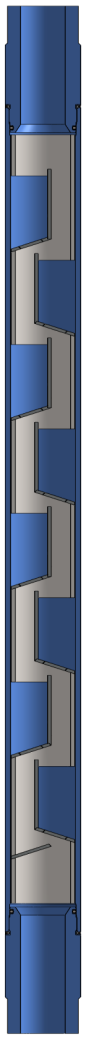
PetroQuip SandMaze



Cut-away showing the Inner Maze

PetroQuip's **SandMaze** captures sand, proppant and debris fallback during production shutdown. The proprietary flow path design captures the sand in holding chambers when the ESP is offline which prevents sand from settling on top of or in the pump's stages. Once a flow is re-established, the **SandMaze's** self-cleaning feature allows sand to re-enter the production flow stream. The cleaning action does not require the sand to be jetted out of the sand chambers which significantly reduces the risk of cutting through the outer chamber of the tool.

Advantages and Features

- Extends the life of the ESP by minimizing hard pump start scenarios due to sand settling on top of the ESP
- Bi-direction flow allows for injection treatments
- Captures sand when the ESP is offline preventing sand settlement on the pump
- Automatic self cleaning feature based on gravel pack screen technology
- No communication to the annulus
- Sand re-enters the production flow stream when the pump is back online
- Minimizes erosion issues to the outer body of the tool

SandMAZE Size	Tubing Size (in)	Thread	Material	OD (in)	OAL (ft)
400	2-3/8	2-3/8" EUE	L80, P110, 13Cr	4.00	20
	2-7/8	2-7/8" EUE			
	3-1/2	3-1/2" EUE			
538				5.38	
	4-1/2	4-1/2 EUE			

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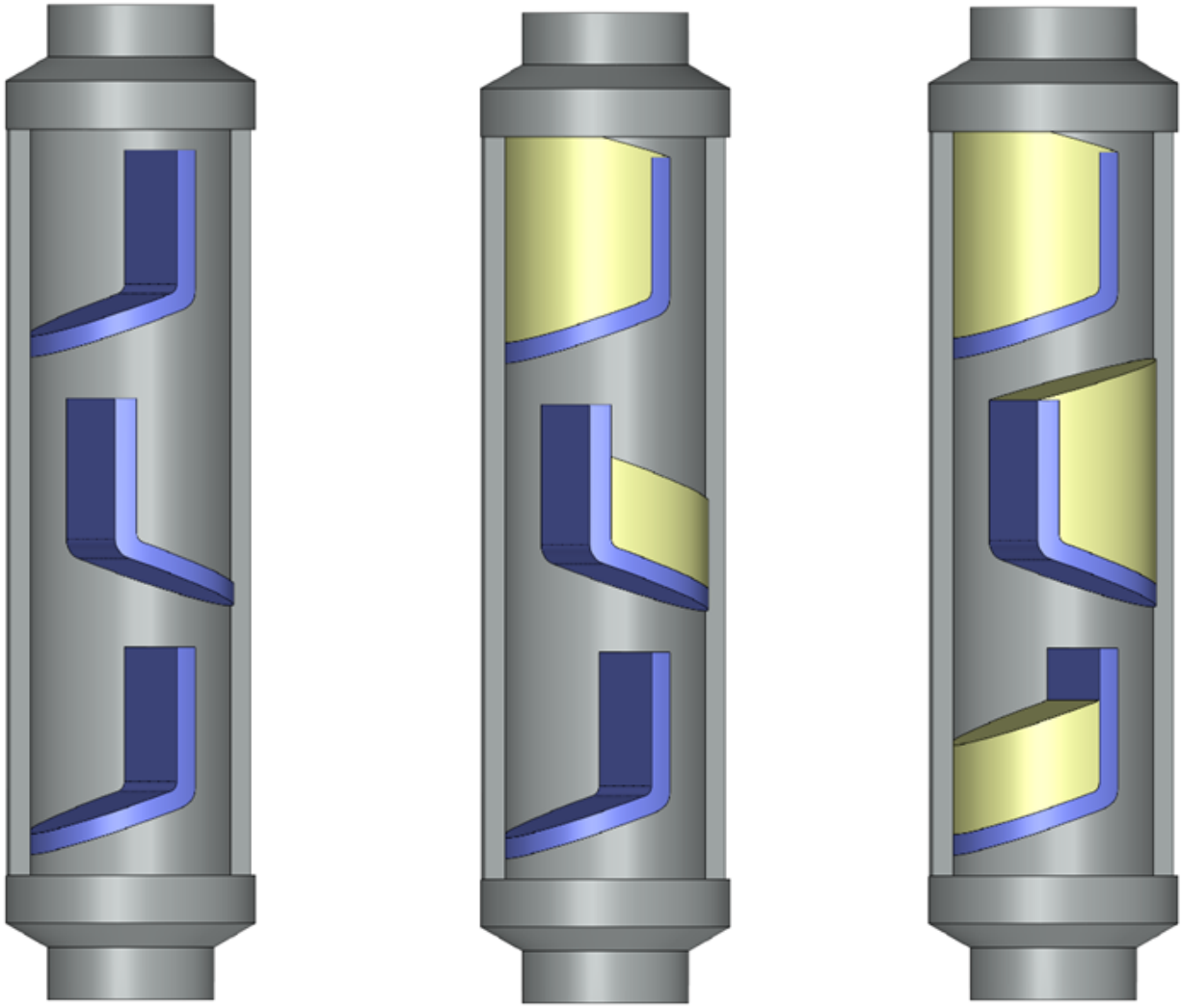

