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 Joint Failure Reporting Requirements

Mechanical Joint Failure Reports (MJFR) 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. This 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 of §192.1009 are:

> *§192.1009 What must an operator report when compression couplings fail?*
> *(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 MJFR 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 MJFR 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 MJFR 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 team's perspective will be documented by the MJFR Team in an electronic format suitable for transmission and filling. 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 MJFR team is comprised of PHMSA engineers, data analysts and other staff. Raw data and analysis on MJFR is available to the public at http://primis.phmsa.dot.gov/dimp/perfmeasures.htm .

1.0 Receipt of Data and Initial Processing

The MJFR Team will obtain the previous calendar year's data from the PDM approximately one month following the deadline to allow for quality checks to be performed on the data by PHMSA IT personnel. The MJFR 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 MJFR Team will begin analysis.

To better unitize the data submitted in the process, the MJFR Team categorizes the various spellings of manufactures uploaded into the data. The MJFR Team keeps the original submitted manufacturer name and the categorized name. The analysis is performed strictly on the categorized names.

2.0 Data Triaging and Analyses

The MJFR Team members will analyze the MJFR 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. Other evaluations and analyses may be performed depending upon the analysis.

2.1 Gather Information to Support Analysis and Review of Data

Input: Excel Spreadsheet from PDM based on data received as of March 31, 2016

Output: Various tables and charts

Responsibility: MJFR Team

Description: The MJFR Team will use the following spreadsheets and tables to gather data in appropriate formats to support the analysis and review:

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 MJFR 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 Time to Failure by Fitting Material	Average and range 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
2.3.4 Fitting Material by Apparent Cause of Leak	Fitting Material (Part C Item 13) by Leak Cause (Part C Item 15)	Table 7
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 8
2.4.1 Apparent Causes of Leaks	Leak cause from cause categories (Part C Item 15)	Figure 2 and Table 9
2.4.2 Leak Cause Expanded	Leak causes expanded (Part C Item 15)	Table 10
2.5.1 Mechanical Fitting Involved	Mechanical Fitting Involved (coupling, adaptor, etc.) (Part C Item 4)	Figure 3 and Table 11
2.5.2 Mechanical Fitting Type	Mechanical Fitting Type (nut follower, stab, etc.) (Part C Item 3)	Figure 4 and Table 12
2.5.3 Fitting Material by Mechanical Fitting Involved	Fitting Material (Part C Item 13) by Mechanical Fitting Involved (Part C Item 3)	Tables 13, 14
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 15
2.6.1 Leak Location	Aboveground/Belowground, Outside/Inside and Meter/Service (Part C Item 5)	Figure 5 and Table 16
2.6.2 How the Leak Occurred	Leaked Through Seal, Leaked Through Body, or Pulled Out (Part C Item 16)	Figure 6
2.6.3 Top 10 States reporting, Top 10 Steel State, and Top 10 Plastic States	Top 10 States reporting, Top 10 Steel State, and Top 10 Plastic States (Part C Items 1 & 13)	Table 17, 18, 19

Description of Data to be analyzed	Description of Data Source(s)	Typical Output
2.6.4 States by Cause	States reporting by causes of leaks (Part C Items 1 & 15)	Table 20
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 21
2.6.6 Leak Location (inside or outside) by Fitting Material	Fitting Material by Location (inside or outside) (Part C Items 5 & 13)	Table 22
2.6.7 Leak Location (service type) by Fitting Material	Fitting Material by Location (service type) (Part C Items 5 & 13)	Table 23
2.7 Quantification of the Role of Mechanical Joints in Hazardous Leaks	Total Number of MJFR submitted each year & Total Number of hazardous leaks repaired or replaced each year from PHMSA reports (primis.phmsa.dot.gov/dimp/perfmeasures.htm)	Table 24
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 25
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 26
2.7.6 Manufacturer by Mechanical Fitting Involved	All years of manufacturer by mechanical fitting type involved (Part C Items 3 & 9)	Table 27
2.8.1 Operator by Year of Failure	Operators reporting by year of failure (Part A Item 2 & Part C Item 2)	Table 28
4.1 Overview of Analysis	Graphic representation of MJFR by year	Figure 10, Figure 11, & Table 29

2.2 General information from MJFR reports

2.2.1 General Overview of the MJFR Information

Input: Original Excel Spreadsheet from PDM

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

Responsibility: MJFR Team

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

Table 1. General overview of the Mechanical Joint Failure Reports, 2011-2015, as of 09/18/2016

	2011	2012	2013	2014	2015
Number of Reports	8342	7607	9922	11718	12865
Number of Reporting Operators	187	191	178	178	177
Number of states of origin	50 and DC	50 and DC	48 and DC	50 and DC	49 and DC
Number of Manufacturers	39	37	42	43	37
Percent of Missing Manufacturers	51%	47%	52%	52%	54%

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: MJFR Team

Description: General information about the year manufactured and/or installed the amounts 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 MJFR 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 manufactured of mechanical fittings reported in Mechanical Joint Failure Reports, 2011-2015

	2011	2012	2013	2014	2015
Percent Missing Year of Manufacture	89%	88%	89%	88%	88%
Percent Missing Year of Installation	42%	36%	38%	32%	38%
Average Time to Failure and Range	33 Years (0 - 124)	33 Years (0 – 132)	34 Years (0 – 121)	37 Years (0-124)	38 Years (0-123)

*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: MJFR Team

Description: Produce a table of 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 MJFR 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 to the Mechanical Joint Failure Reports, 2011-2015

	2011 Count (%)	2012 Count (%)	2013 Count (%)	2014 Count (%)	2015 Count (%)
Pre 1940s	41 (2%)	22 (3%)	15 (3%)	14 (4%)	88 (18%)
1940s	23 (1%)	6 (1%)	25 (5%)	13 (4%)	27 (6%)
1950s	191 (11%)	70 (9%)	59 (13%)	31(8%)	56 (12%)
1960s	337 (19%)	168 (21%)	91 (19%)	53(14%)	60(13%)
1970s	483 (27%)	232 (29%)	122 (25%)	81 (22%)	98 (21%)
1980s	379 (21%)	185 (24%)	82 (17%)	101 (27%)	95 (20%)
1990s	155 (9%)	60 (8%)	51 (11%)	59 (15%)	37 (7%)
2000s	164 (9%)	33 (4%)	27 (6%)	15 (4%)	10 (2%)
2010s	5 (1%)	6 (1%)	3 (1%)	6 (2%)	1 (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: MJFR Team

Description: Produce a table of average and range 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 manufactured 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 there year of install is reported more, table 4 will use year of install. From this information, the MJFR 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 to the Mechanical Joint Failure Reports, 2011-2015

