

Mechanical Fitting Sampling Plan

In response to Staff Recommendation #2 as outlined below, Spire presents the following Plan.

2. *Staff recommends that Spire develop and implement a written plan for removing and testing a statistically valid sample of the plastic pipe joints were installed by joiners during a time interval in which the joiner had not been requalified within 15 months. Staff recommends that this sampling and testing plan includes at a minimum:*
 - a. *A statistical basis for selecting the number of joints to be tested, including total number of joints, and number of each different type of joint installed using a different method,*
 - b. *A method for testing the joints that will identify if the joint has been completed in accordance with the applicable requirements of 20 CSR 4240-40.030(6),*
 - c. *A method to evaluate the results of the sampling and testing program to determine the relative probability of each joint type failure,*
 - d. *Criteria for how the results of the sampling program will be used to evaluate the need for additional joint replacement, and*
 - e. *A schedule for implementation of the sampling and testing program.*

Phase 1: Data Gathering

To assess the installation condition of fittings and fusions that were installed by employees whose OQ qualification had expired for a period of time in 2020, Spire has evaluated a sampling project to determine if conditions are inconsistent with a proper installation of the fittings. Spire contracted with an independent industry expert (GTI Energy) to assist in determining an appropriate sampling amount for initial evaluation and to assist in parameters that would be reviewed in the process. GTI has proposed that a random sample size of 155 of mechanical fittings would create a high confidence level of representing the conditions of the fitting installations. For the sampling of plastic fusions and fittings, Spire is proposing that a smaller initial sample size of 16 would be sufficient to determine the conditions due to the number of installers whose OQ qualification had expired being two and the work was contained in two job sites. Given the number of projects and the personnel that made the installations, Spire is planning to use the following processes for determining locations to inspect.

Mechanical Fittings:

There was estimated to be just over 41,000 mechanical fittings potentially installed by individuals with lapsed OQ. Almost 69% of these fittings were estimated to have been installed on main work orders and related service work, 25% were installed with individual service replacements, and 6% were installed on leak repairs. Per the recommendations from the GTI testing plan to examine 155 fittings at separate work locations, we will distribute those samples among the work types relative to the percentages mentioned above. A single fitting sample will be required from each selected location, but if other mechanical fittings are exposed in the excavation those will be added to the 155-sample test pool.

To select the specific job locations within each work type, we will use a random number generator. To sample fittings installed by the greatest number of installers, as locations are selected, other locations having the same installer will be removed from the potential

location pool. Throughout the sampling process, Spire will document the type of fittings, and the number of each type tested, and monitor if there are any types missing from the sample set. If it is determined that the sampling has not adequately covered a type of fitting, Spire will identify additional jobs with the fitting type to add to the sample set.

Proposed Sample Distribution

Leak Repair:	9
Main Work w/ services:	107
Service Work:	39
Total:	155

Plastic Fusion Connections:

There were two individuals that did work at two job sites with lapsed OQ. There were approximately 33 electrofusion fittings, and 312 Butt Fusion fittings installed on these jobs. Due to only two individuals being out of OQ, a sample size of 4 electrofusion fittings and 12 butt fusion fittings distributed between the job sites will be a sufficient sample size. The locations will be chosen taking into consideration the spacing and timing of the installations to ensure that samples are taken from different locations at the jobsites.

For the sampling process, Spire is planning to initially use three primary methods of inspection upon exposure of the fittings. First, Spire will complete a leak detection on the fitting. Second, the visual components of each connection will be evaluated to determine if the fitting does not meet the appearance of a properly installed fitting. Third, an X-ray analysis of the fitting will be performed. The images from the X-ray will display if the fitting connections are installed in the appropriate position and if fusions are projecting irregularities. If none of these methods are successful on a particular fitting, then other considerations will be determined for how to evaluate the fitting connection, up to removing the fitting and doing analytical testing. Secondary to the sampling processes outlined above, Spire also plans to randomly select 15 mechanical fitting connections (ensuring one of each type is captured in sample), 2 electrofusion fittings, and 4 butt fusion fittings for removal and destructive testing. This step will be to confirm the indications being viewed during the sampling process.

The following testing measures will be used for these connections:

- Mechanical fittings: Connections will be tensile tested to confirm meeting the acceptable parameters set forth in 20 CSR 4240-40.030(6)(G)(2)(D and E).
- Electrofusion fittings: Connections will be tested using a method from 20 CSR 4240-40.030(6)(G)(1)(A)(III) to confirm meeting the acceptable parameters.
- Fusion connections: Connections will be tested according to 20 CSR 4240-40.030(6)(H)(2)(B)(III) by cutting three (3) 1-inch straps of the sample fusion and completing a bending or torquing of the connection. The straps will also be tensile tested to confirm that a failure point does not initiate with the joint.

During the sampling phase, in the event a fitting does not appear to have been installed appropriately based on the visual and X-ray inspection, the results will be documented, and the fitting will be replaced.

Phase 2: Analysis

Appendix 1

As the sampling process is being completed for the 155 mechanical fittings and the 16 fusion connections, the data will be reviewed for confidence that the fittings were installed according to OQ standards and procedures. If irregularities are discovered during the process, then the following review and considerations will be evaluated:

- What are the irregularity conditions, and do they impact the safety of the installation?
- Is there a pattern with the irregularities? If so, what additional investigation is needed?
- Should additional samples be taken from a particular area or project?
- Should additional samples of a particular type of fitting be taken?
 - Anticipated sample representation for mechanical fittings are as follows:
 - Continental: 10-20%
 - Lyco: 60-70%
 - Permasert: 5-15%

Once the sampling is completed, then a determination will be made on the conditions discovered and a report of these conditions will be made to the appropriate departments and to the Missouri PSC Staff to determine next steps. Along with the report, all data and analysis will be provided to Staff, and Spire will work with Staff to determine next steps, which, depending on the findings, could include additional inspections, either visual or destructive, or additional remediation actions.

Phase 3

Upon completion of Phases 1 and 2, Spire will file a preliminary report of findings and recommendations with the Missouri PSC.