Analysis of Data from Required Reporting of Mechanical Fitting Failures that result in a Hazardous Leak (§192.1009)

This procedure describes how PHMSA will process and analyze data from operators of gas distribution pipelines for mechanical fitting failures that result in a hazardous as required in §192.1009.

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Mechanical Fitting Failure Reporting Requirements

Mechanical Fitting Failure Reports (MFFR) for the previous calendar year are required to be submitted to PHMSA by March 15th of the next year. Operators are required to submit their reports electronically through the PHMSA Pipeline Data Mart (PDM) system. This data is then available to PHMSA personnel in the PDM, and the data can be downloaded and analyzed. The following procedure describes how PHMSA will process and analyze data from operators of gas distribution pipelines for mechanical fitting failures that resulted in a hazardous leak as required in §192.1009. The reporting requirements are:

> § 191.12 Distribution Systems: Mechanical Fitting Failure Reports
> Each mechanical fitting failure, as required by § 192.1009, must be submitted on a Mechanical Fitting Failure Report Form PHMSA F-7100.1-2. An operator must submit a mechanical fitting failure report for each mechanical fitting failure that occurs within a calendar year not later than March 15 of the following year (for example, all mechanical failure reports for calendar year 2011 must be submitted no later than March 15, 2012). Alternatively, an operator may elect to submit its reports throughout the year. In addition, an operator must also report this information to the State pipeline safety authority if a State has obtained regulatory authority over the operator's pipeline.
>
> §192.1009 What must an operator report when a mechanical fitting fails?
> (a) Except as provided in paragraph (b) of this section, each operator of a distribution pipeline system must submit a report on each mechanical fitting failure, excluding any failure that results only in a nonhazardous leak, on a Department of Transportation Form PHMSA F-7100.1-2. The report(s) must be submitted in accordance with § 191.12.
> (b) The mechanical fitting failure reporting requirements in paragraph (a) of this section do not apply to the following:
> (1) Master meter operators;
> (2) Small LPG operator as defined in § 192.1001; or
> (3) LNG facilities.

The MFFR Form collects information on the particulars of hazardous leaks involving mechanical fittings so that any identified safety concerns can be addressed appropriately. Information collected includes the type of mechanical fitting involved, fitting material, manufacturer, year manufactured, year installed, the two materials being joined, leak location, and apparent cause of leak.

Overview

The PHMSA process for analyzing MFFR data is described in the following flowcharts and process descriptions along with expected outputs. The intent of the analysis to identify trends, and to that purpose, the following outputs are expected to be produced. These outputs are discussed in greater detail in this document.

- General information from MFFR reports (e.g., number of reports, number of operators, etc.)
- Information pertaining to Material Type of the Fittings
- Information pertaining to Leak Cause
- Information pertaining to Type of Fitting Involved
- Information pertaining to Leak Location
- Information pertaining to Manufacturer of the Fitting
- Operator Reporting
- Future Analysis Ideas and Concepts
- Technical Review and Analysis

The outputs will be analyzed and observations from the MFFR Team's perspective will be documented by the MFFR Team in an electronic format suitable for dissemination. The format may include more informal dissemination of information through the DIMP website or presentations and discussion with stakeholders, or if more formal action is needed, a Memorandum, Technical Report, Advisory Bulletin, or email transmission to PHMSA Associate Administrator. The MFFR team is comprised of PHMSA engineers, data analysts, and other staff.

1.0 Receipt of Data and Initial Processing

The MFFR Team will obtain the previous calendar year's data from the PDM approximately one month following the March 15th deadline to allow for quality checks to be performed on the data by PHMSA IT personnel. The MFFR Team will scan the incoming data to ensure it meets their needs and note any issues to PHMSA IT personnel. Following the acceptance of the data for analysis purposes, the MFFR Team will begin analysis.

2.0 Data Triaging and Analyses

The MFFR Team members will analyze the MFFR data and generate the tables and charts outlined in this procedure. Typically the data from PDM is moved into a computer application called "SAS" in which the data is manipulated for analysis and discussion purposes. Other evaluations and analyses may be performed depending upon the analysis.

2.1 Gather Information to Support Analysis and Review of Data

Input: Spreadsheet from PDM

Output: Various tables and charts

Responsibility: MFFR Team

Description: The MFFR Team will use the following spreadsheets and tables to gather data in appropriate formats to support the analysis and review. Data used in this analysis was that which was submitted as of 03/31/2014.

Table 1 – Spreadsheets and associated Tables required to perform analysis and expected Outputs

Description of Data to be analyzed	Description of Data Source(s)	Typical Output
2.2.1 General Overview of the MFFR Information	Total number of reports, operators, manufacturers and the amounts of missing information for a given year	Table 1
2.2.2 General information on the Age of the Mechanical Fittings that Failed	Year of manufactured/installed, amounts of missing information, and average time to failure and range (Part C Items 6 & 7)	Table 2
2.2.3 Decade of Installation of Mechanical Fitting that Failed	Decade of installation of the mechanical fittings that failed (Part C Items 6 or 8)	Table 3

Description of Data to be analyzed	Description of Data Source(s)	Typical Output
2.3.1 Average and Range of Time to Failure by Fitting Material	Average and range of time to failure by material type (Part C Item 13 compared to Item 6)	Table 4
2.3.2 Frequency of Material Type	Frequency of failure by Material Type (Part C Item 13)	Figure 1 and Table 5
2.3.3 Comparison of First Pipe Material by Second Pipe Material	First pipe material by second pipe material (Part C Item 14)	Tables 6, 7, 8, 9
2.3.4 Fitting Material by Apparent Cause of Leak	Fitting Material (Part C Item 13) by Leak Cause (Part C Item 15)	Table 10
2.3.5 Sizes of Pipe being Joined	Number of failures by sizes of pipe being joined (First Pipe Nominal Size and Second Pipe Nominal Size) (Part C Item 14)	Tables 11, 12, 13, 14
2.4.1 Apparent Causes of Leaks	Leak cause from cause categories (Part C Item 15)	Figure 2 and Table 15
2.4.2 Leak Cause Expanded	Leak causes expanded (Part C Item 15)	Table 16
2.5.1 Mechanical Fitting Involved	Mechanical Fitting Involved (coupling, adaptor, etc.) (Part C Item 4)	Figure 3 and Table 17
2.5.2 Mechanical Fitting Type	Mechanical Fitting Type (nut follower, stab, etc.) (Part C Item 3)	Figure 4 and Table 18
2.5.3 Fitting Material by Mechanical Fitting Involved	Fitting Material (Part C Item 13) by Mechanical Fitting Involved (Part C Item 3)	Tables 19, 20
2.5.4 Material by Type of Mechanical Fitting	Fitting Material (Part C Item 13) by Type of Mechanical Fitting (Part C Item 4)	Table 21
2.6.1 Leak Location	Aboveground/Belowground, Outside/Inside and Meter/Service (Part C Item 5)	Figure 5 and Table 22
2.6.2 How the Leak Occurred	Leaked Through Seal, Leaked Through Body, or Pulled Out (Part C Item 16)	Figure 6 and Table 23

Description of Data to be analyzed	Description of Data Source(s)	Typical Output
2.6.3 Top 10 States reporting, Top 10 Steel States, and Top 10 Plastic States	Top 10 States reporting, Top 10 Steel States, and Top 10 Plastic States (Part C Items 1 & 13)	Table 24
2.6.4 States by Cause	States reporting by causes of leaks (Part C Items 1 & 15)	Table 25
2.6.5 Leak Location (above or below ground) by Fitting Material	Fitting Material by Leak Location (above or below ground) (Part C Items 5 & 13)	Table 26
2.6.6 Leak Location (inside or outside) by Fitting Material	Fitting Material by Location (inside or outside) (Part C Items 5 & 13)	Table 27
2.6.7 Leak Location (service type) by Fitting Material	Fitting Material by Location (service type) (Part C Items 5 & 13)	Table 28
2.7.1 Manufacturer of Fitting by Year Manufactured	Line plot of failures by manufacturer by year manufactured (Part C Items 7 & 9)	Figure 7
2.7.2 Manufacturer by Years in Service	Line plot of failures by manufacturer by years of service (Part C Items 6 & 9)	Figure 8
2.7.3 Top 10 Manufacturers of Fittings	Top 10 reported manufacturers (Part C Item 9)	Table 29
2.7.4 Manufacturer by Year of Failure	Line plot of number of failures by manufacturer by year of failure (Part C Items 2 & 9)	Figure 9
2.7.5 Manufacturer by Leak Causes	Manufacturer by leak causes (Part C Items 9 & 15)	Table 30
2.7.6 Manufacturer by Mechanical Fitting Involved	All years of manufacturer by mechanical fitting type involved (Part C Items 3 & 9)	Table 31
2.8.1 Operator by Year of Failure	Operators reporting by year of failure (Part A Item 2 & Part C Item 2)	Table 32

2.2 General information from MFFR reports

2.2.1 General Overview of the MFFR Information

Input: Original Spreadsheet from PDM

Output: Table 1 - General overview of the Mechanical Fitting Failure Reports

Responsibility: MFFR Team

Description: General information about the number of reports, number of operators, States of origin, number of manufacturers, and the percent of missing information. An example of what the data table looks like is provided below in Table 1. From this information, the MFFR Team will develop observations on coverage and representation of the information reported.

Table 1. General overview of the Mechanical Fitting Failure Reports, 2011-2013 (Data as of 03/31/2014)

	2011	2012	2013
Number of Reports	8349	7585	9240
Number of Reporting Operators	187	186	168
Number of States of origin	49 and DC	50 and DC	47
Number of Manufacturers	65	68	56
Percent of Missing Manufacturers	51%	46%	50%

2.2.2 General information on the Age of the Mechanical Fittings that Failed

Input: Data analyzed from SAS Computer Application

Output: Table 2 - Year of installation and manufacture of failed mechanical fittings

Responsibility: MFFR Team

Description: General information about the year manufactured and/or installed, the percent of missing information, and the average time to failure and range. An example of what the data looks like is provided below in Table 2. From this information, the MFFR Team will develop observations on the validity of data and accuracy of the average service life of reported failures.

Table 2. General information about the year of manufacture of mechanical fittings reported in Mechanical Fitting Failure Reports, 2011-2013

	2011	2012	2013
Percent Missing Year of Manufacture	89%	88%	88%
Percent Missing Year of Installation	42%	36%	36%
Average Time to Failure and Range	33 Years (0 - 124)	33 Years (0 – 132)	34 Years (0 – 121)

*The percent of overlapping year of manufacturer and year of install is a subset of reported values and therefore is very small.

2.2.3 Decade of Installation of Mechanical Fitting that Failed

Input: Data analyzed from SAS Computer Application

Output: Table 3 – Decade of installation of failed mechanical fittings

Responsibility: MFFR Team

Description: Produce a table showing the decade of installation of the mechanical fittings that failed. Compare percentage of this table to percentages from the annual reports about mileage installed in given decades. An example of what the data table looks like is provided below in Table 3. From this information, the MFFR Team will develop observations on the validity of the data because the distribution across the decades should be similar to the distribution of pipe across the decades from the annual reports.

Table 3. Decade of installation of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

	2011 Count (%)	2012 Count (%)	2013 Count (%)
Pre 1940s	41 (2%)	22 (3%)	14 (3%)
1940s	23 (1%)	6 (1%)	24 (5%)
1950s	191 (11%)	71 (9%)	57 (13%)
1960s	338 (19%)	166 (21%)	86 (19%)
1970s	483 (27%)	232 (29%)	114 (25%)
1980s	380 (21%)	185 (24%)	75(17%)
1990s	155 (9%)	61 (8%)	49 (11%)
2000s	164 (9%)	33 (4%)	27 (6%)
2010s	5 (1%)	6 (1%)	3 (1%)

2.3 Fitting Material and Pipe Type

2.3.1 Average and Range Time to Failure by Fitting Material

Input: Data analyzed from SAS Computer Application

Output: Table 4 - Average time to failure by fitting material type

Responsibility: MFFR Team

Description: Produce a table of average and range of the time to failure by fitting material (Part C Item 13 of the form). An example of what the data table looks like is provided below in Table 4. Based on all data and other information, when the year of manufacture and the year of install are both reported, the majority of the dates are within a year of each other. Since, the dates are similar and year of install is reported more, Table 4 will use year of install. From this information, the MFFR Team will develop observations on time to failure on various fitting material types.

Table 4. Average and range of time to failure by fitting material type of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

	2011	2012	2013
	Average (Range)	Average (Range)	Average (Range)
Steel	39 (0 – 124)	41 (0 – 117)	42(0 – 113)
Plastic	21 (-1 – 70)	21 (0 – 87)	22 (0 – 84)
Combination (Steel and Plastic)	26 (0 – 76)	20 (0 – 90)	21 (0 – 113)
Unknown	41 (0 – 71)	37 (1 – 61)	39 (3 – 57)
Other	49 (0 – 111)	51 (1 – 117)	49 (0 – 121)
Brass	41 (0 – 82)	45 (0 – 132)	43 (0 – 69)

Based on all data, when the year of manufacture and the year of install are both reported, the majority of the dates are within a year of each other. Since, the dates are similar and year of install was reported more often, year of install was used.