	2011	2012	2013	2014	2015
	Average (Range)	Average (Range)	Average (Range)	Average (Range)	Average (Range)
Steel	39 (0 – 124)	41 (0 – 117)	42(0 – 113)	44 (0-124)	46 (0-123)
Plastic	21 (0 – 70)	21 (0 – 87)	22 (0 – 84)	23 (0-115)	25 (0-102)
Combination (Steel and Plastic)	26 (0 – 76)	20 (0 – 90)	22 (0 – 113)	23 (0-115)	26 (0-90)
Unknown	42 (0 – 71)	37 (1 – 61)	39 (3 – 60)	43 (2-86)	48 (2-116)
Other	50 (0 – 111)	51 (1 – 117)	49 (0 – 121)	37 (2-113)	33 (0-94)
Brass	41 (0 – 82)	45 (0 – 132)	43 (0 – 69)	46 (1-113)	46 (0-95)

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: MJFR 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 MJFR 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 to the Mechanical Joint Failure Reports, 2011-2015

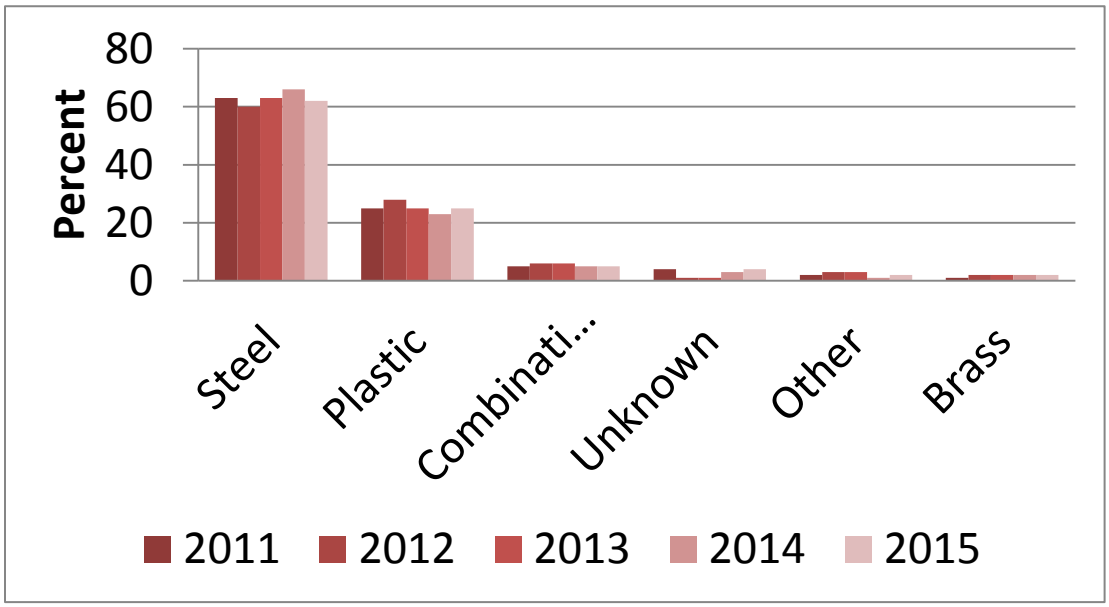


Table 5. Frequency of mechanical fittings by material type reported to the Mechanical Joint Failure Reports, 2011-2015

	2011 Count (%)	2012 Count (%)	2013 Count (%)	2014 Count (%)	2015 Count (%)
Steel	5239 (63%)	4610 (60%)	6260 (63%)	7670 (66%)	7957 (62%)
Plastic	2071 (25%)	2097 (28%)	2498 (25%)	2735 (23%)	3161 (25%)
Combination (Steel and Plastic)	455 (5%)	450 (6%)	555 (6%)	567 (6%)	698 (5%)
Unknown	344 (4%)	94 (1%)	127 (1%)	364 (3%)	518 (4%)
Other	165 (2%)	192 (3%)	297 (3%)	127 (1%)	263 (2%)
Brass	82 (1%)	171 (2%)	93 (2%)	93 (2%)	257 (2%)

2.3.3 Comparison of First Pipe Material by Second Pipe Material Type

Input: Data analyzed from SAS Computer Application

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

Responsibility: MJFR 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 provides a summary of all the data submitted. From this information, the MJFR 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 to the Mechanical Joint Failure Reports, (all years) 2011-2015

	Second Pipe Material Type							
First Pipe Material Type		**Cast/Wro**	**Copper**	**Ductile**	**Other**	**Plastic**	**Steel**	**Unknown**
	Cast/Wro	608 (1%)	8	12	1	48	69	3
	Copper	13	1075 (2%)	0	2	216	281	79
	Ductile	33	0	764 (1%)	0	6	7	0
	Other	0	5	0	81 (<1%)	9	1333	0
	Plastic	36	89	6	18	14544 (29%)	3129	40
	Steel	39	183	8	203	2751	23877 (47%)	136
	Unknown	0	2	0	1	18	26	513 (1%)

2.3.4 Fitting Material by Leak Cause

Input: Data analyzed from SAS Computer Application

Output: Table 7 - Fitting material by leak cause

Responsibility: MJFR 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 7. The table is read comparing percentages in the year column to the other year column for the various causes and fitting material. From this information, the MJFR Team will develop observations on frequency of leak causes by material type.

Table 7. Fitting material by leak cause of mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, 2011-2015

	Corrosion	**Equipment**	**Excavation**	**Incorrect Operation**	**Material or Weld**	**Natural Forces**	**Other**	**Other Outside Forces**
Steel	7%	48%	3%	4%	6%	22%	9%	1%
Plastic	0%	30%	2%	22%	30%	6%	9%	1%
Combination	7%	21%	2%	18%	30%	11%	9%	2%
Unknown	5%	24%	5%	10%	4%	48%	3%	1%
Other	7%	31%	2%	2%	9%	33%	15%	1%
Brass	5%	58%	5%	2%	12%	13%	4%	1%
Total	5%	42%	3%	9%	14%	17%	9%	1%

2.3.5 Sizes of Pipe being Joined

Input: Data analyzed from SAS Computer Application

Output: Table 8 - Comparisons of first pipe and second pipe sizes being joined where mechanical fitting failure occurred

Responsibility: MJFR 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 8. First pipe size is reflected in the rows and Second pipe size is reflected in the columns. From this information, the MJFR Team will develop observations on the number of reported failures from joining various pipe sizes with mechanical fittings.

Table 8. Sizes of pipe being joined by mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, (all years) 2011-2015

	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	97 (<1%)	48	26	7	3	3	0	2	0	0	0	0
½ inch	46	7304 (15%)	2305	620	26	22	0	157	5	17	5	2
¾ inch	18	1182	8646 (17%)	286	43	37	0	226	9	25	6	4
1 inch	8	424	346	11447 (24%)	105	62	2	77	9	23	8	3
1 ¼ inch	4	95	107	211	2001 (5%)	537	1	59	11	13	4	2
1 ½ inch	0	5	6	24	20	253 (1%)	0	1	0	1	0	1
1 ¾ inch	0	1	3	1	2	1	3 (0%)	0	0	0	0	0
2 inch	2	435	378	260	53	67	5	6695 (14%)	25	12	8	4
3 inch	0	19	29	33	7	13	0	31	243 (1%)	5	1	0
4 inch	0	46	36	70	17	16	0	39	7	825 (2%)	11	1
6 inch	0	13	9	21	4	9	0	17	8	6	780 (2%)	1
8 inch or larger	1	40	42	64	3	868	0	21	7	3	14	692 (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 9 - Frequency of leak causes

Responsibility: MJFR 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 9 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 MJFR Team will develop observations on the distribution of leak cause.

