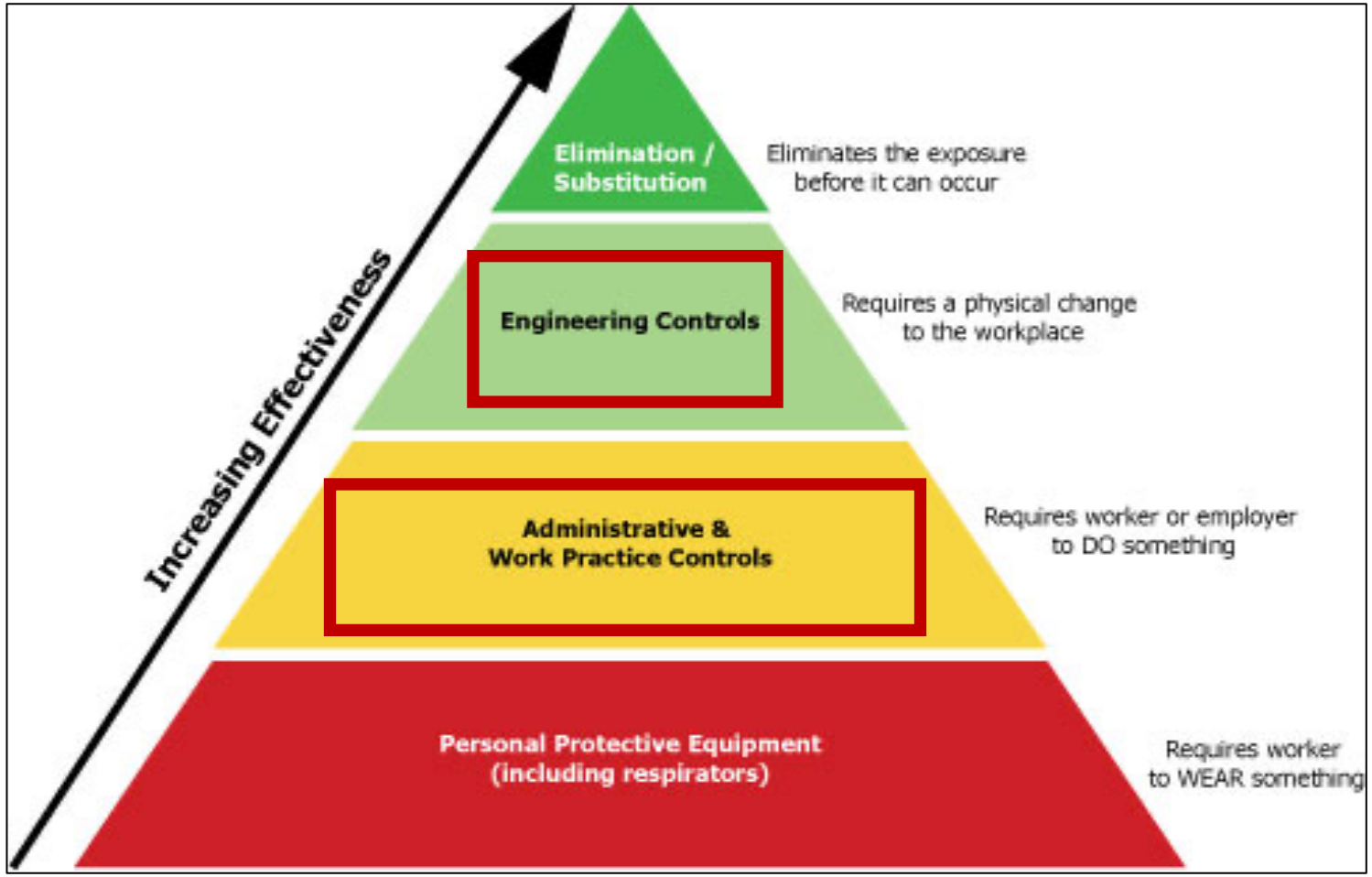
- Fusion area becomes as strong as, if not stronger, than the pipe in tensile strength and pressure properties.
- Leak proof, the fitting and the pipe become one.
- Bar codes ensure the right electrical current is used.
- Fusion machines generate a report afterwards confirming the fusion was successful.
- Use of test caps allow to test fusion area.



Fusion area is stronger than the pipe



Hierarchy of Controls



Key Takeaways

- Proper squeezing is safe. No data exists to suggest otherwise, as long as you follow ASTM F 1041 and use proper tools compliant with ASTM F 1563.
- When performing a squeeze off, the integrity of the pipeline is dependent on people, behaviors and the application of a process.
- Based on the “Strength of Defenses” model, this is the last line of defense to prevent a risk from becoming an incident.
- Solutions with engineered safety features can better protect against pipeline integrity issues.
- If squeezing is your preferred method of isolation, there are hydraulic squeeze tools that have engineered safety features that eliminate some of these risk.
- From a hot tapping and plugging standpoint, line stop fittings are an excellent example of an engineered solution that will reduce risk.

Thank You!