2.3.2 Frequency of Failure by Material Type

Input: Data analyzed from SAS Computer Application

Output: Figure 1 and Table 5 - Frequency of mechanical fitting failures by material type

Responsibility: MFFR Team

Description: Produce a bar chart of material type with the percentages on the y-axis. An example of what the data table looks like is provided below in Figure 1. Table 5 will also be produced representing the data with the counts and percent. From this information, the MFFR Team will develop observations on the ratio of material types that are used and trends across years.

Figure 1. Frequency of mechanical fittings by material type reported in the Mechanical Fitting Failure Reports, 2011-2013

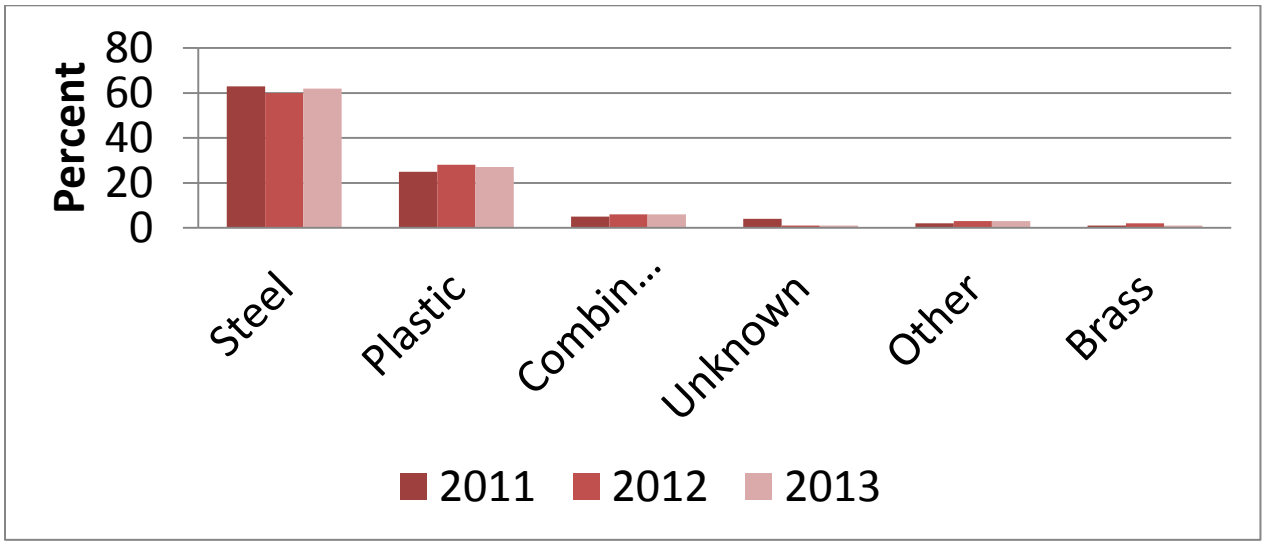


Table 5. Frequency of mechanical fittings by material type reported in the Mechanical Fitting Failure Reports, 2011-2013

	2011 Count (%)	2012 Count (%)	2013 Count (%)
Steel	5233 (63%)	4621 (60%)	5737 (62%)
Plastic	2071 (25%)	2098 (28%)	2426 (27%)
Combination (Steel and Plastic)	452 (5%)	449 (6%)	541 (6%)
Unknown	344 (4%)	94 (1%)	123 (1%)
Other	165 (2%)	192 (3%)	294 (3%)
Brass	82 (1%)	171 (2%)	93 (1%)

2.3.3 Comparison of First Pipe Material by Second Pipe Material Type

Input: Data analyzed from SAS Computer Application

Output: Table 6, Table 7, Table 8, and Table 9 – Comparisons of first pipe and second pipe materials being joined where mechanical fitting failure occurred

Responsibility: MFFR Team

Description: Produce a table comparing first pipe material and second pipe material (Part C Item 14). The highest numbers and percentages should be in the diagonal. Along with the table list the percentage of pipe material that had some plastic and the percentage of pipe material that had some steel. An example of what the data table looks like is provided below: Table 6 is the most current year's information; Table 7 is the previous year's information; Table 8 is information for both years in one table; and Table 9 provides a summary of all the data submitted. From this information, the MFFR Team will develop observations on how the various material types are combined. The various tables will also help identify any outliers.

Table 6. Comparison of first pipe material to second pipe material fittings of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, (most current year) 2013

	Second Pipe Material Type							
First Pipe Material Type		**Cast_Wro**	**Copper**	**Ductile**	**Other**	**Plastic**	**Steel**	**Unknown**
	Cast/Wro	117 (1%)	1	3	1	6	13	0
	Copper	0	134 (1%)	0	0	28	46	13
	Ductile	4	0	155 (2%)	0	1	1	0
	Other	0	0	0	16 (<1%)	1	227	0
	Plastic	9	14	1	1	2950 (32%)	444	9
	Steel	4	48	3	5	592	4287 (47%)	18
	Unknown	0	2	0	0	5	7	14 (<1%)

Percentages are rounded based on total number

43% of fittings had some plastic

64% of fittings had some steel

Table 7. Comparison of first pipe material to second pipe material fittings of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, (most previous year) 2012

	Second Pipe Material Type							
First Pipe Material Type		**Cast/Wro**	**Copper**	**Ductile**	**Other**	**Plastic**	**Steel**	**Unknown**
	Cast/Wro	107 (1%)	3	2	0	19	24	2
	Copper	3	179 (2%)	0	0	41	35	0
	Ductile	5	0	50 (1%)	0	0	1	0
	Other	0	1	0	22 (<1%)	1	250	0
	Plastic	5	14	0	5	2308 (31%)	605	2
	Steel	5	37	0	67	406	3370 (44%)	1
	Unknown	0	0	0	0	5	5	20 (<1%)

Percentages are rounded based on total number

43% of fittings had some plastic

64% of fittings had some steel

Table 8. Comparison of first pipe material to second pipe material fittings of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, (most current 2 years) 2012-2013

		Second Pipe Material Type													
		Cast/Wrought		Copper		Ductile		Other		Plastic		Steel		Unknown	
		2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
First Pipe Material Type	Cast/Wrought	107 (1%)	117 (1%)	3	1	2	3	0	1	19	6	24	13	2	0
	Copper	3	0	179 (2%)	134 (1%)	0	0	0	0	41	28	35	46	0	13
	Ductile	5	4	0	0	50 (1%)	155 (2%)	0	0	0	1	1	1	0	0
	Other	0	0	1	0	0	0	22 (<1%)	16 (<1%)	1	1	250	227	0	0
	Plastic	5	9	14	14	0	1	5	1	2308 (31%)	2950 (32%)	605	444	2	9
	Steel	5	4	37	48	0	3	67	5	406	592	3370 (44%)	4287 (47%)	1	18
	Unknown	0	0	0	2	0	0	0	0	5	5	5	7	20 (<1%)	14 (<1%)

Table 9. Comparison of first pipe material to second pipe material fittings of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, (all years) 2011-2013

	Second Pipe Material Type						
First Pipe Material Type		Cast/Wro	Copper	Ductile	Other	Plastic	Steel	Unknown
	Cast/Wro	334 (1%)	5	5	1	30	46	3
	Copper	5	448 (2%)	0	1	133	162	44
	Ductile	11	0	237 (1%)	0	1	5	0
	Other	0	4	0	56 (<1%)	4	1035	0
	Plastic	24	39	1	13	7615 (30%)	1627	19
	Steel	22	119	3	196	1360	11335 (45%)	74
	Unknown	0	2	0	1	11	14	58 (<1%)

Percentages are rounded based on total number; 43% of fittings had some plastic; 64% of fittings had some steel

2.3.4 Fitting Material by Leak Cause

Input: Data analyzed from SAS Computer Application

Output: Table 10 - Fitting material by leak cause

Responsibility: MFFR Team

Description: Produce a table for Fitting Material (Part C Item 13) by Apparent Cause of Leak (Part C Item 15). An example of what the data table looks like is provided below in Table 6. The table is read comparing percentages in the previous year column to the current year column for the various causes and fitting material. From this information, the MFFR Team will develop observations on frequency of leak causes by material type.

Table 10. Fitting material by leak cause of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, (most current 2 years) 2012-2013

	Corrosion		Equipment		Excavation		Incorrect Operation		Material or Weld		Natural Forces		Other		Other Outside Force	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Steel	7%	7%	49%	47%	3%	3%	4%	4%	6%	8%	19%	20%	11%	10%	1%	1%
Plastic	1%	1%	24%	29%	3%	2%	25%	22%	31%	32%	6%	5%	9%	8%	1%	1%
Combination	8%	5%	15%	20%	5%	2%	28%	20%	22%	32%	11%	11%	8%	8%	3%	2%
Unknown	2%	6%	27%	20%	6%	3%	2%	3%	9%	6%	51%	55%	2%	6%	1%	1%
Other	10%	6%	21%	22%	1%	1%	1%	1%	16%	7%	44%	56%	6%	7%	1%	0%
Brass	3%	5%	53%	43%	9%	3%	4%	2%	6%	23%	20%	15%	4%	9%	1%	0%
Total	5%	5%	40%	40%	3%	2%	11%	10%	14%	16%	16%	17%	10%	9%	1%	1%

2.3.5 Sizes of Pipe being Joined

Input: Data analyzed from SAS Computer Application

Output: Table 11, Table 12, Table 13, and Table 14 - Comparisons of first pipe and second pipe sizes being joined where mechanical fitting failure occurred

Responsibility: MFFR Team

Description: Produce a plot of the number of failures by pipe sizes being joined (Part C Item 14, First Pipe Nominal Size and Second Pipe Nominal Size). An example of what the data table looks like is provided below in Table 11. First pipe size is reflected in the rows and Second pipe size is reflected in the columns. From this information, the MFFR Team will develop observations on the number of reported failures from joining various pipe sizes with mechanical fittings.

Table 11. Sizes of pipe being joined by mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, (most current year) 2013

	¼ inch	½ inch	¾ inch	1 inch	1 ¼ inch	1 ½ inch	1 ¾ inch	2 inch	3 inch	4 inch	6 inch	8 inch or larger
¼ inch	27 (< 1%)	13	9	2	3	0	0	2	0	0	0	0
½ inch	14	1270 (14%)	437	122	6	1	0	9	0	1	1	0
¾ inch	4	180	1448 (16%)	37	7	0	0	41	2	2	2	0
1 inch	1	115	70	2422 (26%)	35	0	0	7	0	6	2	0
1 ¼ inch	1	26	21	52	696 (7%)	11	0	18	2	2	1	0
1 ½ inch	0	0	2	3	6	42 (1%)	0	0	0	0	0	0
1 ¾ inch	0	0	0	0	1	0	1 (0%)	0	0	0	0	0
2 inch	0	102	54	55	9	3	0	1158 (12%)	4	2	1	1
3 inch	0	4	4	8	1	1	0	8	49 (<1%)	1	0	0
4 inch	0	15	7	8	8	0	0	5	2	144 (2%)	1	0
6 inch	0	3	3	4	1	0	0	6	0	0	156 (2%)	0
8 inch or larger	0	0	1	2	2	0	0	2	1	0	1	160 (2%)

Percentages are rounded based on total number

Table 12. Sizes of pipe being joined by mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, (previous year) 2012

	¼ inch	½ inch	¾ inch	1 inch	1 ¼ inch	1 ½ inch	1 ¾ inch	2 inch	3 inch	4 inch	6 inch	8 inch or larger
¼ inch	27 (< 1%)	13	9	2	3	0	0	2	0	0	0	0
½ inch	14	1270 (14%)	437	122	6	1	0	9	0	1	1	0
¾ inch	4	180	1448 (16%)	37	7	0	0	41	2	2	2	0
1 inch	1	115	70	2422 (26%)	35	0	0	7	0	6	2	0
1 ¼ inch	1	26	21	52	696 (7%)	11	0	18	2	2	1	0
1 ½ inch	0	0	2	3	6	42 (1%)	0	0	0	0	0	0
1 ¾ inch	0	0	0	0	1	0	1 (0%)	0	0	0	0	0
2 inch	0	102	54	55	9	3	0	1158 (12%)	4	2	1	1
3 inch	0	4	4	8	1	1	0	8	49 (<1%)	1	0	0
4 inch	0	15	7	8	8	0	0	5	2	144 (2%)	1	0
6 inch	0	3	3	4	1	0	0	6	0	0	156 (2%)	0
8 inch or larger	0	0	1	2	2	0	0	2	1	0	1	160 (2%)

Percentages are rounded based on total number

Table 13. Sizes of pipe being joined by mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, (most current 2 years) 2012- 2013