Figure 2. Frequency of leak causes of mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, 2011-2015

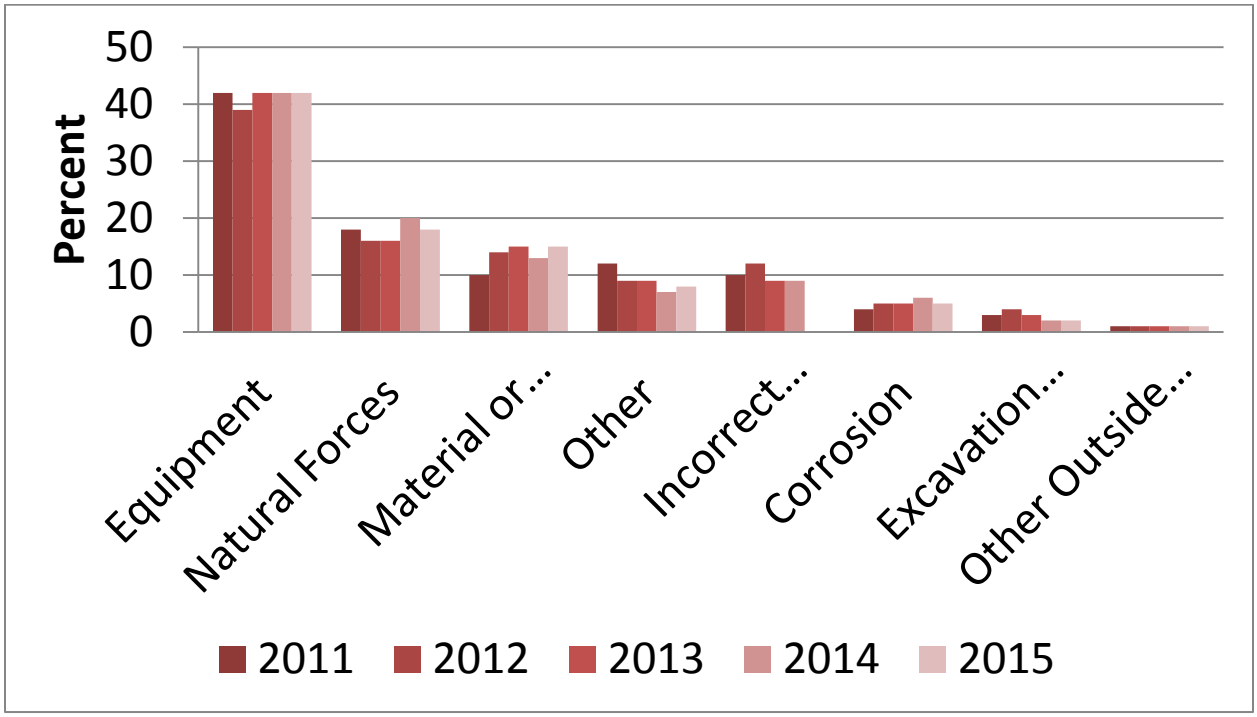


Table 9. Frequency of leak causes of mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, 2011-2015

	2011 Count (%)	2012 Count (%)	2013 Count (%)	2014 Count (%)	2015 Count (%)
Equipment	3506 (42%)	2985 (39%)	4214 (42%)	4898 (42%)	5445 (42%)
Natural Forces	1558 (18%)	1201 (16%)	1614 (16%)	2336 (20%)	2318 (18%)
Material or Weld	802 (10%)	1093 (14%)	1483 (15%)	1571 (13%)	1994 (15%)
Other	1003 (12%)	718 (9%)	880 (9%)	852 (7%)	970 (8%)
Incorrect Operation	807 (10%)	876 (12%)	910 (9%)	1067 (9%)	1097 (9%)
Corrosion	332 (4%)	389 (5%)	534 (5%)	692 (6%)	654 (5%)
Excavation	229 (3%)	266 (4%)	223 (3%)	255 (2%)	294 (2%)
Other Outside Force Damage	105 (1%)	79 (1%)	62 (1%)	47 (1%)	82 (1%)

2.4.2 Leak Causes Expanded

Input: Data analyzed from SAS Computer Application

Output: Table 10 - Frequency of leak causes (expanded)

Responsibility: MJFR 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 10. The table is read comparing percentages in the year column to the other year column for the various questions. From this information, the MJFR Team will develop observations on any issues identified in specific leak causes.

Table 10. Frequency of leak causes expanded information of mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, 2011-2015

Question	Responses	2011 Count (%)	2012 Count (%)	2013 Count (%)	2014 Count (%)	2015 Count (%)
Leak Cause Natural Forces Thermal Expansion / Contraction	**No**	762 (57%)	650 (59%)	792 (50%)	856 (37%)	944 (41%)
	Yes	573 (43%)	459 (41%)	777 (50%)	1469 (63%)	1359 (59%)
Leak Cause Material/Welds	**Construction/Installation Defect**	174 (21%)	311 (28%)	456 (31%)	396 (25%)	712 (35%)
	Design Defect	628 (78%)	782 (72%)	1027 (69%)	1175 (75%)	1282 (65%)
Leak Cause Excavation Damage	**At time of leak discovery**	166 (75%)	228 (86%)	194 (87%)	229 (90%)	262 (89%)
	Previous to leak discovery	54 (25%)	36 (14%)	28 (13%)	25 (10%)	32 (11%)

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 11 – Frequency of applications where failures are occurring

Responsibility: MJFR 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 11 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 MJFR 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 to the Mechanical Joint Failure Reports, 2011-2015

