

Alert Notice

Alert Notice #: ALN-87-01 **File Code:** ALN

Date: 03/13/87

CFR Reference(s):

Keyword(s): Fillet, Welding, Failure

Subject:

Incident involving the fillet welding of a full encirclement repair sleeve on a 14" API 5LX-52 pipeline; King of Prussia, PA, 10/07/86 pipeline failure.



US Department of Transportation
Research and Special Programs Administration

400 Seventh Street, SW.
Washington, DC 20590

PIPELINE SAFETY ALERT NOTICE

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Date: 03/13/87

To: All Natural Gas Pipeline Transmission Operators & all Hazardous Liquid Pipeline Owners

Subject:

Purpose:

The purpose of this letter is to advise you of a pipeline incident involving the fillet welding of a full encirclement repair sleeve on a 14" API 5LX-52 pipeline.

The Office of Pipeline Safety recommends that you read the enclosed "ALERT NOTICE" and take appropriate preventive steps if you have used a similar welding procedure for making fillet welds on your pipeline.

Richard L. Beam, Director, Office of Pipeline Safety

Notice:

Background:

On October 7, 1986, there was a pipeline failure which released thousands of barrels of gasoline from a pipeline near King of Prussia, PA. The failure occurred in a 14" API 5LX-52 seamless pipe manufactured in 1956. A crack developed in the carrier pipe in the Heat Affected Zone (HAZ) where a full encirclement repair sleeve had been fillet welded to the pipe. The pipe failed less than one month after the sleeve had been installed. This failed pipeline was analyzed by Battelle Laboratories (Columbus Division).

The following were findings made by Battelle:

The pipeline failed by partial circumferential rupture. The rupture initiated on the bottom of the pipe (6 o'clock position) at the toe of circumferential fillet weld at the end of a full encirclement repair sleeve. The rupture propagated about one-half of the way around the pipe, terminating

approximately at the 3 o'clock and 9 o'clock positions. The cause of the failure was found to be underbead cracking in the HAZ's of the fillet weld beads in the carrier pipe. The underbead cracks are believed to have formed from hydrogen-stress cracking of the excessively hard heat affected material in the carrier pipe. Contributing factors included poor weldability of the carrier pipe due to its high carbon equivalent (carbon - 0.27 & manganese = 1.14), a very high cooling rate of the weld due to liquid product being present inside the pipeline during welding, the presence of hydrogen in the welding environment due to the use of cellulosic coated electrodes (nonlow-hydrogen welding rod), residual stresses, and high restraint inherent in the geometry of the sleeve weldment. The pipe had recently been excavated and backfilled under 14-feet of overburden which may have contributed to the failure because of the probable abnormal bending stress to the pipeline.

The following is a description of the welding procedure used to make these fillet welds:

The full encirclement sleeve was installed on the pipe with fillet welded overlapping side bars and its ends were fillet welded to the API 5LX-52 carrier pipe. At the time of welding, the pipeline was filled with product, but the product was not under pressure and not flowing. The end fillet welds were made by preheating the carrier pipe to 200°F. Welding to the carrier pipe was done downhill with three passes using 5/32-inch E6010 electrodes (a cellulosic coated nonlow-hydrogen electrode). The balance of each end weld was made with 5/32-inch E7010 electrodes (also cellulosic coated). The E7010 welding was done in contact with the previously deposited E60101 weld metal of the sleeve and not in contact with the carrier pipe.

Failures under conditions similar to those described herein have been experienced on the pipeline system of Interprovincial Pipe Line Limited of Canada. A report including findings and recommendations relative to one such failure that occurred near Camrose, Alberta, Canada, in February 1985, was issued by the National Energy Board (NEB) in June 1986. NEB's findings as to the cause of the failure are very similar to the findings of Battelle.

The Office of Pipeline Safety strongly recommends that all operators who have fillet welded any items to a high pressure carrier pipe, review their welding procedures used to make fillet welds. Operators whose fillet welding procedures are similar to those described above should immediately discontinue this procedure. Operators who have used a similar fillet welding procedure in the past may want to consider a field inspection program of the fillet welds to determine if cracks have developed in the HAZ and to take appropriate action. The Fluorescent Magnetic Wet Particle Examination method performed in accordance with ASME Section V, Article 7, has proven to be an accurate method in determining if underbead cracking has occurred.