	¼ inch		½ inch		¾ inch		1 inch		1 ¼ inch		1 ½ inch		1 ¾ inch		2 inch		3 inch		4 inch		6 inch		8 inch or larger	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
¼ inch	31 (0 %)	27 (< 1 %)	8	13	7	9	3	2	0	3	2	0	0	0	0	2	0	0	0	0	0	0	0	0
½ inch	8	14	1150 (15 %)	1270 (14 %)	432	437	149	122	7	6	0	1	0	0	19	9	0	0	5	1	1	1	1	0
¾ inch	7	4	220	180	1237 (16 %)	1448 (16 %)	45	37	14	7	1	0	0	0	24	41	0	2	9	2	0	2	0	0
1 inch	3	1	63	115	71	70	1805 (24 %)	2422 (26 %)	22	35	1	0	1	0	12	7	4	0	2	6	4	2	2	0
1 ¼ inch	0	1	21	26	23	21	51	52	492 (6 %)	696 (7 %)	9	11	1	0	13	18	4	2	1	2	2	1	1	0
1 ½ inch	0	0	3	0	0	2	7	3	6	6	60 (1 %)	42 (1 %)	0	0	0	0	0	0	0	0	0	0	0	0
1 ¾ inch	0	0	1	0	0	0	0	0	0	1	0	0	1 (0 %)	1 (0 %)	0	0	0	0	0	0	0	0	0	0
2 inch	0	0	78	102	69	54	35	55	22	9	8	3	1	0	876 (12 %)	1158 (12 %)	4	4	3	2	2	1	2	1
3 inch	0	0	1	4	5	4	6	8	6	1	1	1	0	0	6	8	38 (0 %)	49 (<1 %)	1	1	1	0	0	0
4 inch	0	0	10	15	6	7	11	8	7	8	0	0	0	0	12	5	0	2	117 (2 %)	144 (2 %)	2	1	0	0
6 inch	0	0	2	3	1	3	3	4	6	1	1	0	0	0	2	6	3	0	2	0	90 (1 %)	156 (2 %)	0	0
8 inch or larger	0	0	0	0	0	1	2	2	0	2	0	0	0	0	2	2	1	1	0	0	1	1	86 (1 %)	160 (2 %)

Percentages are rounded based on total number

Table 14. Sizes of pipe being joined by mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, (all years) 2011-2013

	¼ inch	½ inch	¾ inch	1 inch	1 ¼ inch	1 ½ inch	1 ¾ inch	2 inch	3 inch	4 inch	6 inch	8 inch or larger
¼ inch	81 (<1%)	28	18	6	3	2	0	0	0	0	0	0
½ inch	32	3609 (14%)	1638	420	26	2	0	48	1	9	2	1
¾ inch	14	670	3820 (15%)	133	37	2	0	86	5	11	2	3
1 inch	5	243	198	6248 (25%)	95	4	2	27	6	12	6	3
1 ¼ inch	3	74	73	160	1761 (7%)	27	1	34	7	10	4	1
1 ½ inch	0	4	2	15	17	152 (1%)	0	0	0	0	0	0
1 ¾ inch	0	1	2	0	2	0	2 (0%)	0	0	0	0	0
2 inch	1	249	172	132	47	11	1	3075 (12%)	20	9	4	2
3 inch	0	7	14	19	8	2	0	22	122 (1%)	2	1	0
4 inch	0	34	23	25	18	0	0	22	3	384 (1%)	4	0
6 inch	0	5	5	8	9	1	0	9	4	3	340 (1%)	0
8 inch or larger	0	0	3	4	2	0	0	5	4	1	3	264 (1%)

Percentages are rounded based on total number

2.4 Causes of Hazardous Leak

2.4.1 Chart of Leak Causes

Input: Data analyzed from SAS Computer Application

Output: Figure 2 and Table 15 - Frequency of leak causes

Responsibility: MFFR Team

Description: Produce a bar chart of Apparent Cause of Leak (Part C Item 15) with percentages on the y-axis and causes on x-axis. An example of what the figure looks like is provided below in Figure 2. Table 15 will also be produced representing the data with the counts and percent. The table is read comparing percentages in the year column to the other year column for the various causes. From this information, the MFFR Team will develop observations on the distribution of leak cause.

Figure 2. Frequency of leak causes of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

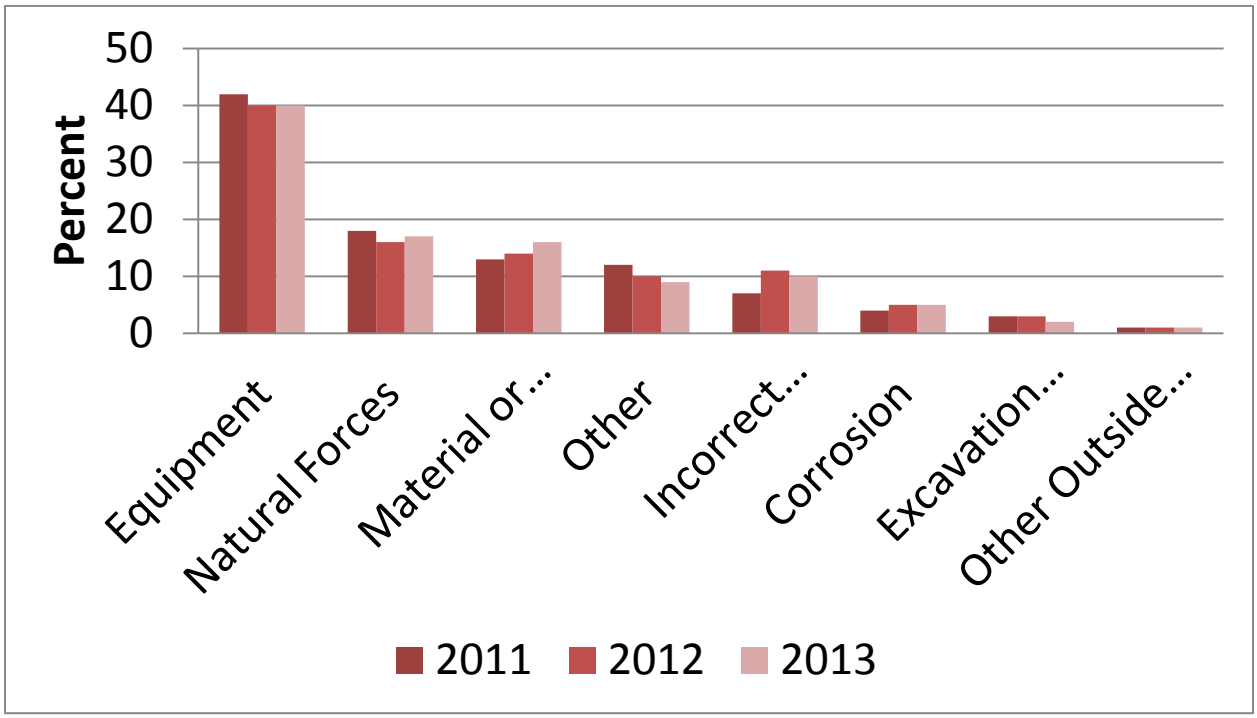


Table 15. Frequency of leak causes of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

	2011 Count (%)	**2012 Count (%)**	**2013 Count (%)**
Equipment	3504 (42%)	3008 (40%)	3662 (40%)
Natural Forces	1558 (18%)	1199 (16%)	1572 (17%)
Material or Weld	1044 (13%)	1134 (14%)	1464 (16%)
Other	1004 (12%)	718 (10%)	851 (9%)
Incorrect Operation	572 (7%)	834 (11%)	892 (10%)
Corrosion	332 (4%)	388 (5%)	503 (5%)
Excavation	229 (3%)	265 (3%)	211 (2%)
Other	105 (1%)	79 (1%)	59 (1%)

2.4.2 Leak Causes Expanded

Input: Data analyzed from SAS Computer Application

Output: Table 16 - Frequency of leak causes (expanded)

Responsibility: MFFR Team

Description: Produce a table with leak causes expanded as the title and Leak Cause Natural Forces Thermal Expansion/Contraction, Leak Cause Material/Welds and Leak Cause Excavation Damage Occurred presenting both the count and percent by report year. An example of what the data table looks like is provided below in Table 16. The table is read comparing percentages in the year column to the other year column for the various questions. From this information, the MFFR Team will develop observations on any issues identified in specific leak causes.

Table 16. Frequency of leak causes expanded information of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

Question	Responses	2011 Count (Percent)	2012 Count (Percent)	2013 Count (Percent)
Leak Cause Natural Forces Thermal Expansion / Contraction	**No**	762 (57%)	648 (59%)	759 (50%)
	Yes	574 (43%)	459 (41%)	768 (50%)
Leak Cause Material/Welds	**Construction/Installation Defect**	242 (23%)	41 (4%)	N/A
	Design Defect	174 (17%)	311 (28%)	451 (31%)
	Material Defect	628 (60%)	782 (68%)	1013 (69%)
Leak Cause Excavation Damage	**At time of leak discovery**	166 (75%)	227 (86%)	182 (87%)
	Previous to leak discovery	54 (25%)	36 (14%)	28 (13%)

2.5 Type of Fitting

2.5.1 Chart of Mechanical Fitting Involved

Input: Data analyzed from SAS Computer Application

Output: Figure 3 and Table 17 – Frequency of applications where failures are occurring

Responsibility: MFFR Team

Description: Produce a bar chart of percentages by Mechanical Fitting Involved (Part C Item 4 on the report form) with percentages on the y-axis and Type on x-axis. An example of what the data table looks

like is provided below in Figure 3. Table 17 will also be produced representing the data with the counts and percent. The table is read comparing percentages in the year column to the other year column for the various types of fittings. From this information, the MFFR Team will develop observations on the distribution of type of mechanical fitting failing.

Figure 3. Frequency of mechanical fitting involved of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

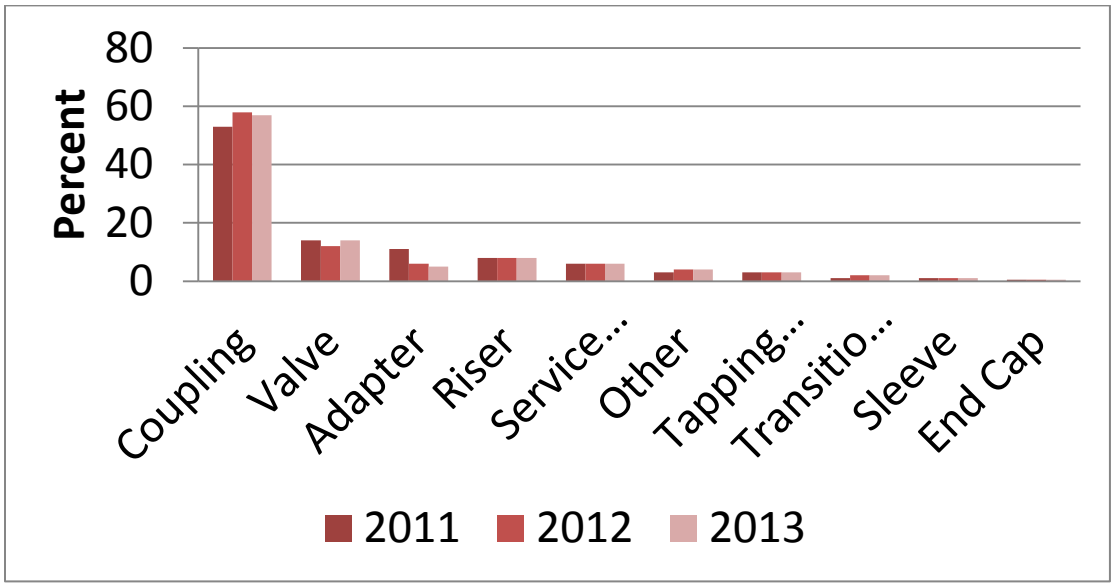


Table 17. Frequency of mechanical fitting involved of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

	2011 Count (%)	2012 Count (%)	2013 Count (%)
Coupling	4426 (53%)	4386 (58%)	5299 (57%)
Valve	1197 (14%)	906 (12%)	1299 (14%)
Adapter	877 (11%)	500 (6%)	462 (5%)
Riser	701 (8%)	602 (8%)	749 (8%)
Service or Main Tee	472 (6%)	501 (6%)	527 (6%)
Other	275 (3%)	304 (4%)	354 (4%)
Tapping Tee	210 (3%)	205 (3%)	307 (3%)
Transitional	98 (1%)	139 (2%)	133 (2%)
Sleeve	66 (1%)	55 (1%)	50 (1%)
End Cap	27 (<1%)	25 (<1%)	34 (<1%)

2.5.2 Chart of Mechanical Fitting Type

Input: Data analyzed from SAS Computer Application

Output: Figure 4 and Table 18 - Frequency of failure by type of mechanical fitting

Responsibility: MFFR Team

Description: Produce a bar chart of percentages by Type of Mechanical Fitting (Part C Item 3 on the report form) with percentage on the y-axis and type of mechanical fitting on the x-axis. An example of what the data table looks like is provided below in Figure 4. Table 18 will also be produced representing the data with the counts and percent. The table is read comparing percentages in the last three years column for the various mechanical fitting types. From this information, the MFFR Team will develop observations on the distribution of type of mechanical fitting involved in the failure.