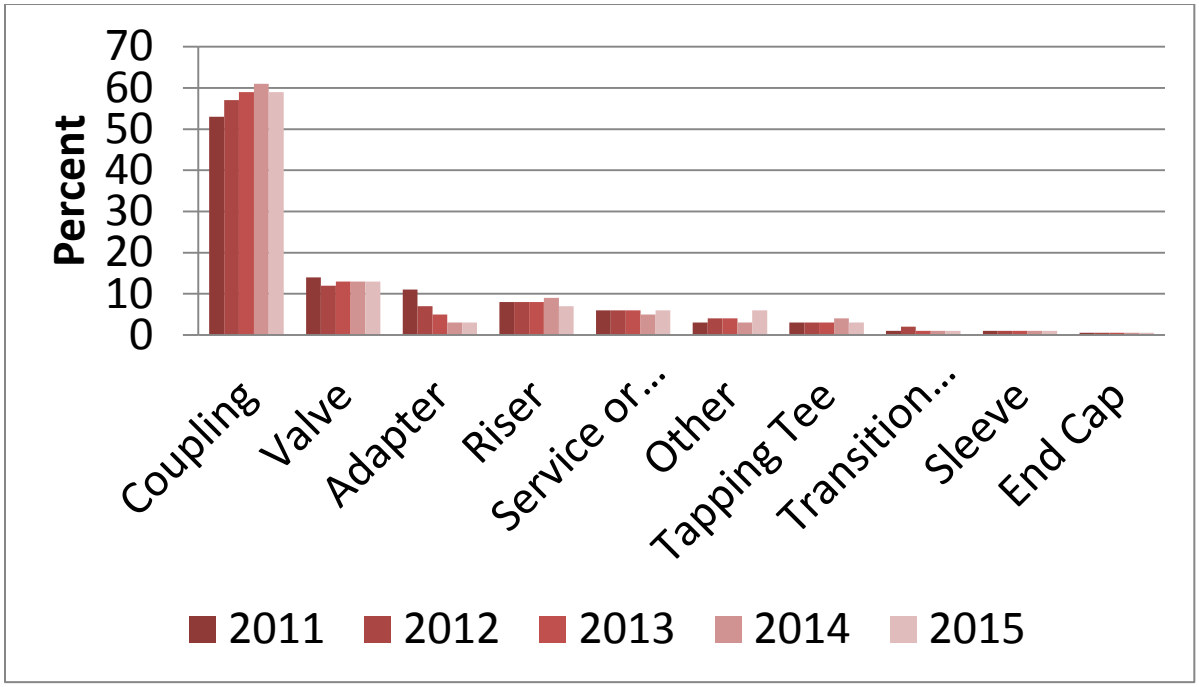


Table 11. Frequency of mechanical fitting involved of mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, 2011-2015

	2011 Count (%)	2012 Count (%)	2013 Count (%)	2014 Count (%)	2015 Count (%)
Coupling	4421 (53%)	4363 (57%)	5853 (59%)	7131 (61%)	7595 (59%)
Valve	1196 (14%)	908 (12%)	1339 (13%)	1545 (13%)	1734 (13%)
Adapter	877 (11%)	507 (7%)	493 (5%)	387 (3%)	442 (3%)
Riser	700 (8%)	602 (8%)	761 (8%)	985 (9%)	926 (7%)
Service or Main Tee	471 (6%)	502 (6%)	571 (6%)	615 (5%)	777 (6%)
Other	275 (3%)	301 (4%)	360 (4%)	364 (3%)	738 (6%)
Tapping Tee	211 (3%)	205 (3%)	318 (3%)	444 (4%)	351 (3%)
Transitional	98 (1%)	139 (2%)	140 (1%)	109 (1%)	127 (1%)
Sleeve	66 (1%)	55 (1%)	51 (1%)	103 (1%)	61 (1%)
End Cap	27 (<1%)	25 (<1%)	34 (<1%)	33 (<1%)	51 (<1%)

2.5.2 Chart of Mechanical Fitting Type

Input: Data analyzed from SAS Computer Application

Output: Figure 4 and Table 12 - Frequency of failure by type of mechanical fitting

Responsibility: MJFR 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 12 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 mechanical fitting types. From this information, the MJFR 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 to the Mechanical Joint Failure Reports, 2011-2015

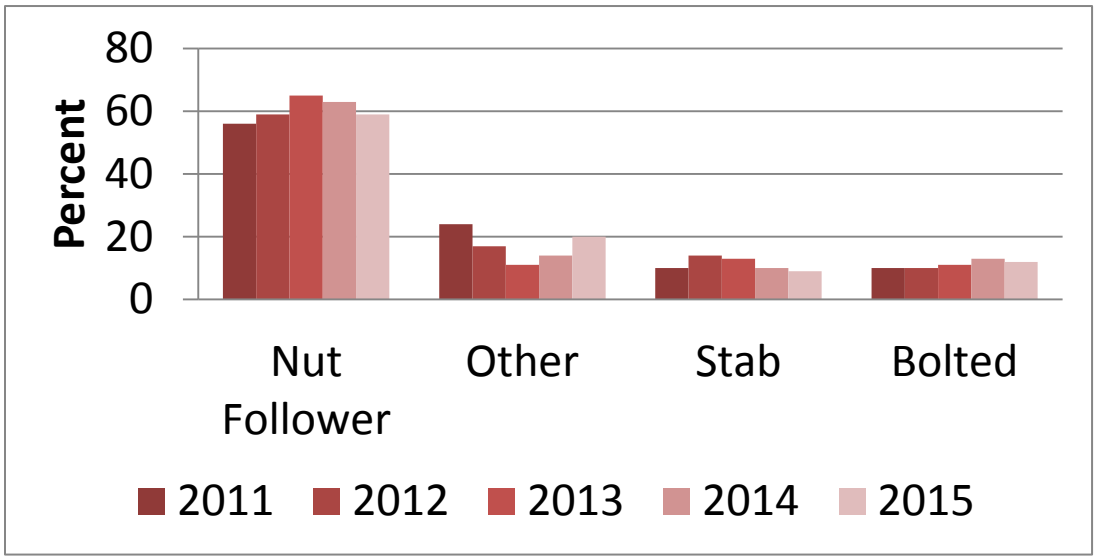


Table 12. Frequency of mechanical fitting type of mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, 2011-2015

	2011 Count (%)	2012 Count (%)	2013 Count (%)	2014 Count (%)	2015 Count (%)
Nut Follower	4715 (56%)	4457 (59%)	6449 (65%)	7373 (63%)	7585 (59%)
Other	2011 (24%)	1286 (17%)	1126 (11%)	1719 (14%)	2586 (20%)
Stab	812 (10%)	1084 (14%)	1262 (13%)	1159 (10%)	1117 (9%)
Bolted	804 (10%)	780 (10%)	1083 (11%)	1467 (13%)	1566 (12%)

2.5.3 Material of Mechanical Fitting Involved

Input: Data analyzed from SAS Computer Application

Output: Table 13 and Table 14 - Frequency of failure of material of mechanical fitting involved

Responsibility: MJFR 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 year column to the other year column for the various fitting material and types. Table 14 is provided with all the data across the reporting years and is read comparing the percentages across the rows. From this information, the MJFR Team will develop observations on which type of mechanical fitting is most likely from the various material types.

Table 13. Frequency of material of mechanical fitting involved of mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, 2012-2015

	Bolted				Nut Follower				Stab				Other			
	2012	2013	2014	2015	2012	2013	2014	2015	2012	2013	2014	2015	2012	2013	2014	2015
Steel	10%	10%	14%	10%	69%	75%	70%	69%	4%	4%	1%	1%	17%	11%	15%	20%
Plastic	7%	7%	9%	10%	37%	44%	44%	41%	40%	36%	34%	30%	16%	13%	13%	19%
Combo	4%	3%	6%	20%	59%	59%	49%	46%	16%	20%	21%	13%	21%	18%	24%	21%
Unk	7%	6%	13%	60%	87%	80%	58%	33%	4%	1%	1%	1%	2%	13%	28%	6%
Other	65%	81%	32%	10%	20%	15%	59%	30%	1%	1%	3%	1%	14%	3%	6%	59%
Brass	10%	3%	5%	5%	77%	93%	88%	91%	1%	2%	4%	1%	12%	2%	3%	3%
Total	10%	11%	12%	12%	59%	65%	63%	59%	14%	13%	10%	9%	17%	11%	15%	20%

Table 14. Frequency of material of mechanical fitting involved of mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, all years combined 2011-2015

	Bolted	Nut Follower	Stab	Other
Steel	10%	59%	2%	29%
Plastic	6%	51%	31%	12%
Combination	3%	55%	13%	29%
Unknown	6%	70%	1%	23%
Other	58%	35%	2%	5%
Brass	12%	66%	4%	18%
Total	10%	56%	10%	24%

2.5.4 Fitting Material by Type of Mechanical Fitting

Input: Data analyzed from SAS Computer Application

Output: Table 15 - Frequency of failure of material of mechanical fitting by its application

Responsibility: MJFR 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 15. The table is read comparing percentages in the year column to the other year column for the various mechanical fitting and fitting material. From this information, the MJFR Team will develop observations based on percentages of material type and type of fitting.

