

National Energy
Board



Office national
de l'énergie

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To: All companies under National Energy Board Jurisdiction
Canadian Energy Pipeline Association
Canadian Association of Petroleum Producers
Provincial and Territorial Regulators

**National Energy Board Safety Advisory
NEB SA 2019-01
Potential for Low Toughness and Lack of Fusion of Weld Zone in
Hyundai API 5L Electric Resistance Weld (Hyundai API 5L ERW) Pipe**

Please find attached Safety Advisory SA 2019-01.

The National Energy Board (NEB or the Board) expects regulated companies to demonstrate a proactive commitment to continual improvement in safety, security and environmental protection, and to promote a positive safety culture as part of their management systems.

Safety Advisories are issued periodically in order to improve the oil and gas industry's awareness of an identified safety or environmental concern with the goal of preventing incidents from occurring. A Safety Advisory also serves to further highlight NEB requirements, and conveys the Board's expectation that regulated companies take appropriate action to mitigate any potential impacts to people or the environment.

If you have any questions regarding this advisory please contact the Director of Research and Innovation at the Board through our toll free number at 1-800-899-1265.

Yours truly,

Original signed by L. George for

Sheri Young
Secretary of the Board

Attachment

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Potential for Low Toughness and Lack of Fusion of Weld Zone in Hyundai API 5L Electric Resistance Weld Pipe

Background

The National Energy Board (NEB or the Board) is aware of instances in the United States where Hyundai API 5L Electric Resistance Weld (Hyundai API 5L ERW) pipe manufactured in 2014 and 2015 by Hyundai Steel Company (Hyundai) in Ulsan, South Korea, failed during pre-service field hydrostatic testing (hydrotest).

In one instance, an operator experienced an issue with Hyundai API 5L ERW pipe that demonstrated both lack of fusion (LOF)¹ and low toughness properties at the weld zone that were below the required specifications. The subject pipe failed during field hydrotest in 2017. The fracture was initiated at a LOF defect and propagated along the longitudinal seam for the entire length of the pipe joint due to low toughness. The line pipe was API Monogram² 5L HFN ERW PSL2 manufactured by Hyundai in Ulsan, South Korea, and purchased from a distributor in the United States.

The operator proceeded to test other Hyundai API 5L ERW line pipe purchased from distributors for their current projects and found other pipe joints that had insufficient Charpy V Notch (CVN) toughness values. API 5L specifies 27 J @ 0 °C (20 ft-lbs @ 32 °F) as the minimum required toughness value for longitudinal seam, however some tested pipe exhibited single digit CVN values. The operator replaced suspect Hyundai line pipe in several dozen stations and several kilometers of pipeline.

From July 2018 until April 2019 the NEB and United States Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA) held a number of meetings with Hyundai and Hyundai Canada Inc. During the meetings, the NEB asked a number of questions of Hyundai. Hyundai and Hyundai Canada Inc. have been responsive to all questions raised. Hyundai has provided information to the NEB concerning root cause and corrective action. Hyundai also outlined the implementation of corrective actions it is taking. The NEB has considered all of Hyundai's submissions and filings.

¹ The term lack of fusion means incomplete fusion as used in CSA Z662-19.

² API Monogram is a voluntary licensing program that facilitates the consistent manufacturing of product that conforms to applicable API Specifications. Licensed manufacturers are given the authority to apply the API Monogram registered mark to equipment that meets the requirements.



Hyundai's Actions

Hyundai has stopped selling API 5L pipe from its manufacturing facility in Ulsan, South Korea, since August 31, 2018.

On January 16, 2019, Hyundai sent a notice to inform its customers (distributors) that it became aware that some API ERW 5L Monogram pipe have exhibited poor weld quality. The notice includes Hyundai's advice for inventory API 5L ERW pipe joints that are manufactured in 2014 or later. Hyundai has stated that no action is being requested for in-service pipe.

Hyundai stated that it has not sold API 5CT tubulars into Canada since 2014 for commercial reasons and is not aware of any pre-service hydrotest failure of its API 5CT tubulars that are manufactured in the Ulsan facility.

Hyundai launched an investigation into the root causes of the LOF and low toughness values at the longitudinal seam that did not meet API 5L specifications. Hyundai is working on implementation of a number of corrective actions to resolve this issue.