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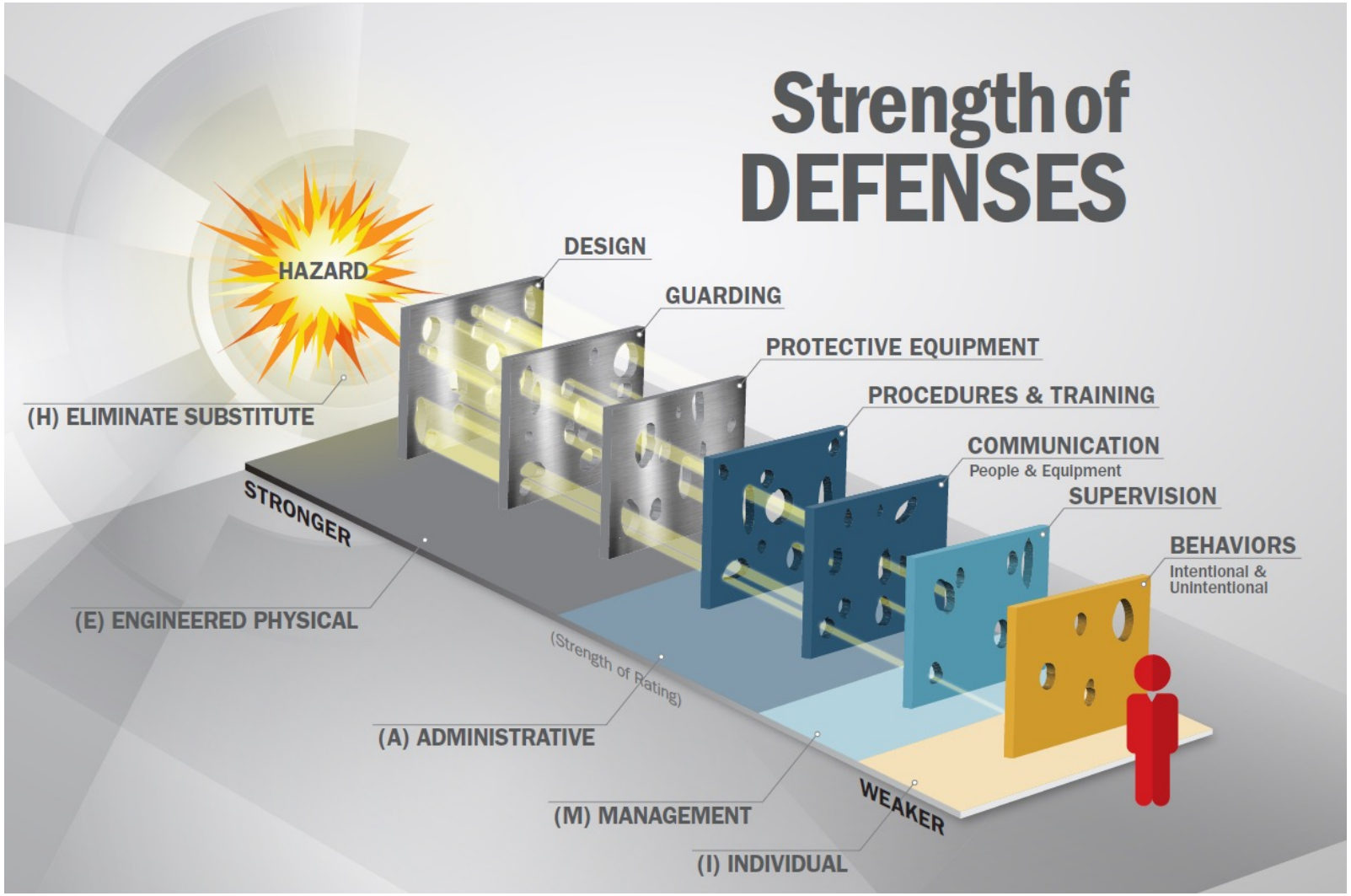
Questions?



THANK YOU

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With special thanks to Larry Alspaugh, Sr. Technical Sales Consultant (retired).

Procedures Used With Line Stopping Fittings

- Are there processes and human behavior required for fusion of a fitting onto a pipe?
  - Yes. Pipe preparation is required
    - Most notably peeling the outside layer of the pipe to remove oxidation
  - You must use an approved peeling tool, other steps are very straightforward

- This would most likely be an intentional decision NOT to prep the pipe compared to squeezing where the deviation from procedure would more likely be unintentional
  - Intentional actions are easier to correct and control than unintentional actions

Squeeze Tools with Engineered Safety Features

Certain Hydraulic Squeeze Tools

- Some have needle valves in place to avoid releasing the squeeze too fast
- Some have double-acting hydraulic cylinders give you much more control on the release

- This does not eliminate all the procedural issues
- You still must not squeeze too fast
- You still must use the correct stops

It would be prudent to evaluate the squeeze tools you currently use and consider upgrading to a model that has engineered safety features implemented that prevent squeezing and releasing too fast

Risk Assessment