Table 15. Frequency of fitting material by type of mechanical fitting of mechanical fitting involved of mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, (all years) 2011-2015

	Adapter	Coupling	End Cap	Other	Riser	Service or Main Tee	Sleeve	Tapping Tee	Transition Fitting	Valve
Steel	8%	66%	0%	3%	7%	5%	1%	2%	1%	7%
Plastic	1%	45%	1%	1%	4%	8%	0%	7%	1%	32%
Combination	7%	25%	0%	4%	44%	6%	0%	1%	9%	4%
Unknown	1%	69%	0%	8%	2%	13%	1%	0%	1%	5%
Other	1%	19%	0%	45%	2%	6%	5%	1%	0%	21%
Brass	5%	79%	1%	2%	1%	5%	0%	0%	1%	6%
Total	5%	58%	0%	4%	8%	6%	1%	4%	1%	13%

2.6 Location of Hazardous Leaks

2.6.1 Leak Location

Input: Data analyzed from SAS Computer Application

Output: Figure 5 and Table 16 – Leak location

Responsibility: MJFR 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 16 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 fitting material and types. From this information, the MJFR 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 to the Mechanical Joint Failure Reports, 2011-2015

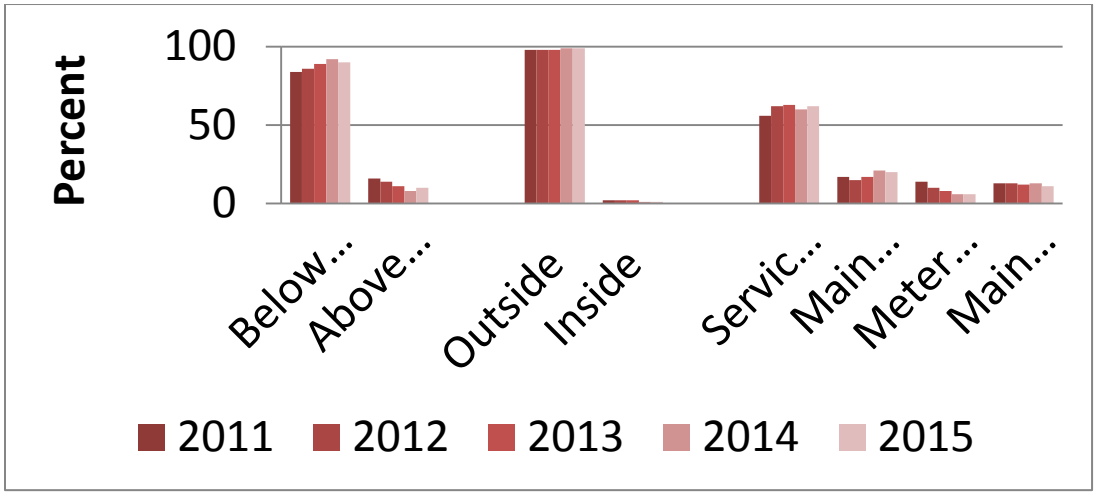


Table 16. Frequency of the location of the hazardous leak of mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, 2011-2015

	2011 Count (%)	2012 Count (%)	2013 Count (%)	2014 Count (%)	2015 Count (%)
Belowground	6984 (84%)	6564 (86%)	8846 (89%)	10741 (92%)	11535 (90%)
Aboveground	1358 (16%)	1043 (14%)	1074 (11%)	977 (8%)	1319 (10%)
Outside	8214 (98%)	7439 (98%)	9749 (98%)	11584 (99%)	12717 (99%)
Inside	128 (2%)	168 (2%)	171 (2%)	134 (1%)	137 (1%)
Service to Service	4702 (56%)	4688 (62%)	6247 (63%)	6995 (60%)	7999 (62%)
Main to Main	1389 (17%)	1110 (15%)	1739 (17%)	2494 (21%)	2591 (20%)
Meter Set	1147 (14%)	798 (10%)	781 (8%)	735 (6%)	820 (6%)
Main to Service	1104 (13%)	1011 (13%)	1153 (12%)	1494 (13%)	1444 (11%)

2.6.2 How the Leak Occurred

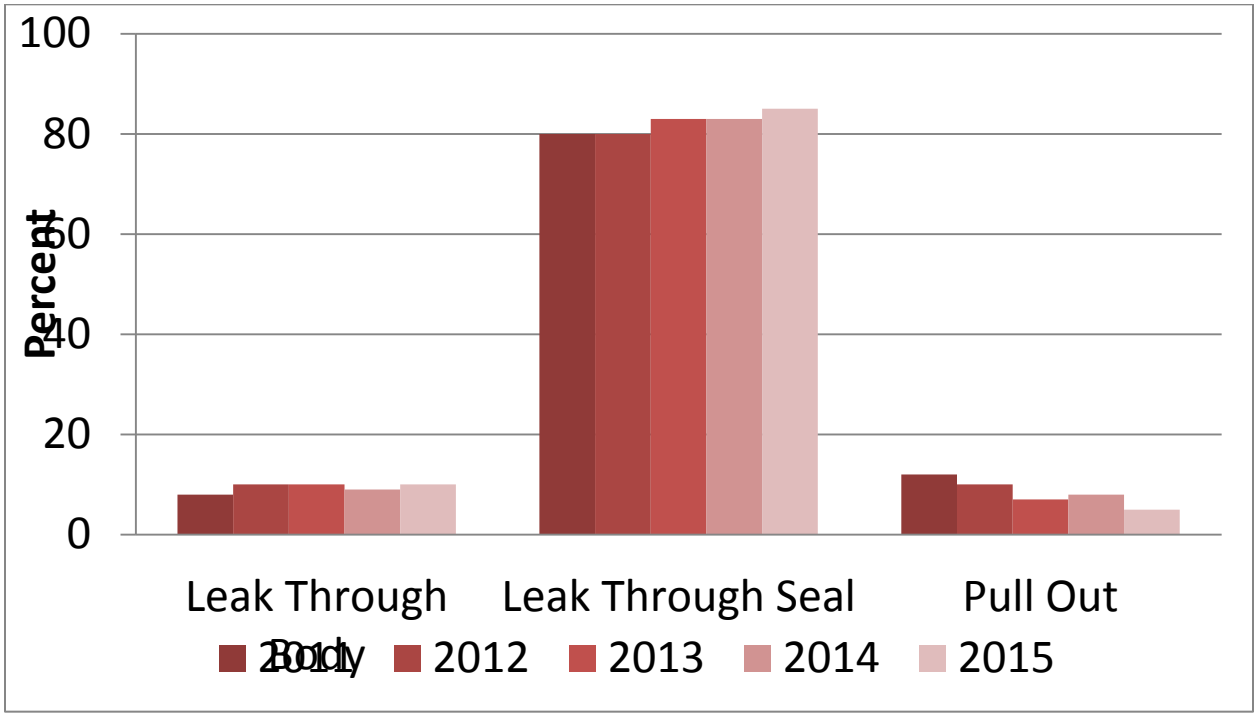
Input: Data analyzed from SAS Computer Application