The SandMaze has 26 chambers in a 20’ section. Only 3 shown for clarity. The SandMaze fills from the top chamber and the sand cascades down to the next chamber until the SandMaze is full.

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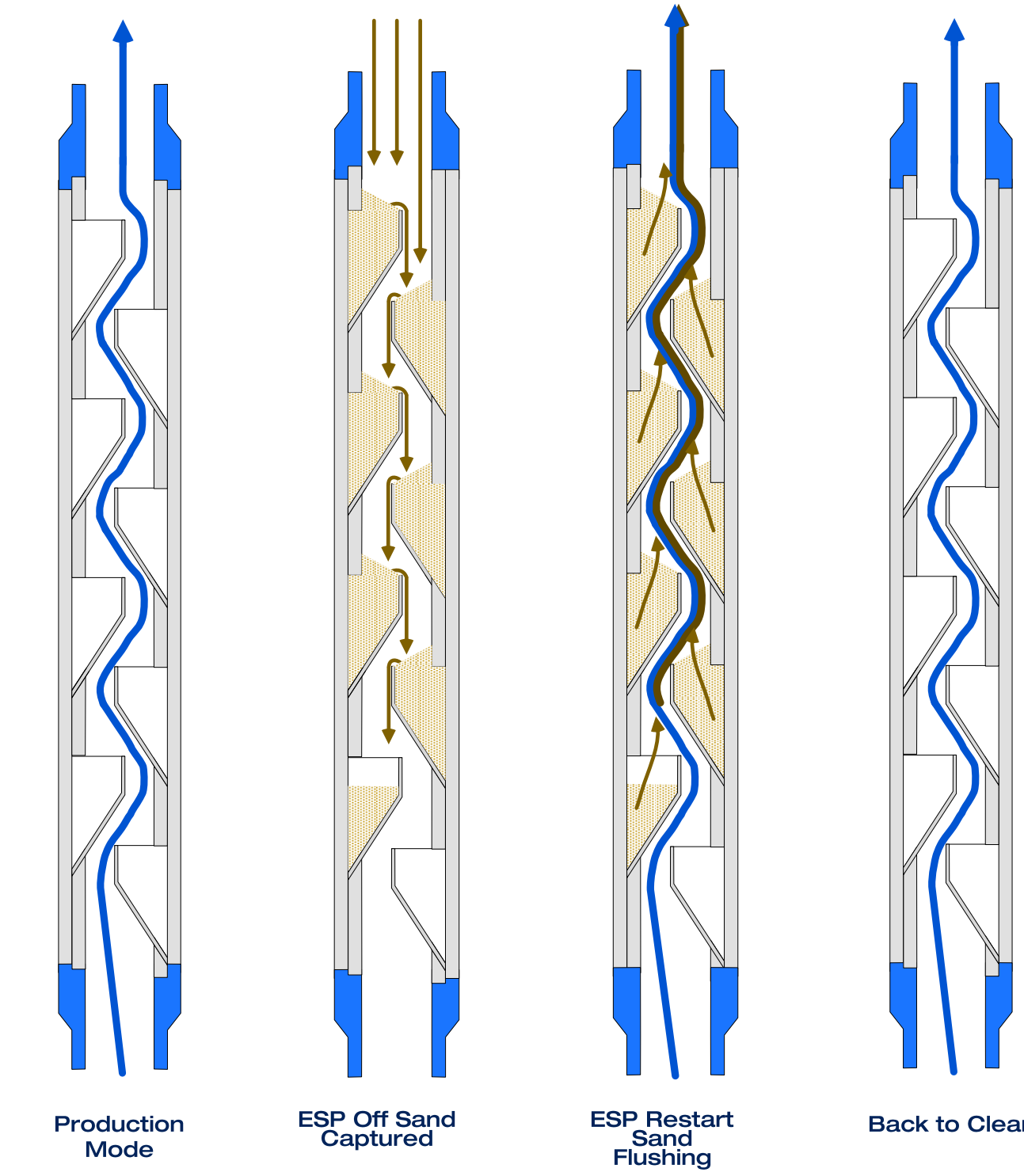