Figure 4. Frequency of mechanical fitting type of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

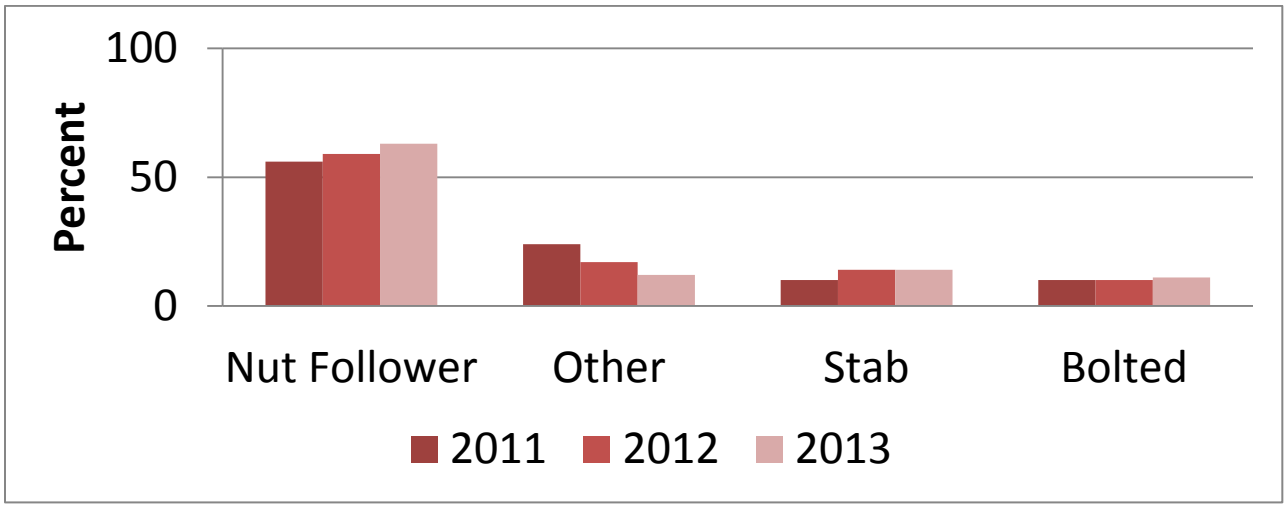


Table 18. Frequency of mechanical fitting type of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

	2011 Count (%)	2012 Count (%)	2013 Count (%)
Nut Follower	4720 (56%)	4487 (59%)	5824 (63%)
Other	2014 (24%)	1280 (17%)	1084 (12%)
Stab	817 (10%)	1084 (14%)	1254 (14%)
Bolted	798 (10%)	777 (10%)	1052 (11%)

2.5.3 Material of Mechanical Fitting Involved

Input: Data analyzed from SAS Computer Application

Output: Table 19 and Table 20 - Frequency of failure of material of mechanical fitting involved

Responsibility: MFFR Team

Description: Produce a table of Fitting Material (Part C Item 13) by Mechanical Fitting Involved (Part C Item 3) by the reporting years. An example of what the data table looks like is provided below. The table is read comparing percentages in the last three years for the various fitting material and types. Table 20 is provided with all the data across the reporting years and is read comparing the percentages across the rows. From this information, the MFFR Team will develop observations on which type of mechanical fitting is most likely from the various material types.

Table 19. Frequency of material of mechanical fitting involved of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

	Bolted			Nut Follower			Stab			Other		
	2011	2012	2013	2011	2012	2013	2011	2012	2013	2011	2012	2013
Steel	10%	10%	11%	59%	69%	74%	2%	4%	4%	29%	17%	11%
Plastic	6%	7%	7%	51%	37%	43%	31%	40%	37%	12%	16%	13%
Combination	3%	4%	3%	55%	60%	59%	13%	16%	20%	29%	20%	18%
Unknown	6%	7%	6%	70%	87%	81%	1%	4%	1%	23%	2%	12%
Other	58%	66%	82%	35%	20%	15%	2%	1%	1%	5%	13%	2%
Brass	12%	10%	6%	66%	77%	87%	4%	1%	4%	18%	12%	3%
Total	9%	10%	11%	57%	59%	63%	10%	14%	14%	24%	17%	12%

Table 20. Frequency of material of mechanical fitting involved of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, all years combined 2011-2013

	Bolted	Nut Follower	Stab	Other
Steel	10%	68%	3%	19%
Plastic	6%	44%	36%	14%
Combination	3%	58%	17%	22%
Unknown	6%	75%	2%	17%
Other	71%	21%	1%	7%
Brass	9%	77%	3%	11%
Total	10%	60%	13%	17%

2.5.4 Fitting Material by Type of Mechanical Fitting

Input: Data analyzed from SAS Computer Application

Output: Table 21 - Frequency of failure of material of mechanical fitting by its application

Responsibility: MFFR Team

Description: Produce a table of Fitting Material by Type of Mechanical Fitting. An example of what the data table looks like is provided below in Table 21. The table is read comparing percentages in the last two years for the various mechanical fitting and fitting material. From this information, the MFFR Team will develop observations based on percentages of material type and type of fitting.

Table 21. Frequency of fitting material by type of mechanical fitting of mechanical fitting involved of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports,(most current 2 years) 2012-2013

	Adapter		**Coupling**		**End Cap**		**Other**		**Riser**	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Steel	9%	7%	65%	67%	0%	0%	4%	2%	7%	7%
Plastic	1%	1%	50%	47%	1%	1%	2%	1%	4%	2%
Combination	6%	3%	26%	28%	0%	0%	2%	0%	43%	48%
Unknown	3%	2%	50%	70%	1%	0%	2%	3%	11%	6%
Other	0%	0%	33%	12%	1%	1%	38%	66%	5%	1%
Brass	8%	4%	70%	70%	2%	1%	5%	0%	0%	3%
Total	6%	5%	58%	58%	<1%	<1%	4%	4%	8%	8%

	Service or Main Tee		**Sleeve**		**Tapping Tee**		**Transition Fitting**		**Valve**	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Steel	5%	5%	1%	1%	1%	3%	1%	1%	7%	7%
Plastic	9%	9%	0%	0%	6%	6%	2%	1%	25%	32%
Combination	7%	3%	1%	1%	2%	1%	11%	9%	2%	7%
Unknown	27%	13%	2%	0%	0%	0%	0%	1%	4%	5%
Other	3%	3%	6%	5%	2%	0%	0%	0%	12%	12%
Brass	6%	6%	1%	0%	0%	1%	1%	1%	6%	14%
Total	7%	6%	1%	1%	3%	3%	2%	1%	11%	14%

2.6 Location of Hazardous Leaks

2.6.1 Leak Location

Input: Data analyzed from SAS Computer Application

Output: Figure 5 and Table 22 – Leak location

Responsibility: MFFR Team

Description: Produce a bar chart with Leak Location (Part C Item 5) as the title and Aboveground/Belowground, Outside/Inside and Meter/Service on the x-axis with the percentages on the y-axis. An example of what Figure 5 looks like is provided. Table 22 will also be produced representing the data with the counts and percent. The table is read comparing percentages in the last three years for the various fitting material and types. From this information, the MFFR Team will develop observations on the general description of the leak location.

Figure 5. Frequency of the location of the hazardous leak of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

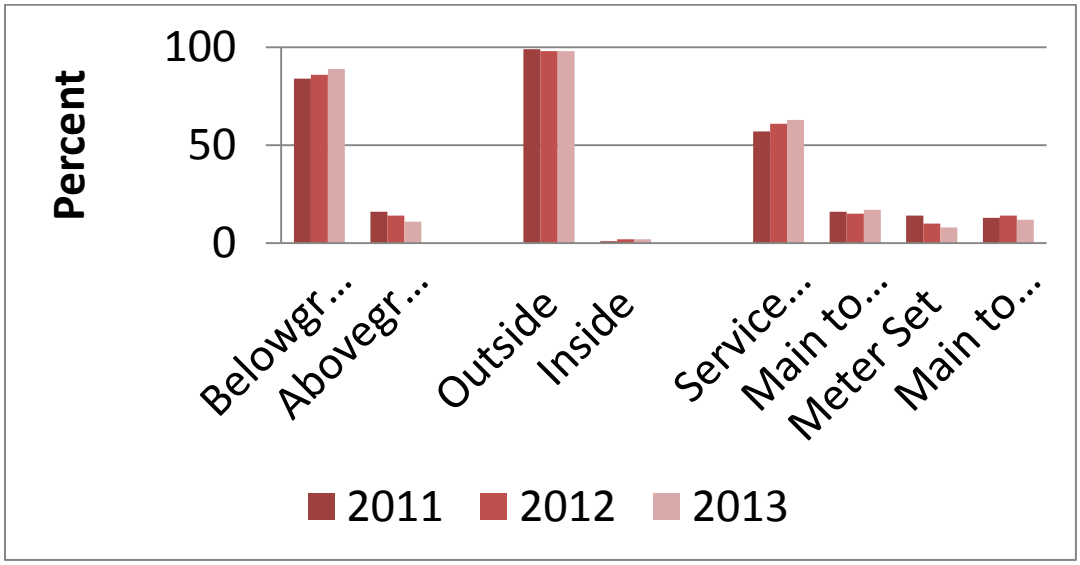


Table 22. Frequency of the location of the hazardous leak of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

	2011 Count (%)	2012 Count (%)	2013 Count (%)
Belowground	6990 (84%)	6590 (86%)	8189 (89%)
Aboveground	1359 (16%)	1035 (14%)	1025 (11%)
Outside	8221 (99%)	7457 (98%)	9049 (98%)
Inside	128 (1%)	168 (2%)	165 (2%)
Service to Service	4711 (57%)	4715 (61%)	5782 (63%)
Main to Main	1384 (16%)	1108 (15%)	1565 (17%)
Meter Set	1148 (14%)	791 (10%)	749 (8%)
Main to Service	1106 (13%)	1011 (14%)	1118 (12%)

2.6.2 How the Leak Occurred

Input: Data analyzed from SAS Computer Application

Output: Figure 6 and Table 23 - Frequency of how the leak occurred

Responsibility: MFFR Team

Description: Produce a bar chart of how the leak occurred (Part C Item 16 of the report form) with percentage on the y-axis and options for how the leak occurred on the x-axis. An example of what the Figure 6 looks like is provided below. Table 23 will also be produced representing the data with the counts and percent. The table is read comparing percentages in the last three years for the various leak occurrences. From this information, the MFFR Team will develop observations on distribution of leak occurrence.

Figure 6. Frequency of how the leak occurred for mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

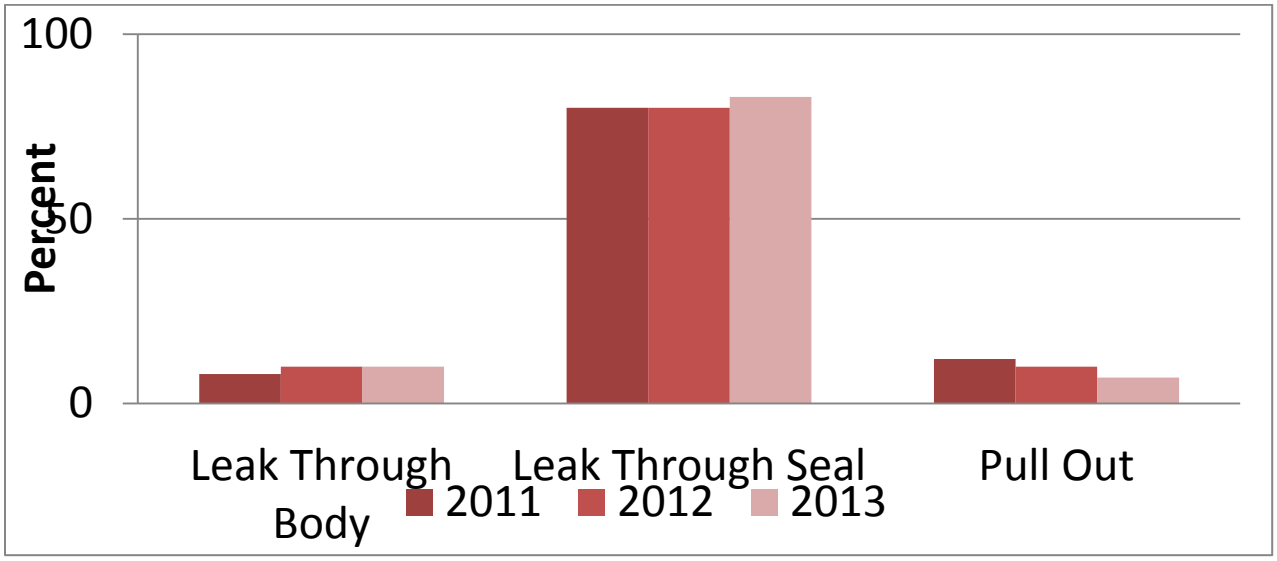


Table 23. Frequency of how the leak occurred for mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

	2011 Count (%)	2012 Count (%)	2012 Count (%)
Leak Through Body	661 (8%)	746 (10%)	906 (10%)
Leak Through Seal	6650 (80%)	6152 (80%)	7627 (83%)
Pull Out	1038 (12%)	727 (10%)	681 (7%)

2.6.3 Top 10 States reporting, Top 10 Steel States, and Top 10 Plastic States

Input: Data analyzed from SAS Computer Application

Output: Table 24 – Comparison of percentages of failures in States by material

Responsibility: MFFR Team

Description: Produce a table with the columns Top 10 States based on total services reported by operators in Annual Reports, Top 10 Steel States, and Top 10 Plastic States, and Top 10 States where Mechanical Fitting Failures occurred for each. This table takes into account where the MFF occurred based on the raw data of all reports. An example of what the data table looks like is provided below in Table 24. For reference, a column of the percentages of the total number of services in each State in 2011, based on annual report data, is also added for each category. From this information, the MFFR Team will develop observations on distribution of percentages of mechanical fitting failures in the States taking into context percentage of pipe material installed based on the annual reports.

