

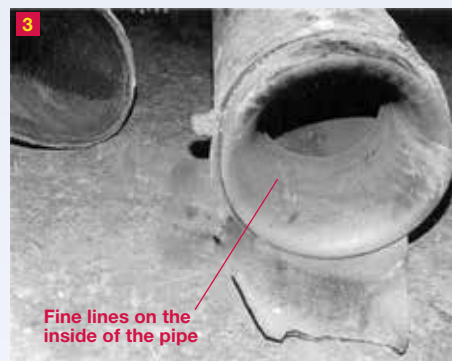
## Investigating a Steam Pipe Failure

A 36-in. (~1-m) section of a 12-in.-dia. (30.5-cm), 600-psig (~41-barg) steam pipe in a large chemical plant suddenly ruptured, causing major damage in November 1998 (Image 1). The pipe was located upstream of a decommissioned venturi flowmeter. Steam supply throughout the plant was lost, the steam generation equipment shut down, and there was no production in most of the plant for more than five days. Fortunately, no injuries or fatalities were reported.

A team consisting of utility operating and management personnel, materials and mechanical engineers (*i.e.*, piping, reliability, and failure analysis experts), and chemical engineers was immediately formed to investigate the cause of the failure of the 30-year-old pipe (Image 2). The investigation was of particular importance because there was concern other steam piping might be in danger of a similar failure.

The initial hypothesis for the cause of the failure was erosion of the pipe wall immediately upstream of the venturi caused by poor-quality (*i.e.*, wet) steam, which can cause thinning of pipe walls. Investigators observed lines on the pipe (Image 3), which they believed were created by erosion.

The investigators determined that the pipe that failed had been designed to have a slight taper of about 10 deg. to smooth the flow to the venturi. The taper was created by boring a thicker piece of pipe to the desired profile. An experienced machinist inspected the failed pipe and immediately recognized that the lines were not signs of erosion, but actually tool marks from a boring tool. When the pipe was bored, the tool had been inserted off-center, which caused the finished pipe to be about 25% of the intended thickness at the top, weakening the pipe and making it more susceptible to failure.



### Did you know?

There is good reason for including a team of people with different expertise in an incident investigation, or any other process safety management activity (*e.g.*, process hazard analysis, management of change, prestartup safety review). Each team member brings a unique perspective to the discussion based on their education, training, and, most importantly, their work experience.

In this incident, the engineers and other experts did not recognize the machine tool marks on the failed pipe, and yet it was immediately obvious to the experienced machinist. His knowledge completely changed the conclusion of the investigation, and was essential to determining the true cause.

### What can you do?

If you are asked to participate in an incident investigation, fully engage and participate and share your knowledge and expertise with the rest of the team. Your experience may be vital to determining the cause. Share your knowledge and also ask questions. If a point of discussion does not sound consistent with your experience, speak up and make sure it is resolved to your satisfaction.

You may be involved in other process safety management activities, such as management of change, process hazard analysis, procedure development, training material development, prestartup safety reviews, etc. Be an active participant in these activities, and share your knowledge with the other participants.

**Everyone has something to contribute to an incident investigation!**

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