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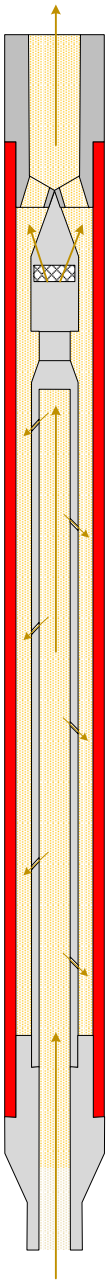
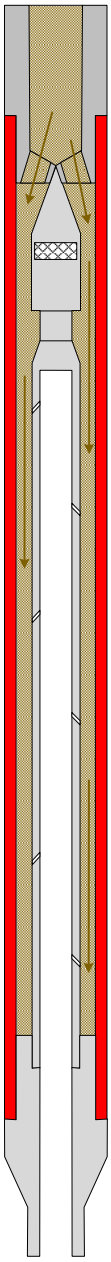
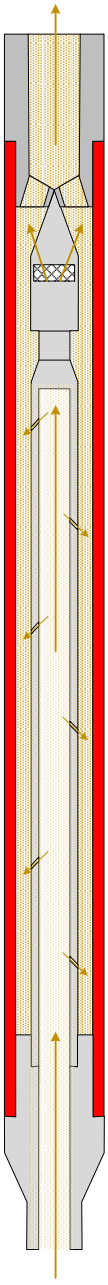
PetroQuip SandMaze Competitor Comparison



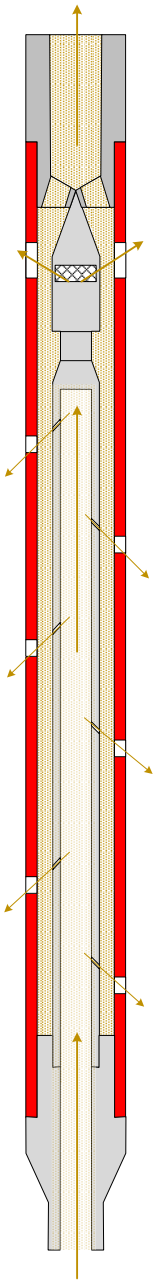
Competition
Flow path



Competition-ESP
Off Sand Captured



Competition-ESP
Restart Sand
Flushing



Competition -
Constant jetting of
the sand laden fluid
cuts the body

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PetroQuip SandMaze Discussion & Questions

How it works:

When an ESP is shutdown, solids suspended in the production stream in the tubing above the ESP settle on top of the ESP pump after it's shut down and flow stops. The sand often settles on top of or gets lodged inside the ESP pump's stages. When the ESP is restarted, this often creates a "hard start" to get the sand moving again which overstresses the motor and shortens the pump life. Additionally, it accelerates pump wear, both of which cause premature pump failures.

The SandMaze not only protects pumps from permanent damage due to solids fallback but also significantly increases an ESP's runtime in unconventional applications. Once flow is resumed, the sand chambers' self-cleaning feature (which is based on standard gravel pack screen design) allows the captured sand to re-enter the production flow stream. The cleaning action does not require the sand to be jetted out of the sand chambers (as the current models on the market do) which significantly reduces the risk of cutting through the outer chamber of the tool.

Questions:

1. Do you have ESP damage from sand fallback when the ESP is shut off?
2. Do you sometimes have hard pump startup events due to sand lodging in the pump stages?
3. Do you run any kind of filter above the ESP to protect it from the fallback of sand and debris when the ESP is offline?
4. Have you had to fish an ESP completion because of a parting of the fallback filter?

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