Even with this information provided, PHMSA cautions users of this data analysis on the need to consider the information in the appropriate context. There is no definitive information publicly available about the number of fittings in a given State. Therefore, PHMSA is unable to adjust the failure reports by the quantity produced or in use. For additional information specific to a certain State to help put numbers in better context, users are encouraged to contact the State.

Table 24. Percentage of MFFR by State, 2011-2013

Top 10 States				Top 10 Steel States				Top 10 Plastic States			
% of Total Services Annual Report 2011	% of 2011 MFFRs	% of 2012 MFFRs	% of 2013 MFFRs	% of Steel Services Annual Report 2011	% of 2011 MFFRs	% of 2012 MFFRs	% of 2013 MFFRs	%of Plastic Services Annual Report 2011	% of 2011 MFFRs	% of 2012 MFFRs	% of 2013 MFFRs
CA 17%	TX 13%	TX 13%	TX 12%	CA 13%	TX 19%	TX 18%	TX 18%	CA 12%	PA 26%	PA 20%	PA 22%
TX 10%	IL 11%	IL 9%	PA 11%	TX 7%	IL 18%	IL 13%	IN 12%	TX 7%	OH 11%	CA 14%	CA 13%
IL 5%	PA 9%	PA 8%	IN 9%	IL 6%	IN 9%	IN 10%	IL 10%	NY 5%	CA 10%	OH 7%	OH 8%
NY 5%	OH 7%	IN 8%	NY 7%	OH 5%	NY 6%	MI 7%	TN 10%	OH 5%	NY 5%	NY 6%	NY 8%
MI 4%	IN 6%	MI 7%	IL 7%	NY 5%	OH 6%	NY 6%	NY 7%	MI 5%	GA 4%	AZ 5%	VA 6%
OH 4%	NY 6%	NY 6%	TN 7%	MI 5%	MI 5%	TN 6%	MI 6%	IL 5%	CT 4%	NV 4%	NV 4%
NJ 4%	MI 5%	OH 6%	OH 6%	PA 4%	MS 5%	OH 5%	OH 6%	PA 5%	MA 4%	VA 4%	AZ 4%
PA 4%	MS 3%	TN 5%	MI 6%	NJ 3%	TN 4%	VA 4%	VA 3%	GA 3%	MO 3%	TN 3%	TN 3%
LA 3%	CA 3%	CA 4%	CA 4%	GA 3%	CO 3%	MD 3%	PA 3%	NJ 3%	SC 3%	TX 3%	CT 3%
CO 3%	VA 3%	VA 4%	VA 4%	IN 3%	VA 3%	MS 3%	WI 3%	IN 3%	AZ 3%	CT 3%	IN 3%

2.6.4 States by Causes of Hazardous Leak

Input: Data analyzed from SAS Computer Application

Output: Table 25 - Comparison of frequency of failures in States by cause

Responsibility: MFFR Team

Description: Produce a table with the columns of State where the failures occurred and causes of leaks for all years of data. From this information, the MFFR Team will develop observations on distribution of which states the failures are occurring and the distribution of the causes in states.

Table 25. Number of MFF by leak cause by State for all years of data

State	Equipment	Natural Forces	Corrosion	Excavation Damage	Incorrect Operation	Material or Weld	Other	Other Outside Force Damage
AK	10	19	0	0	0	0	0	0
AL	54	58	28	8	23	91	8	10
AR	8	30	3	3	5	4	11	1
AZ	16	0	1	2	116	129	1	3
CA	1	10	8	7	410	385	91	10
CO	264	57	5	26	4	12	1	1
CT	283	94	5	1	11	138	7	1
DC	45	1	3	5	2	0	0	0
DE	0	2	1	0	2	5	13	0
FL	57	5	7	10	16	16	42	0
GA	246	9	2	15	19	19	0	6
HI	2	0	4	1	1	0	40	0
IA	34	47	3	6	5	33	2	0
ID	0	1	0	2	14	12	2	1
IL	1601	428	101	34	24	52	88	10
IN	891	340	69	18	50	205	290	14
KS	148	41	15	15	7	22	2	2
KY	70	27	35	11	298	183	116	7
LA	19	18	3	9	18	11	10	0
MA	17	50	16	1	11	86	141	0
MD	172	6	14	21	47	12	44	4
ME	0	0	0	0	5	1	1	0
MI	776	386	68	126	34	54	36	16
MN	97	73	12	1	11	54	45	1
MO	291	12	7	20	5	37	4	1
MS	46	191	2	17	256	11	0	1
MT	8	37	0	6	0	1	0	2
NC	66	13	0	30	17	57	2	2
ND	2	2	0	0	0	2	0	0
NE	6	5	0	1	1	3	4	0
NH	0	0	1	0	2	0	0	0
NJ	70	192	57	12	45	46	24	9

State	Equip ment	Natural Forces	Corrosion	Excavation Damage	Incorrect Operation	Material or Weld	Other	Other Outside Force Damage
NM	274	0	0	1	5	2	0	1
NV	21	5	0	1	108	164	1	1
NY	1131	21	140	19	72	87	160	2
OH	79	95	243	57	222	293	552	14
OK	5	3	4	0	3	33	16	0
OR	9	0	0	21	29	28	7	1
PA	657	470	95	8	113	793	128	53
RI	0	1	0	0	0	1	0	1
SC	99	2	6	8	45	86	19	1
SD	12	29	1	0	1	13	0	0
TN	1051	89	2	17	11	63	18	2
TX	970	1279	101	94	64	157	520	48
UT	8	8	4	4	4	6	5	3
VA	459	108	95	12	97	30	78	5
VI	1	0	0	0	0	0	0	0
VT	8	7	0	0	10	0	0	0
WA	10	1	16	14	46	32	12	2

2.6.5 Leak Location (above or below ground) by Fitting Material

Input: Data analyzed from SAS Computer Application

Output: Table 26 – Leak location

Responsibility: MFFR Team

Description: Produce a table of Fitting Material by Leak Location (above or below ground). An example of what the data table looks like is provided below in Table 26. The table is read comparing percentages in the last three years for the various materials and leak location. From this information, the MFFR Team will develop observations based on percentage of material type and location

Table 26. Comparison of Fitting Material by Leak Location, 2011-2013

	Aboveground			Belowground		
	2011	2012	2013	2011	2012	2013
Steel	79%	71%	75%	59%	59%	61%
Plastic	2%	3%	2%	30%	31%	30%
Combination	14%	16%	19%	4%	4%	4%
Unknown	2%	2%	1%	4%	1%	1%
Other	1%	2%	1%	2%	3%	3%
Brass	2%	5%	2%	1%	2%	1%
Total	16%	13%	11%	84%	87%	89%

2.6.6 Leak Location (inside or outside) by Fitting Material

Input: Data analyzed from SAS Computer Application

Output: Table 27 – Leak location

Responsibility: MFFR Team

Description: Produce a table of Fitting Material by Location (inside or outside). An example of what the data table looks like is provided below in Table 27. The table is read comparing percentages in the last three years for the various materials and leak locations. From this information, the MFFR Team will develop observations on percentage of material type and location.

Table 27. Frequency of leak location (inside or outside) by fitting material of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

	Inside			Outside		
	2011	**2012**	**2013**	**2011**	**2012**	**2013**
Steel	70%	82%	89%	62%	60%	62%
Plastic	10%	6%	4%	25%	28%	27%
Combination	5%	5%	3%	5%	6%	6%
Unknown	2%	1%	1%	4%	1%	1%
Other	2%	0%	0%	2%	3%	3%
Brass	10%	6%	3%	1%	2%	1%
Total	2%	2%	2%	98%	98%	98%

2.6.7 Leak Location (main and service connection) by Fitting Material

Input: Data analyzed from SAS Computer Application

Output: Table 28 - Frequency of leak location (main or service connection) by fitting material

Responsibility: MFFR Team

Description: Produce a table of Fitting Material by Location (main and service connections). An example of what the data table looks like is provided below in Table 28. The table is read comparing percentages in the last three years for the various materials and leak locations. From this information, the MFFR Team will develop observations based on percentage of material type and location.

Table 28. Frequency of leak location (main or service connection) by fitting material of mechanical fittings that failed and were reported in the Mechanical Fitting Failure Reports, 2011-2013

	Main to Main			Main to Service			Meter Set			Service to Service		
	2011	2012	2013	2011	2012	2013	2011	2012	2013	2011	2012	2013
Steel	80%	79%	75%	66%	62%	67%	78%	70%	70%	53%	54%	57%
Plastic	6%	6%	5%	24%	26%	25%	2%	3%	3%	36%	37%	35%
Combination	2%	2%	2%	5%	5%	3%	16%	20%	24%	4%	5%	5%
Unknown	5%	1%	2%	3%	3%	2%	2%	2%	1%	5%	1%	1%
Other	7%	11%	15%	1%	1%	2%	<1%	1%	0%	1%	1%	1%
Brass	1%	1%	1%	1%	2%	1%	1%	4%	2%	1%	2%	1%
Total	16%	15%	17%	13%	13%	12%	14%	10%	8%	57%	62%	63%

2.7 Manufacturer of Fitting

Special note for this section: The section is based on the name of manufacturer associated with the MFF as reported by the operator. PHMSA cautions users of this data analysis on potential data quality issues that may exist with the information reported and the need to consider the information in the appropriate context (e.g., amount of fittings that may be in service, length of time a manufacturer may have been producing fittings, and amount of fittings a manufacturer may produce (i.e. overall market share)). PHMSA conducted some additional conservative data analysis in an attempt to improve the data quality mostly due to spelling errors. These tables are based on the frequency of reporting. There is no definitive information publicly available about the number of fittings produced or installed. Therefore, PHMSA is unable to adjust the failure reports by the quantity produced or in use. The best measure PHMSA is able to use to put the information into context based on other information reported is rate of hazardous leaks eliminated/repaired. The rate of hazardous leaks repaired involving a mechanical fitting for 2013 is the number of MFFR (9240) divided by the total number of hazardous leaks reported as eliminated/repaired in 2013 (189,802) which is 4.9%. For additional information specific to a certain manufacturer to help put numbers in better context such as amount fittings they may have produced or sold, users are encouraged to contact the manufacturer. Manufacturers would not be able to provide information on amount of fittings they've sold that were actually installed, as that is information the operators would have.

2.7.1 Manufacturer of Fitting by Year Manufactured

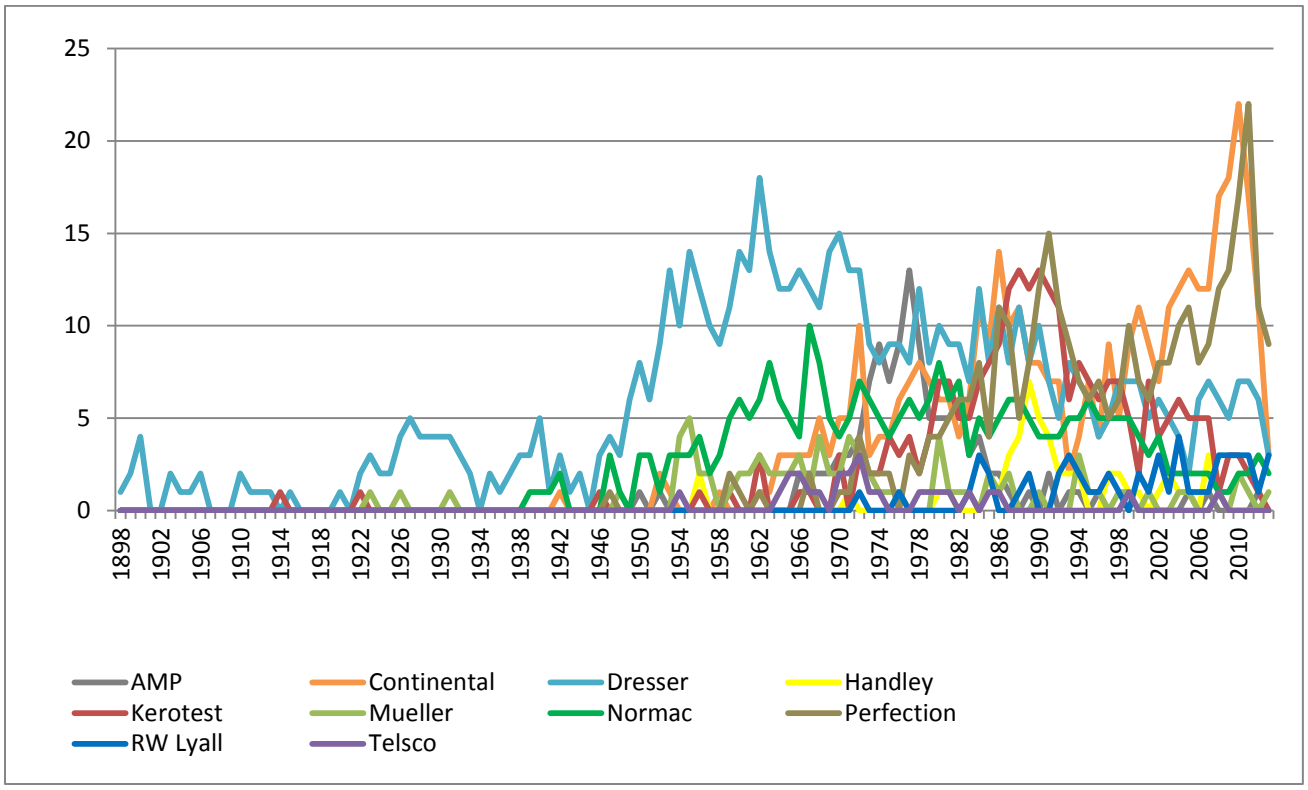
Input: Data analyzed from SAS Computer Application

Output: Figure 7 - Line plot of the number of failures by manufacturer by year fitting manufactured

Responsibility: MFFR Team

Description: Produce a line plot of the number of failures by manufacturer as reported by operators by year fitting manufactured on the x-axis. All data will be presented in the plot. An example of what the data table looks like is provided below in Figure 7. From this information, the MFFR Team will develop observations on the validity of the data by those manufacturers with known issues for give manufactured years.