Output: Figure 6 – Frequency of how the leak occurred

Responsibility: MJFR 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. From this information, the MJFR 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 a Mechanical Joint Failure Report, 2011-2015



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

Input: Data analyzed from SAS Computer Application

Output: Table 17 – Comparison of percentages of failures in States Overall
Table 18 – Comparison of percentages of failures in States for steel
Table 19 – Comparison of percentages of failures in States by plastic

Responsibility: MJFR Team

Description: Produce a table with the columns Top 10 States reporting (Table 17), Top 10 Steel State (Table 18), and Top 10 Plastic States (Table 19). This table takes into account where the MFF occurred based on the raw data of all reports. 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 MJFR 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 data for comparison 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 17. Percentage of MJFR by State, 2011-2015

Top 10 States – based on number of services reported from Gas Distribution Annual Reports					
Number of Services	**2011**	**2012**	**2013**	**2014**	**2015**
CA 13%	TX 13%	TX 13%	TX 12%	PA 12%	PA 13%
TX 7%	IL 11%	IL 9%	PA 11%	TX 10%	TX 11%
IL 6%	PA 9%	PA 8%	IN 8%	IN 8%	IN 9%
OH 5%	OH 7%	IN 7%	NY 7%	VA 8%	VA 8%
MI 5%	IN 7%	MI 6%	IL 7%	OH 7%	NY 7%
NY 5%	NY 6%	NY 6%	TN 7%	NY 6%	MI 6%
PA 4%	MI 5%	OH 6%	VA 6%	IL 5%	OH 5%
NJ 4%	MS 3%	TN 5%	OH 6%	MI 5%	IL 4%
GA 3%	CA 3%	CA 4%	MI 5%	TN 5%	CA 3%
IN 3%	VA 3%	VA 4%	CA 3%	WI 4%	MD 3%

Table 18. Percentage of MJFR Steel by State, 2011-2015

Top 10 Steel States– based on number of steel services reported from Gas Distribution Annual Reports					
Number of Steel Services	**2011**	**2012**	**2013**	**2014**	**2015**
CA 17%	TX 19%	TX 18%	TX 16%	TX 13%	TX 16%
TX 9%	IL 18%	IL 13%	IN 12%	IN 11%	IN 12%
IL 5%	IN 9%	IN 10%	IL 9%	VA 9%	VA 9%
NY 4%	NY 6%	MI 6%	TN 9%	PA 8%	NY 7%
MI 4%	OH 6%	NY 6%	VA 6%	OH 7%	MI 7%
OH 4%	MI 5%	TN 6%	NY 6%	IL 6%	IL 7%
NJ 4%	MS 5%	OH 5%	MI 6%	TN 6%	OH 6%
PA 4%	TN 4%	VA 4%	OH 5%	NY 5%	MD 5%
LA 4%	CO 3%	MD 3%	PA 3%	MI 5%	PA 4%
CO 3%	VA 2%	MS 3%	WI 2%	MD 4%	TN 3%

Table 19. Percentage of MJFR Plastic by State, 2011-2015

Top 10 Plastic States - – based on number of plastic services reported from Gas Distribution Annual Reports					
Number of Plastic Services	**2011**	**2012**	**2013**	**2014**	**2015**
CA 12%	PA 26%	PA 20%	PA 22%	PA 23%	PA 26%
TX 7%	OH 11%	CA 14%	CA 12%	OH 9%	CA 13%
OH 5%	CA 10%	OH 7%	OH 8%	CA 8%	OH 7%
NY 5%	NY 5%	NY 6%	NY 8%	VA 7%	NY 5%
MI 5%	GA 4%	AZ 5%	VA 6%	NY 6%	VA 5%
PA 5%	CT 4%	NV 4%	NV 4%	WI 5%	NV 4%
IL 5%	MA 4%	VA 4%	AZ 3%	GA 3%	AZ 4%
NJ 3%	MO 3%	TN 3%	TN 3%	TN 3%	WI 3%
GA 3%	SC 3%	TX 3%	CT 3%	TX 3%	MA 3%
IN 3%	AZ 3%	CT 3%	MA 3%	CT 3%	TN 2%

2.6.4 States by Causes of Hazardous Leak

Input: Data analyzed from SAS Computer Application

Output: Table 20 - Comparison of frequency of failures in States by cause

Responsibility: MJFR Team

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

Table 20. 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	16	35	1	0	0	0	0	0
AL	127	86	8	30	12	41	134	10
AR	15	34	14	3	4	5	5	2
AZ	25	2	7	1	3	203	213	5
CA	4	12	283	21	18	848	422	24
CO	463	99	5	5	49	5	18	3
CT	582	223	11	11	4	13	256	1
DC	245	1	0	13	9	12	0	0
DE	1	9	14	2	1	2	8	0
FL	95	6	50	8	14	20	20	2
GA	396	18	1	3	35	71	32	7
HI	2	0	70	4	2	1	0	0
IA	44	55	3	5	13	6	74	0
ID	0	1	5	0	4	33	36	1
IL	2297	689	127	156	53	31	103	15
IN	1615	1197	500	199	67	110	283	26
KS	213	110	2	82	20	19	23	13
KY	139	75	155	66	16	420	356	12
LA	112	28	11	5	11	27	15	0
MA	17	148	312	37	2	36	190	2
MD	959	18	71	49	46	98	20	7
ME	0	1	1	0	0	9	0	0
MI	1481	710	86	129	186	94	60	17
MN	229	102	48	24	1	51	53	2
MO	631	50	159	24	72	35	55	21
MS	197	355	0	3	22	313	20	1
MT	15	66	0	0	10	0	6	2
NC	352	43	30	3	57	42	92	4
ND	3	27	0	0	2	1	9	1
NE	9	10	4	0	1	5	5	0
NH	104	11	17	17	2	7	1	0
NJ	163	401	29	125	16	201	123	12
NM	375	0	0	1	4	6	1	1
NV	23	9	2	0	1	213	282	1
NY	2241	56	212	250	31	147	243	4
OH	182	241	772	532	83	698	491	17
OK	5	4	17	11	2	7	56	0
OR	9	0	15	1	22	43	51	2
PA	1337	1358	202	229	12	284	1854	59
RI	1	1	5	0	0	2	2	1
SC	154	3	36	6	14	89	132	1
SD	12	53	0	2	3	2	24	0
TN	1810	115	19	4	22	37	102	4
TX	1926	2208	879	182	156	136	290	70
UT	8	8	7	4	4	5	5	3
VA	2186	222	141	221	34	201	68	6
VT	10	29	0	0	0	13	0	0
WA	22	2	23	20	25	90	52	2
WI	147	41	16	99	83	21	604	10