Hyundai conducted non-destructive testing (hydrostatic and ultrasonic testing) of a large sample of the inventory pipe in the United States that were manufactured in 2014 or later. All except one test result were acceptable in accordance with API 5L specifications. In addition Hyundai conducted CVN testing of a representative sample. All test results were acceptable in accordance with API 5L specifications. Due to the limited availability in distributors' inventory, only a few pipe joints from pre-2014 production were tested (non-destructively and destructively).

Requirements of API 5L, CSA Z662 and CSA Z245.1 Standards

Section 9.8.3 of API 5L standard states the requirements for CVN values of PSL2 pipe at the weld zone. However table 18 of API 5L allows CVN testing of ERW seam to be subject to agreement between parties.

CSA Z245.1-18 requires impact testing of the weld zone for Category II and III pipes that are intended to be used at a temperature lower than -5°C (e.g. above ground pipe). CSA Z662-19 allows use of API 5L PSL2³ pipe for Category II and Category III pipe⁴ applications with some limitations. The standard however does not require impact testing of the weld zone for pipe that is intended to be used at a temperature above -5°C (e.g. below ground pipe).

³ Product Specification Level 2. PSL 2 pipe is used in transmission of natural gas or crude oil.

⁴ According to CSA Z245.1, Category II pipe body is required to exhibit a minimum CVN value of 27 J for pipe smaller than 457 mm OD, and 40 J for pipe 457 mm or larger. Category III pipe body is required to exhibit a minimum CVN value of 18 J.



As a result of the failures in the United States, API reviewed its Monogram certification of the Hyundai pipe. API website includes information on suspension of its Monogram certification program for API 5L pipe and API 5CT tubulars that are manufactured in Hyundai's Ulsan facility.

Preventive Actions

The Board holds pipeline operators responsible for safe operation of their pipeline systems.

Existing industry standards such as CSA Z245.1, CSA Z662, and API 5L are essential in preventing the manufacture of pipe that do not meet required material properties. The CSA and API standards are living documents that are updated as needed. The Board will continue to communicate with the standard bodies on this issue. In the interim, the Board expects operators to develop or enhance their own requirements beyond the current standards to ensure that the pipe they procure and install is fit for service.

Ongoing safety measures for pipeline companies regulated by the NEB include a requirement for companies to develop specifications for the pipe and components to be used in a pipeline and the company shall submit them to the Board when required to do so, as per section 14 of the *National Energy Board Onshore Pipeline Regulations* (OPR). In addition, companies must have quality assurance programs in place to ensure that the pipe and components meet the specifications developed by the company, as required by section 15 of the OPR.

The Board reminds its regulated companies of their continued obligation to comply with the requirements of MO-003-2018 for mandatory reporting of the existence of pipe or components that may not meet the mechanical property requirements of industry standards, such as Canadian Standards Association, or company specifications. The Order further requires the regulated companies to revise their quality assurance programs, to prevent the manufacture and installation of pipe and components with mechanical properties not meeting industry standards or company specifications.

Although this issue may not be an immediate safety concern, low toughness pipe could lead to future pipeline integrity issues.

Hyundai's investigative and testing results do not conclusively rule out the possibility of additional pipe joints that are noncompliant and could exhibit sub-prime characteristics over the course of time. Therefore, unless it can be demonstrated otherwise, companies should not consider Hyundai API 5L ERW pipe to be free of manufacturing defects or to be compliant with minimum low toughness specifications.

At the time of procurement, companies should require CVN impact testing of the longitudinal seam weld from their suppliers.



For pipe that is procured and not yet in service, companies should take the following actions:

- destructive verification of CVN weld toughness values on randomly selected pipe from representative samples;
- hydrotest; and,
- non-destructive examination of longitudinal weld (e.g. ultrasonic inspection).

For pipe that is procured and is in service:

- Unless it can be demonstrated otherwise, Hyundai API 5L ERW pipe should not be considered to be free of manufacturing defects or to be compliant with minimum low toughness specifications. Therefore, Companies should take this factor into consideration as part of their ongoing integrity management programs, assessments and evaluations. This potential hazard should be appropriately documented and communicated to the applicable staff dealing with ongoing operations, maintenance and integrity of pipeline.

Further Information

If you have any questions regarding this advisory please contact the Director of Research and Innovation at the Board through a toll free number at 1-800-899-1265.