Figure 7. Example of the line plot of the number of failures by top 10 manufacturers by year fitting manufactured, 2011-2013



2.7.2 Manufacturer by Years in Service

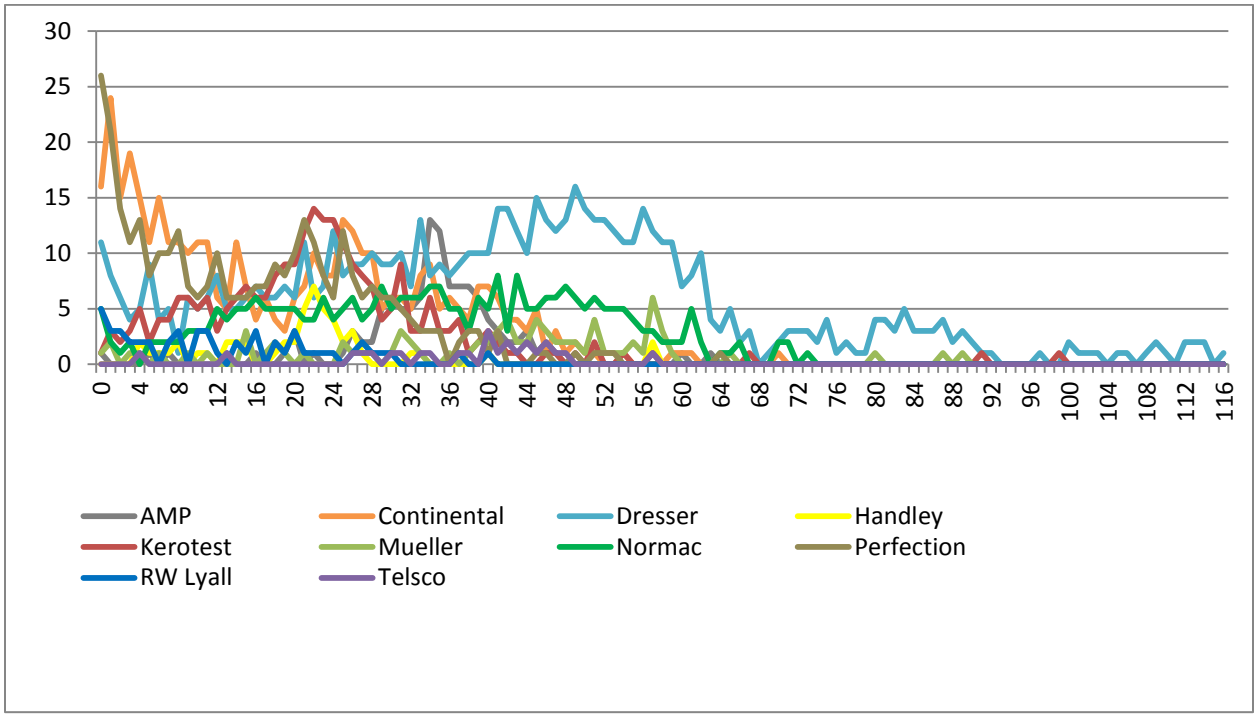
Input: Data analyzed from SAS Computer Application

Output: Figure 8 - Line plot of the number of failures by manufacturer by years of service

Responsibility: MFFR Team

Description: Produce a line plot of the number of failures by manufacturer as reported by operators by years of service on the x-axis. All data will be presented in the plot. An example of what the data table looks like is provided below in Figure 8. From this information, the MFFR Team will develop observations on those manufacturers who do have longer/shorter times in service.

Figure 8 – Example of the line plot of number of failures by top 10 manufacturers by years of service



2.7.3 Frequency of Manufacturers of Fittings

Input: Data analyzed from SAS Computer Application

Output: Table 29 – Manufacturers of failed mechanical fittings

Responsibility: MFFR Team

Description: Produce a table of the frequency of manufacturers reported by operators based on percentage of the data base. Due to the extent of the table, only the top 10 manufacturers are listed. An example of what the data table looks like is provided below in Table 29. The table is read comparing percentages in the year column to the other year column for the various manufacturers. From this information, the MFFR Team will develop observations on prospective view of those manufacturers who have the highest reported number of failures.

The current view of Table 29 shows the last 3 years. Future versions of Table 29 will include additional columns added for each year up to the previous 5 years. From this information, the MFFR Team will develop observations on the changes to the top 10 reported manufacturers.

Table 29. Frequency of manufacturers reported in MFFR data based on percentage of the data, 2011-2013. Top 10 shown.

Manufacturer	2011	2012	2013
Dresser	22%	27%	22%
Kerotest	9%	8%	8%
Normac	5%	7%	4%
Continental	4%	6%	4%
Perfection	4%	8%	5%
AMP	1%	2%	2%
Mueller	<1%	1%	1%
RW Lyall	<1%	1%	<1%
Handley	<1%	<1%	<1%
Telsco	<1%	<1%	<1% (no longer in top 10)

2.7.4 Manufacturer by Year of Failure

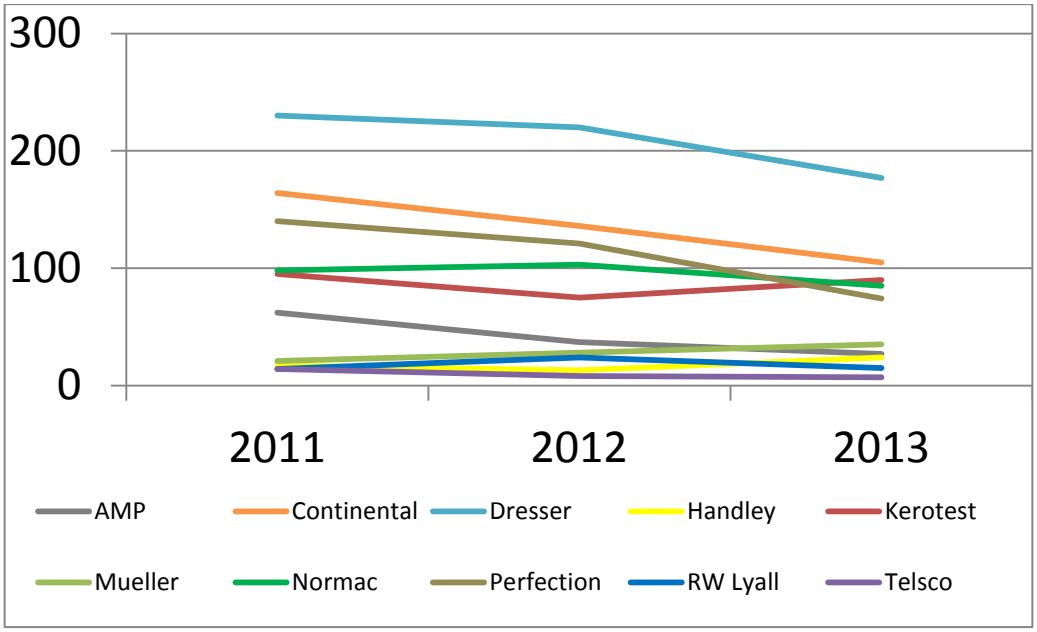
Input: Data analyzed from SAS Computer Application

Output: Figure 9 – Line plot of the number of failures by manufacturer by year of failure

Responsibility: MFFR Team

Description: Produce a line plot of the number of failures by manufacturer as reported by operators by year of failure on the x-axis. All data will be presented in the plot. An example of what the data table looks like is provided below in Figure 9. From this information, the MFFR Team will develop observations on prospective view of those manufacturers who have an upward trend in the number of reported failures.

Figure 9 – Example of the line plot of number of failures by top 10 manufacturers by year of failure



2.7.5 Manufacturer by Leak Causes

Input: Data analyzed from SAS Computer Application

Output: Table 30 – Frequency of manufacturers by reported apparent cause of leak

Responsibility: MFFR Team

Description: Produce a table of manufacturers reported by operators by reported apparent cause of leak (Part C Item 15) based on all data for all years. An example of what the data table looks like is provided below in Table 30. From this information, the MFFR Team will develop observations on manufacturers and leaks causes associated with those manufacturers.

Table 30 – Manufacturers by reported apparent cause of leak

Manufacturer	Equipment	Natural Forces	Corrosion	Excavation Damage	Incorrect Operation	Material or Weld	Other	Other Outside Force Damage
A.Y. MCDONALD	0	0	0	1	0	0	1	0
AMERICAN (AMERICAN ME	0	0	0	0	9	1	1	5
AMP	5	23	1	3	34	259	16	63
APC	0	0	0	0	0	0	0	1
Acron	0	0	0	0	0	0	0	1
Actaris	1	0	0	0	0	0	0	1
Aldyl	0	1	0	0	0	3	3	0
American	0	0	0	0	0	0	1	1
Anvil Red	1	1	0	0	1	1	0	0
BKPVCDRESSER	0	0	0	0	0	0	0	6
Bell	0	0	0	0	0	1	0	0
CENTRAL PLASTICS (GEO	5	5	2	0	9	18	12	7
CON	0	1	0	0	0	0	0	0
COROLLED BEND	0	0	0	0	0	0	1	0
COUPLING SYSTEMS INC	0	0	0	0	0	1	0	0
CSI/SMITH BLAIR/ROCKW	4	14	3	2	4	11	5	26
Chevron	0	0	0	0	0	0	0	1
Chicago	4	8	1	0	10	5	1	118

Manufacturer	Equipment	Natural Forces	Corrosion	Excavation Damage	Incorrect Operation	Material or Weld	Other	Other Outside Force Damage
Classon	0	0	0	0	0	0	0	1
Cleavenger	0	0	0	0	0	2	0	1
Conino	0	0	0	0	2	2	0	2
Continental	35	77	27	16	364	278	75	196
CorrPro	1	0	0	0	0	0	0	0
DAYTON	0	0	0	0	0	0	0	1
DR	0	0	0	0	0	0	0	1
DRISCOLL	1	0	0	0	0	0	0	0
DRS	0	0	2	0	1	2	0	0
Dezuirk	0	2	0	0	0	1	0	1
Dresser	290	966	160	43	329	317	392	2947
Drisco	1	2	1	1	0	2	0	7
Driscopipe	0	0	1	0	0	0	0	0
Driscoplex	0	0	0	0	0	2	0	1
Dupont	0	1	0	1	6	5	3	0
EMCO	0	0	0	0	0	0	1	0
Eastern Eberhard	0	0	0	0	1	2	2	1
Field Built	0	0	0	1	0	0	0	0
Fisher	0	2	0	0	0	2	0	1
Fittings	0	1	0	0	0	0	0	0
Flange Valve	0	0	0	0	0	0	1	0
Flo-Control	0	5	0	0	0	0	0	0
Flodar	0	3	0	0	0	0	0	0
Frialen	0	0	0	0	0	1	0	0
G10	0	0	0	0	1	0	0	0
GTO	1	0	0	0	0	0	0	0

Manufacturer	Equipment	Natural Forces	Corrosion	Excavation Damage	Incorrect Operation	Material or Weld	Other	Other Outside Force Damage
Generic	0	0	3	0	1	6	4	12
Gray Water	0	0	0	0	0	0	0	1
H and H	0	0	0	0	1	0	0	0
Hammond	0	0	0	0	0	0	0	1
Handley	1	6	0	1	9	38	8	19
Hot Dawg	0	0	0	0	0	1	0	0
Inner-tite	45	6	1	0	3	7	2	6
Innogaz	0	0	0	0	0	0	0	1
International	1	0	0	0	1	2	1	0
K	0	0	0	0	0	1	0	0
KBI	0	1	0	0	0	0	0	0
KEYHOLE	0	0	0	0	0	0	0	1
Kerotest	2	108	2	20	56	869	134	787
Latimer-Stevens	0	0	0	0	0	1	0	0
MERCO	0	2	0	0	0	2	0	0
MLR	0	0	0	0	0	0	0	1
MT Deason	0	0	0	0	1	0	1	0
Marpac	0	0	0	0	0	1	0	0
McElroy	0	0	0	0	0	0	0	1
Metfit	5	4	4	0	14	16	4	10
Metlok	0	0	0	0	0	0	0	1
Mueller	7	46	11	1	9	23	10	51
NBK	0	0	0	0	1	0	0	0
NORMAL	0	0	0	0	0	3	0	0
National Meter Parts	0	0	0	0	1	0	0	0
No-Stress mfg	2	0	0	0	0	0	1	0