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

Input: Data analyzed from SAS Computer Application

Output: Table 21 – Leak location

Responsibility: MJFR 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 21. The table is read comparing percentages in the year column to the other year column for the various locations fitting and fitting material. From this information, the MJFR Team will develop observations based on percentage of material type and location

Table 21. Comparison of Fitting Material by Leak Location, 2011-2015

	Aboveground					Belowground				
	2011	2012	2013	2014	2015	2011	2012	2013	2014	2015
Steel	79%	72%	75%	74%	68%	59%	59%	62%	65%	61%
Plastic	2%	3%	2%	2%	12%	29%	31%	28%	25%	26%
Combination	14%	16%	18%	19%	15%	4%	4%	4%	4%	4%
Unknown	2%	2%	1%	1%	1%	4%	1%	1%	3%	5%
Other	1%	2%	1%	1%	1%	2%	3%	3%	1%	2%
Brass	2%	5%	3%	3%	3%	1%	2%	2%	2%	2%
Total	16%	14%	11%	8%	10%	84%	86%	89%	92%	90%

2.6.6 Leak Location (inside or outside) by Fitting Material

Input: Data analyzed from SAS Computer Application

Output: Table 22 – Leak location

Responsibility: MJFR 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 22. The table is read comparing percentages in the year column to the other year column for the locations and fitting material. From this information, the MJFR Team will develop observations on percentage of material type and location.

Table 22. Frequency of leak location (inside or outside) by fitting material of mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, 2011-2015

	Inside					Outside				
	2011	2012	2013	2014	2015	2011	2012	2013	2014	2015
Steel	70%	82%	89%	69%	69%	63%	60%	63%	66%	63%
Plastic	10%	6%	4%	13%	11%	25%	28%	26%	24%	25%
Combination	5%	5%	3%	6%	5%	5%	6%	6%	5%	5%
Unknown	2%	1%	1%	3%	1%	4%	1%	1%	3%	4%
Other	2%	0%	0%	1%	1%	2%	3%	3%	1%	1%
Brass	10%	7%	3%	8%	13%	1%	2%	2%	1%	2%
Total	2%	2%	2%	1%	1%	98%	98%	98%	99%	99%

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

Input: Data analyzed from SAS Computer Application

Output: Table 23 - Frequency of leak location (main or service connection) by fitting material

Responsibility: MJFR 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 23. The table is read comparing percentages in the year column to the other year column for the various locations and fitting material. From this information, the MJFR Team will develop observations based on percentage of material type and location.

Table 23. Frequency of leak location (main or service connection) by fitting material of mechanical fittings that failed and were reported to the Mechanical Joint Failure Reports, 2012-2015

	Main to Main				Main to Service				Meter Set				Service to Service			
	2012	2013	2014	2015	2012	2013	2014	2015	2012	2013	2014	2015	2012	2013	2014	2015
Steel	79%	77%	88%	75%	62%	67%	61%	66%	70%	70%	69%	60%	54%	58%	58%	57%
Plastic	7%	6%	4%	4%	26%	26%	27%	24%	3%	2%	5%	11%	37%	33%	32%	33%
Combo	2%	2%	1%	3%	5%	3%	4%	5%	19%	24%	23%	27%	5%	5%	4%	4%
Unknown	1%	2%	6%	15%	3%	2%	5%	2%	2%	1%	1%	1%	1%	1%	2%	1%
Other	11%	13%	1%	1%	1%	2%	2%	3%	1%	0%	1%	1%	1%	1%	1%	2%
Brass	1%	1%	1%	1%	2%	1%	1%	1%	4%	2%	1%	2%	2%	2%	3%	2%
Total	15%	17%	21%	20%	13%	12%	12%	11%	10%	8%	6%	6%	62%	63%	60%	62%

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 information available about the number fitting various manufactures produced and sold. Therefore, PHMSA is unable to adjust the failure reports by the quantity 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 2015 is the number of MJFR (12,854) divided by the total number of hazardous leaks reported as eliminated/repaired in 2015 (213,684) which is 6.0%. 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 may 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.

Table 24. Quantification of the Role of Mechanical Joints in Hazardous Leaks, Mechanical Joint Failure Reports, 2011-2015

	2011	2012	2013	2014	2015	Total
Number of MJFR submitted	8,342	7,607	9,920	11,718	12,855	50,442
Hazardous Leaks eliminated/repaired	192,011	187,416	191,129	206,067	213,684	990,307
% MJFR of Total Hazardous Leaks eliminated/repaired	4.30	4.10	5.20	5.70	6.00	5.50

2.7.1 Manufacturer of Fitting by Year Manufactured

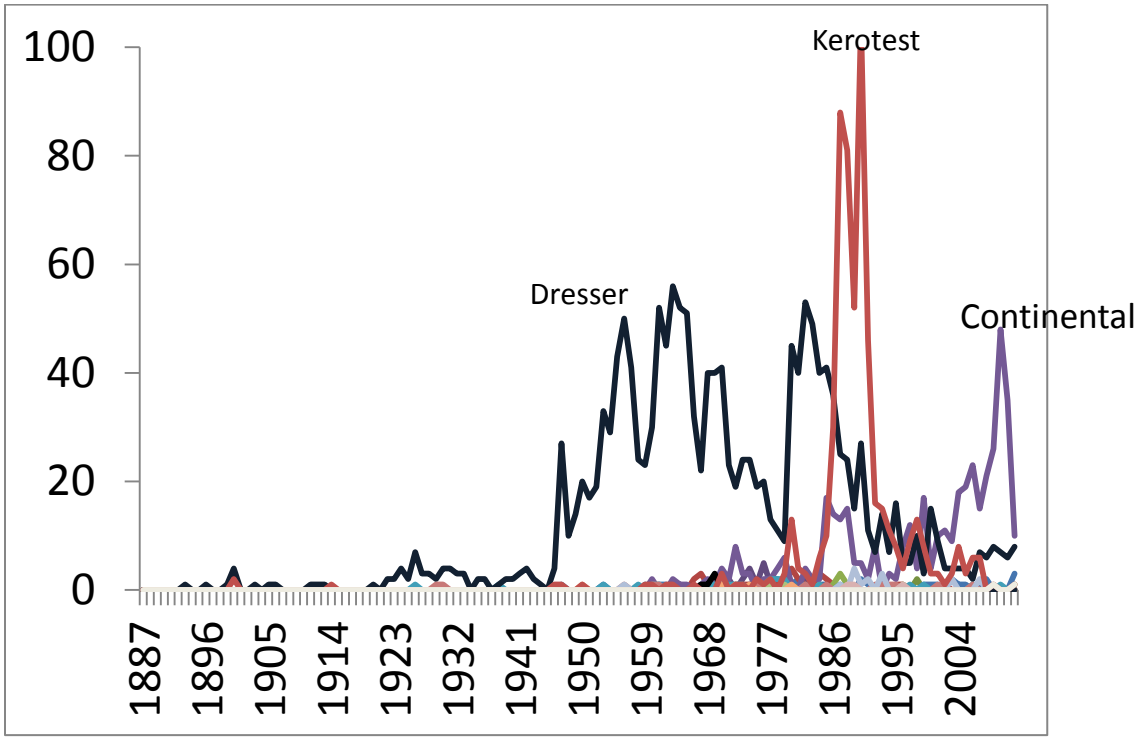
Input: Data analyzed from SAS Computer Application

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

Responsibility: MJFR 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 MJFR Team will develop observations on the validity of the data by those manufacturers with known issues for give manufactured years. Manufacturers with 3 or less MJFRs are put into the "Other" category and not plotted.