Manufacturer	Equipment	Natural Forces	Corrosion	Excavation Damage	Incorrect Operation	Material or Weld	Other	Other Outside Force Damage
Nordstrom	0	0	0	0	2	2	0	0
Normac	95	157	26	9	243	137	248	333
OTHER	0	9	3	3	3	0	12	2
PBV-USA INC	0	0	0	0	0	1	0	0
PER	0	0	0	0	2	0	0	0
Perfection	36	53	16	19	509	325	191	184
Perfex	0	2	0	0	0	0	0	0
Performance	0	0	2	0	2	0	1	2
Pergeltion	0	0	0	0	0	3	0	1
Pescore	0	0	0	0	0	0	0	1
Pieyco	0	0	0	0	1	0	0	0
Plasto Net	0	0	0	0	0	1	0	0
Plexco	0	0	0	0	2	11	1	1
Polyvalve	0	0	0	0	0	0	0	1
Powell	0	0	0	0	0	13	0	0
RW Lyall	5	12	19	2	27	33	10	34
RobRoy	6	4	0	0	8	3	7	3
SCH	0	0	0	1	0	0	0	0
SPR	0	0	0	0	0	1	0	0
STYLE 54	0	0	0	0	0	0	1	0
Servi sert	1	0	0	0	0	0	0	0
Skinner	1	7	1	0	1	1	2	3
Spears	0	5	0	0	1	0	0	0
Swagelok	0	0	1	0	0	0	1	1
TD Williamson	0	0	1	0	0	0	0	0
TEARDROP	0	0	1	0	0	0	0	0

Manufacturer	Equipment	Natural Forces	Corrosion	Excavation Damage	Incorrect Operation	Material or Weld	Other	Other Outside Force Damage
Telsco	3	1	1	0	12	14	5	19
US Poly	0	0	1	0	3	1	2	1
Umac	0	0	0	0	0	0	1	0
Unk	654	2778	413	119	605	1183	1402	5282
Uponor	2	5	0	0	3	4	2	6
VIC	1	2	0	0	0	1	1	0
Walworth	0	0	0	0	0	1	0	0
Wayne Mfg	7	9	0	0	6	20	5	16
Welchback	0	0	0	0	0	0	0	1
Williams	0	0	0	0	0	0	0	1
e	0	0	0	0	0	0	1	0
meter set	0	0	1	0	0	0	0	0
pvc	0	0	0	0	0	1	0	0
rcw	0	1	0	0	0	0	0	0

2.7.6 Manufacturer by Mechanical Fitting Involved

Input: Data analyzed from SAS Computer Application

Output: Table 31 – Frequency of manufacturer by mechanical fitting involved

Responsibility: MFFR Team

Description: Produce a table based on all years of manufacturer by mechanical fitting involved. An example of what the data table looks like is provided below in Table 31. From this information, the MFFR Team will develop observations on prospective view of those manufacturers and mechanical fitting involved associated with those manufacturers.

Table 31 – Manufacturers by mechanical fitting type involved

Manufacturer	Nut Follower	Stab	Bolted	Other
A.Y. MCDONALD	2	0	0	0
AMERICAN (AMERICAN ME	2	14	0	0
AMP	19	46	31	308
APC	0	1	0	0
Acron	0	0	1	0
Actaris	2	0	0	0
Aldyl	1	0	0	6
American	1	0	0	1
Anvil Red	4	0	0	0
BKPVCDRESSER	0	0	0	6
Bell	0	0	1	0
CENTRAL PLASTICS (GEO	15	7	6	30
CON	1	0	0	0
COROLLED BEND	0	1	0	0
COUPLING SYSTEMS INC	0	0	1	0
CSI/SMITH BLAIR/ROCKW	21	1	39	8
Chevron	1	0	0	0
Chicago	38	2	1	106
Classon	0	1	0	0
Cleavenger	1	0	0	2
Conino	2	0	0	4
Continental	411	389	173	95
CorrPro	0	1	0	0
DAYTON	0	1	0	0
DR	0	0	0	1
DRISCOLL	0	0	1	0
DRS	2	0	0	3
Dezuirk	1	1	2	0
Dresser	4217	103	846	278
Drisco	2	6	1	5
Driscopipe	0	1	0	0
Driscoplex	0	1	0	2
Dupont	0	1	1	14
EMCO	1	0	0	0
Eastern Eberhard	2	0	4	0
Field Built	0	0	0	1
Fisher	1	0	2	2
Fittings	0	0	0	1
Flange Valve	0	0	1	0
Flo-Control	5	0	0	0
Flodar	1	0	0	2
Frialen	0	0	0	1
G10	1	0	0	0
GTO	0	0	0	1

Manufacturer	Nut Follower	Stab	Bolted	Other
Generic	14	1	0	11
Gray Water	0	1	0	0
H and H	0	0	1	0
Hammond	0	0	1	0
Handley	71	3	0	8
Hot Dawg	0	1	0	0
Inner-tite	56	2	1	11
Innogaz	0	1	0	0
International	5	0	0	0
K	1	0	0	0
KBI	1	0	0	0
KEYHOLE	1	0	0	0
Kerotest	1856	51	14	57
Latimer-Stevens	1	0	0	0
MERCO	4	0	0	0
MLR	0	0	0	1
MT Deason	1	0	0	1
Marpac	0	0	0	1
McElroy	0	0	0	1
Metfit	4	14	2	37
Metlok	0	0	0	1
Mueller	112	8	22	16
NBK	1	0	0	0
NORMAL	3	0	0	0
National Meter Parts	1	0	0	0
No-Stress mfg	0	0	0	3
Nordstrom	1	0	1	2
Normac	1143	22	15	68
OTHER	16	1	5	10
PBV-USA INC	0	0	1	0
PER	0	2	0	0
Perfection	26	1144	61	102
Perfex	2	0	0	0
Performance	0	2	0	5
Pergeltion	0	4	0	0
Pescore	1	0	0	0
Pieyco	0	0	0	1
Plasto Net	0	0	0	1
Plexco	3	7	1	4
Polyvalve	0	0	1	0
Powell	13	0	0	0
RW Lyall	23	45	33	41
RobRoy	24	4	0	3
SCH	0	0	0	1
SPR	0	0	0	1
STYLE 54	0	0	1	0

Manufacturer	Nut Follower	Stab	Bolted	Other
Servi sert	1	0	0	0
Skinner	5	0	10	1
Spears	6	0	0	0
Swagelok	1	0	0	2
TD Williamson	0	0	1	0
TEARDROP	0	0	0	1
Telsco	48	1	2	4
US Poly	0	2	0	6
Umac	1	0	0	0
Unk	6775	1250	1337	3074
Uponor	11	4	1	6
VIC	0	0	5	0
Walworth	0	0	0	1
Wayne Mfg	41	7	0	15
Welchback	0	0	0	1
Williams	1	0	0	0
e	0	1	0	0
meter set	0	0	0	1
pvc	0	0	0	1
rcw	0	0	0	1

2.8 Operators submitting MFFR

The MFFR Team members will analyze the MFFR data and generate the tables and charts outlined in this procedure. Typically the data from PDM is moved into a computer application called “SAS” in which the data is manipulated for analysis. The output from SAS is moved into PowerPoint for presentation and discussion purposes. The most current data is available on the public and internal sides of the PDM. Other evaluations and analyses may be performed depending upon the trends in the data. For instance, the MFFR Team may decide to evaluate the number of MFFR by mile of main or service that an Operator is reporting and on an individual operator basis, as appropriate.

Similar to information provided by manufacturer, PHMSA cautions users of this data analysis on the need to consider the information in the appropriate context (e.g., amount and type of fittings an operator may have in their systems, system mileage, etc.). There is no definitive information publicly available about the number of fittings produced or installed. Many operators do maintain an inventory tracking system of the amount of fittings that may have purchased vs. in stock vs. installed, but numbers can vary. Therefore, PHMSA is unable to adjust the failure reports by the quantity produced or in use. For additional information specific to a certain operator to help put numbers in better context, users are encouraged to contact the operator.

2.8.1 Frequency of Operator Submitting MFFR by Year of Failure

Input: Data analyzed from SAS Computer Application

Output: Table 32 – Frequency of operators reporting fitting failures by year of failure

Responsibility: MFFR Team

Description: Produce a table of operators reporting by year of failure. An example of what the data table looks like is provided below in Table 32. From this information, the MFFR Team will develop observations on prospective view of operators and reports.

Table 32 – Operators reporting by year of failure

Operator Name	2011	2012	2013
ALABAMA GAS CORPORATION	48	48	55
ALLIANT ENERGY – INTERST	0	7	3
AMEREN ILLINOIS COMPANY	136	141	169
AMERENUE	1	2	1
ARKANSAS WESTERN GAS CO	1	1	0
ATLANTA GAS LIGHT CO	140	82	59
ATMOS ENERGY CORPORATION	771	594	646
ATMOS PIPELINE – TEXAS	0	11	51
AUSTELL NATURAL GAS SYST	1	0	0
AUSTIN UTILITIES	0	0	1
AVISTA CORP	19	37	32
BALTIMORE GAS & ELECTRIC	23	15	13
BANGOR GAS CO LLC	1	5	0
BERKSHIRE GAS CO	5	4	17
BLACK HILLS ENERGY	4	6	5
BLACKSTONE GAS CO	0	1	2

Operator Name	2011	2012	2013
BOSTON GAS CO	5	2	1
BRADY MUNICIPAL GAS CORP	0	6	6
BRENHAM UTILITY, CITY OF	3	1	2
CALERA MUNICIPLE GAS SYS	2	0	0
CARTERSVILLE GAS DEPT, C	2	4	1
CASTROVILLE UTILITY SYST	0	1	0
CENTERPOINT ENERGY RESOU	39	160	248
CENTERVILLE, TOWN OF	2	0	0
CENTRAL FLORIDA GAS CORP	0	0	3
CENTRAL HUDSON GAS & ELE	25	27	30
CHATTANOOGA GAS CO	30	33	25
CHESAPEAKE UTILITIES COR	0	15	8
CHESAPEAKE UTILITY CORP	7	0	0
CHEYENNE LIGHT FUEL & PO	0	1	4
CIRCLE PINES UTILITY	3	0	0
CITIZENS GAS & COKE UTIL	190	235	371
CITY OF CALERA NATURAL G	0	1	1
CITY OF ROCKPORT	4	3	1
COLORADO SPRINGS, CITY O	6	7	7
COLUMBIA GAS OF KENTUCKY	13	30	64
COLUMBIA GAS OF MARYLAND	14	20	18
COLUMBIA GAS OF MASSACHU	91	44	95
COLUMBIA GAS OF OHIO INC	359	239	351
COLUMBIA GAS OF PENNSYLV	52	74	89

Operator Name	2011	2012	2013
COLUMBIA GAS OF VIRGINIA	45	60	117
COMMUNITY NATURAL GAS IN	2	0	0
CONNECTICUT NATURAL GAS	16	17	39
CONSOLIDATED EDISON CO O	412	352	417
CONSUMERS ENERGY CO	369	397	470
CONSUMERS GAS UTILITY CO	0	1	0
CORNING MUNICIPAL UTILIT	1	1	3
CORPUS CHRISTI, CITY OF	10	14	6
COVINGTON GAS DEPT, CITY	0	3	0
CPS ENERGY	360	224	253
CULLMAN - JEFFERSON CO G	1	0	0
DANVILLE, CITY OF	1	1	1
DECATUR UTILITIES – GAS	0	1	0
DELMARVA POWER & LIGHT C	1	1	0
DOMINION EAST OHIO	76	63	62
DOMINION HOPE	12	19	19
DTE GAS COMPANY	0	0	8
DUBLIN, CITY OF	4	0	0
DUKE ENERGY KENTUCKY	1	10	11
DUKE ENERGY OHIO	26	78	26
EASTERN NATURAL GAS CO	7	3	0
ELIZABETHTOWN GAS CO	31	21	37
ENERGY NORTH NATURAL GAS	0	0	3
ENERGY WEST MONTANA	7	0	0

Operator Name	2011	2012	2013
ENSTAR NATURAL GAS CO	14	13	2
ENTERGY GULF STATES	4	0	8
ENTERGY NEW ORLEANS, INC	3	5	3
ENTEX, A NORAM ENERGY CO	198	45	0
EQUITABLE GAS COMPANY, L	0	17	32
EQUITABLE RESOURCES (A.K	10	0	0
ESSEX COUNTY GAS CO	0	2	0
FAIRFIELD MUNICIPAL GAS	2	1	0
FAIRHOPE GAS SYSTEM, CIT	0	1	0
FALFURRIAS UTILITY BOARD	0	18	0
FALLS CITY UTILITIES	0	1	0
FAYETTEVILLE PUBLIC UTIL	0	0	2
FITCHBURG GAS & ELECTRIC	2	9	18
FLORENCE GAS DEPT, CITY	3	1	0
FLORIDA CITY GAS	1	0	0
FLORIDA PUBLIC UTILITIES	6	10	7
GAINESVILLE REGIONAL UTI	2	0	0
GREAT PLAINS NATURAL GAS	4	1	0
GREENVILLE UTILITIES COM	2	1	9
GREENWOOD COMMISSION OF	2	9	2
GUYMON MUNICIPAL GAS CO	0	1	0
HALLS GAS DEPT, TOWN OF	1	0	0
HALSTEAD GAS DEPT, CITY	0	1	0
HAMILTON GAS DEPT, CITY	8	8	10

Operator Name	2011	2012	2013
HASTINGS UTILITIES	2	0	0
HAWAI`IGAS	0	0	11
HAWARDEN GAS DEPT, CITY	1	2	2
HOLYOKE GAS & ELECTRIC D	0	1	0
HUMBOLDT UTILITIES – GAS	13	17	9
HUNTSVILLE GAS SYSTEM	13	9	13
INDIANA GAS CO INC	87	66	61
INTERMOUNTAIN GAS CO	9	4	3
JACKSON ENERGY AUTHORITY	44	19	31
KANSAS GAS SERVICE	89	68	62
KEYSPAN ENERGY DELIVERY	1	0	0
KEYSTONE RURAL GAS DISTR	2	1	2
KNG ENERGY INC	2	0	0
KNOXVILLE UTILITIES BOAR	6	7	12
LACLEDE GAS CO	181	11	0
LAKE APOPKA NATURAL GAS	4	2	0
LAKE PARK MUNICIPAL UTIL	1	0	0
LANCASTER MUNICIPAL GAS	10	4	5
LAS CRUCES, CITY OF	1	4	1
LAWRENCEBURG GAS DEPT, C	16	10	8
LAWRENCEVILLE, CITY OF	0	1	1
LEBO MUNICIPAL GAS SYSTE	1	0	0
LEFORS GAS DEPT, CITY OF	0	1	0
LEWISBURG GAS DEPARTMENT	3	0	1

Operator Name	2011	2012	2013
LEXINGTON GAS SYSTEM	7	8	5
LIBERTY UTILITIES MASSAC	0	0	8
LITTLE RIVER MUNICIPAL S	0	0	1
LIVE OAK GAS DEPT, CITY	0	1	0
LONG BEACH GAS DEPT, CIT	9	7	7
LOUISVILLE GAS & ELECTRI	167	174	207
LYTLE MUNICIPAL SYSTEM	0	1	0
MADISON GAS & ELECTRIC C	2	2	3
MADISON, CITY OF	5	9	0
MARIANNA, CITY OF	1	1	2
MARSHALL COUNTY GAS DIST	5	7	11
MEMPHIS LIGHT GAS & WATE	106	247	545
METROPOLITAN UTILITIES D	4	2	0
MICHIGAN CONSOLIDATED GA	2	5	0
MICHIGAN GAS UTILITIES C	19	30	29
MIDAMERICAN ENERGY COMPA	41	58	38
MIDDLEBOROUGH GAS & ELEC	5	0	0
MIDWEST NATURAL GAS CORP	2	0	3
MIDWEST NATURAL GAS INC	1	0	0
MINNESOTA ENERGY RESOURC	1	1	0
MISSISSIPPI RIVER GAS LL	2	1	0
MISSOURI GAS ENERGY	1	1	0
MOBILE GAS SERVICE CORP	15	8	14
MONROE NATURAL GAS DEPT,	0	0	1

Operator Name	2011	2012	2013
MONTANA - DAKOTA UTILITI	23	23	20
MOULTON MUNICIPAL GAS SY	0	0	1
MOULTRIE GAS DEPT, CITY	1	0	0
MOUNTAINEER GAS CO	7	5	5
MT CARMEL PUBLIC UTILITY	0	1	0
NATIONAL FUEL GAS DISTRI	62	97	135
NATIONAL GAS & OIL CORP	23	21	67
NAVASOTA, CITY OF	0	4	2
NEBRASKA CITY UTILITIES	1	0	0
NEW ALBANY GAS SYSTEM	5	0	0
NEW ENGLAND GAS COMPANY	3	5	1
NEW JERSEY NATURAL GAS C	20	34	47
NEW MEXICO GAS COMPANY	116	84	77
NEW YORK STATE ELECTRIC	0	23	34
NIAGARA MOHAWK POWER COR	8	4	2
NORTH SHORE GAS CO	4	33	1
NORTHERN ILLINOIS GAS CO	780	426	350
NORTHERN INDIANA PUBLIC	139	127	274
NORTHERN STATES POWER CO	86	43	73
NORTHERN UTILITIES INC (	1	0	0
NORTHWEST ALABAMA GAS DI	0	1	2
NORTHWEST NATURAL GAS CO	20	27	9
NORTHWESTERN ENERGY LLC	13	5	5
NORWICH DEPT OF PUBLIC U	0	1	0

Operator Name	2011	2012	2013
NSTAR GAS COMPANY	0	1	0
NV Energy	13	18	52
OHIO GAS CO	3	2	0
OKLAHOMA NATURAL GAS CO	15	8	0
OKLAHOMA NATURAL GAS COM	0	0	23
ORANGE & ROCKLAND UTILIT	0	0	48
PACIFIC GAS & ELECTRIC C	229	288	295
PALO ALTO, CITY OF	1	2	0
PECO ENERGY CO	7	15	4
PENSACOLA, ENERGY SERVIC	4	26	7
PEOPLES GAS LIGHT & COKE	68	107	138
PEOPLES GAS SYSTEM INC	8	9	16
PEOPLES NATURAL GAS COMP	21	20	36
PEOPLES TWP LLC	3	5	3
PHILADELPHIA GAS WORKS	248	203	425
PIEDMONT NATURAL GAS CO	3	58	76
POWELL CLINCH UTIL DIST	0	2	3
PRESQUE ISLE ELECTRIC &	1	2	1
PUBLIC SERVICE CO OF COL	139	95	112
PUBLIC SERVICE CO OF NOR	11	7	24
PUBLIC SERVICE ELECTRIC	71	38	64
PUGET SOUND ENERGY	38	40	19
QUESTAR GAS COMPANY	33	45	1
RELIANT ENERGY ARKLA, DI	56	0	0

Operator Name	2011	2012	2013
REMSEN MUNICIPAL UTILITI	0	0	1
RICHMOND, CITY OF	41	47	52
ROANOKE GAS CO	10	16	27
ROBSTOWN GAS SYSTEM, CIT	2	0	0
ROCHESTER GAS & ELECTRIC	0	11	28
ROCKY MOUNT MUNICIPAL SY	4	0	0
ROZEL MUNICIPAL GAS SYST	1	1	0
SAN DIEGO GAS & ELECTRIC	0	2	2
SAVANNAH PUBLIC UTILITY	3	1	0
SEMCO ENERGY GAS COMPANY	50	50	33
SEVIER COUNTY UTIL DIST	0	3	1
SOMERSET GAS SERVICE	4	2	11
SOURCEGAS ARKANSAS INC.	0	0	5
SOURCEGAS LLC	5	2	5
SOUTH ALABAMA GAS DISTRI	7	0	0
SOUTH CAROLINA ELECTRIC	101	77	50
SOUTH JERSEY GAS CO	26	36	30
SOUTHEASTERN NATURAL GAS	1	0	0
SOUTHERN CALIFORNIA EDIS	0	0	1
SOUTHERN CALIFORNIA GAS	0	23	27
SOUTHERN CONNECTICUT GAS	15	7	20
SOUTHERN INDIANA GAS & E	121	93	91
SOUTHERN PUBLIC SERVICE	1	0	0
SOUTHWEST GAS CORP	116	178	192

Operator Name	2011	2012	2013
SOUTHWESTERN VIRGINIA GA	2	6	10
SPRINGFIELD GAS SYSTEM	0	2	0
SPRINGFIELD, CITY UTILIT	56	40	71
SUBURBAN NATURAL GAS COM	1	0	0
SUGAR HILL NATURAL GAS S	2	0	0
SUPERIOR WATER LIGHT & P	0	7	3
SWEENY GAS SYSTEM, CITY	0	0	6
SYCAMORE GAS COMPANY	4	8	4
TALLAHASSEE, CITY OF	29	0	0
TEAVEE OIL & GAS INC	0	0	1
TEXAS GAS SERVICE COMPAN	92	145	113
THE EMPIRE DISTRICT GAS	3	1	1
THE GAS COMPANY	16	20	1
TRUSSVILLE, UTILITIES BO	1	5	7
UGI CENTRAL PENN GAS, IN	5	9	1
UGI PENN NATURAL GAS	199	115	105
UGI UTILITIES, INC	143	140	207
UNION OIL & GAS INC	0	1	7
UNION UTILITY DEPT, CITY	3	0	0
UNISOURCE ENERGY SERVICE	3	13	12
VALLEY ENERGY, INC.	2	1	46
VECTREN ENERGY DELIVERY	44	17	33
VERMONT GAS SYSTEMS INC	5	16	4
VILLAGE OF MORTON	1	0	0

Operator Name	2011	2012	2013
VIRGINIA NATURAL GAS	16	41	116
WALNUT MUNICIPLE GAS SYS	1	2	0
WASHINGTON GAS LIGHT CO	238	296	1
WATERVILLE GAS & OIL CO	2	1	3
WE ENERGIES	12	0	0
WEST TEXAS GAS INC	0	0	4
WILLMUT GAS & OIL CO	4	3	1
WILSON GAS DEPT, CITY OF	0	11	4
WISCONSIN ELECTRIC POWER	0	1	0
WISCONSIN GAS CO	7	0	0
WISCONSIN GAS LLC DBA WE	0	38	219
WISCONSIN PUBLIC SERVICE	4	4	1
YANKEE GAS SERVICES CO	140	121	164
YORK COUNTY NATURAL GAS	0	0	1

3.0 Future Analysis Ideas and Concepts

With the collection of additional years of data the MFFR can be viewed as a sample in time. The additional years of data will allow for the application of the appropriate statistics. The format of the tables and figures will need to change over time to accommodate the additional information.

3.1 Limitations

Due to the nature of the data some types of analysis cannot be accomplished. For example, some analysis requires multiple years' worth of information. For surveillance systems, 5 years is the generally accepted minimum. Once that threshold is met, the MFFR is still a surveillance system. The largest limitation facing MFFR is the absent of denominator information. The information of how many and what type of fittings were installed and where the fittings were installed is not available. Another limitation that is common among surveillance systems is issues with the interpretation of the report form itself. The MFFR team has made attempts to edit any potential misunderstandings with the report form and instructions for the report form. Also, as with any other surveillance system, there is the variance of data quality between reports. An example would be the naming convention of manufacturers.

3.2 Updates

Data submitted for 2013 shows similar trends to the previous years of data. A couple of additional tables were added in 2013, 2.7.6 and 2.8.1. The operator data table, 2.8.1, created a new section 2.8. At this time no other additional analysis has been identified for inclusion.

In the future, the Team plans on including in the annual report supplemental items, such as a historical list of updates or changes to the form, updates to the electronic submittal process, discussion of advisory bulletins pertaining to MFFR, etc.

4.0 Technical Review and Analysis

Input: Figures, Tables, Data generated from Analysis in Section 2

Output: This procedure with updated tables and figures inserted into the document or other appropriate documentation

Responsibility: MFFR Team

Description: The MFFR Team will meet to discuss the initial analysis, vet concepts and ideas about what the data analysis represents, and potential additional analysis. The meetings will be held in person or via web-based meeting. Meeting minutes documenting initial observations and recommendations will be distributed for comments and review internally within PHMSA.

Following MFFR Team annual discussions of the data and analysis, observations and recommendations will be documented in an electronic format suitable for transmission and filling. This documentation is typically the completion of this procedural document. Other documentation may include more informal dissemination of information through the DIMP website or presentations and discussion with stakeholders, or if more formal action is needed, a Memorandum, Technical Report, Advisory Bulletin, or email transmission to PHMSA personnel. The analysis should include consideration and discussion of, but not limited to, the following:

- Trends in data analysis
- Suspect materials, specific models of mechanical fittings, etc.
- Identification of issues that represent a threat to the integrity of the nation's distribution pipeline system
- Areas of concern identified by the MFFR Team

4.1 Overview of Analysis

No action is being taken at this time based on the findings because we are seeing what was expected when we initiated this information collection activity; trends are holding steady with 3 years of data; and from the data analysis, it appears 5 years' worth of data will be needed to make statistically valid decisions. Communication of Performance Data is through the DIMP web page. To view MFFR data, go to: http://primis.phmsa.dot.gov/dimp/perfmeasures.htm

Total Report Submitted Numbers (03/31/2014):

MFFRs submitted in 2011 – 8349
MFFRs submitted in 2012 – 7585
MFFRs submitted in 2013 – 9240

In summary, data submitted for 2013 shows similar trends to previous 2 years of data collection. The majority of mechanical fitting failures resulting in a hazardous leak involve nut-follower, coupling type fittings. Valves are involved in 14% of reported failures. Equipment failure is the leading reported cause of leaks (41%), and Natural forces is second (17%). The majority of leaks occur outside (98%), belowground (87%) involving service-to-service connections (60%). Steel fittings (62%) are involved the majority of reports, and plastic fittings are second (26%). The rate of hazardous leaks repaired involving a mechanical fitting for 2013 is the number of MFFR (9240) divided by the total number of hazardous leaks reported as eliminated/repaired in 2013 (189,802) which is 4.9%.