Figure 7. Example of the line plot of the number of failures by manufacturer by year fitting manufactured, 2011-2015



2.7.2 Manufacturer by Years in Service

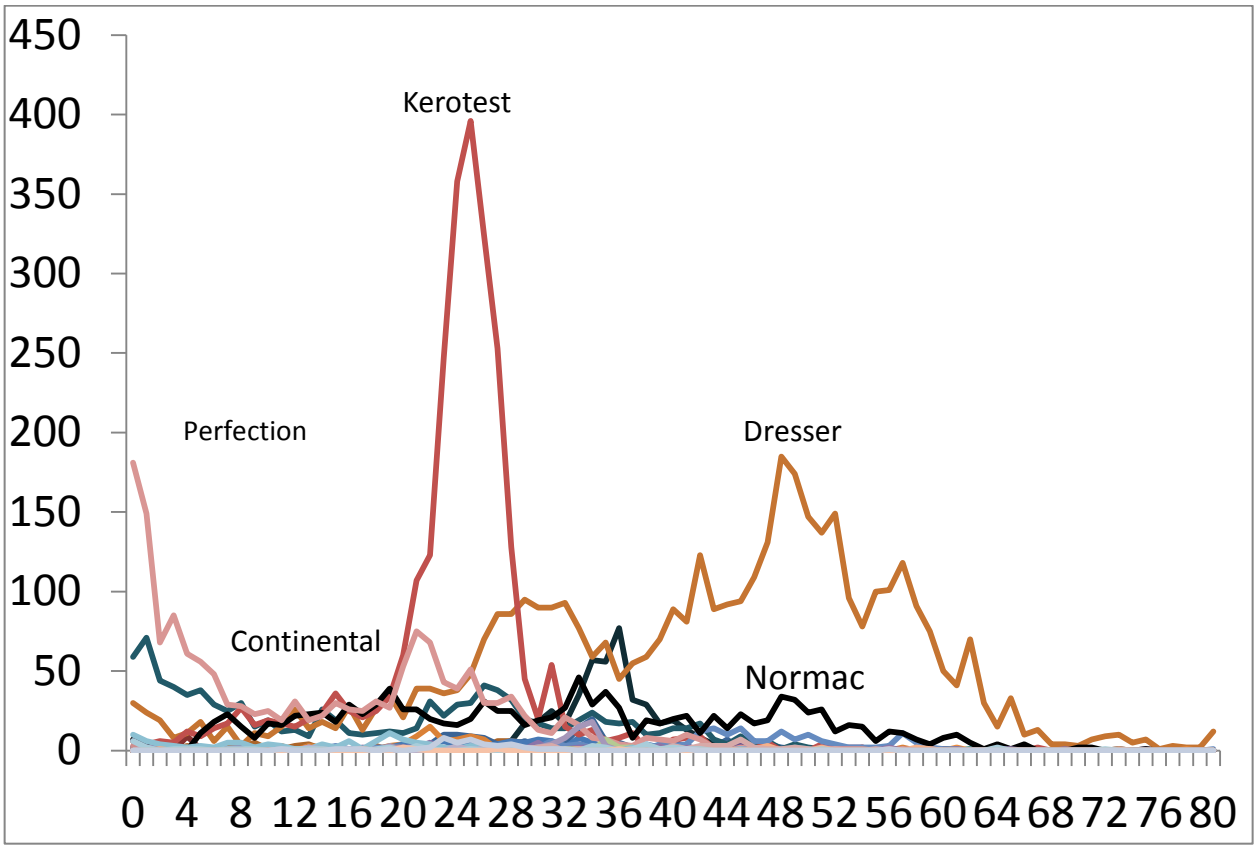
Input: Data analyzed from SAS Computer Application

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

Responsibility: MJFR 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 present in the plot. An example of what the data table looks like is provided below in Figure 8. From this information, the MJFR Team will develop observations on those manufacturers who do have longer/shorter times in service. Manufacturers with 3 or less MJFRs are put into the "Other" category and not plotted.

Figure 8 – Example of the line plot of number of failures by manufacturer by years of service



2.7.3 Frequency of Manufacturers of Fittings

Input: Data analyzed from SAS Computer Application

Output: Table 25 – Manufacturers of failed mechanical fittings

Responsibility: MJFR 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 first 10 are listed. An example of what the data table looks like is provided below in Table 25. The table is read comparing percentages in the year column to the other year column for the various manufacturers. From this information, the MJFR Team will develop observations on prospective view of those manufacturers who have the highest reported number of failures.

The current view of Table 25 shows the last 4 years. Future version of Table 25 will include additional columns added for each year up to the previous 5 years. From this information, the MJFR Team will develop observations on the changes to the top 10 reported manufacturers.

Table 25. Frequency of manufacturers reported in MJFR data based on percentage of data, 2011-2015

Manufacturer	2011	Manufacturer	2012	Manufacturer	2013	Manufacturer	2014	Manufacturer	2015
Dresser	22%	**Dresser**	21%	**Dresser**	21%	**Dresser**	22%	**Dresser**	**22%**
Kerotest	9%	**Perfection**	6%	**Kerotest**	8%	**Kerotest**	7%	**Kerotest**	**7%**
Normac	5%	**Kerotest**	5%	**Perfection**	5%	**Normac**	5%	**Perfection**	**4%**
Continental	4%	**Normac**	5%	**Normac**	4%	**Perfection**	5%	**Normac**	**4%**
Perfection	4%	**Continental**	7%	**Continental**	4%	**Continental**	3%	**Continental**	**3%**
AMP	1%	**AMP**	2%	**AMP**	1%	**AMP**	1%	**AMP**	**1%**
Mueller	<1%	**Chicago**	1%	**Mueller**	1%	**Mueller**	1%	**Mueller**	**1%**
RW Lyall	<1%	**RW Lyall**	1%	**RW Lyall**	<1%	**RW Lyall**	1%	**RW Lyall**	**<1%**
Handley	<1%	**Mueller**	<1%	**Handley**	<1%	**RobRoy**	1%	**Central Plastics**	**<1%**
Telsco	<1%	**Inner-tite**	<1%	**Inner-tite**	<1%	**Central Plastics**	<1%	**Chicago**	**<1%**

2.7.4 Manufacturer by Year of Failure

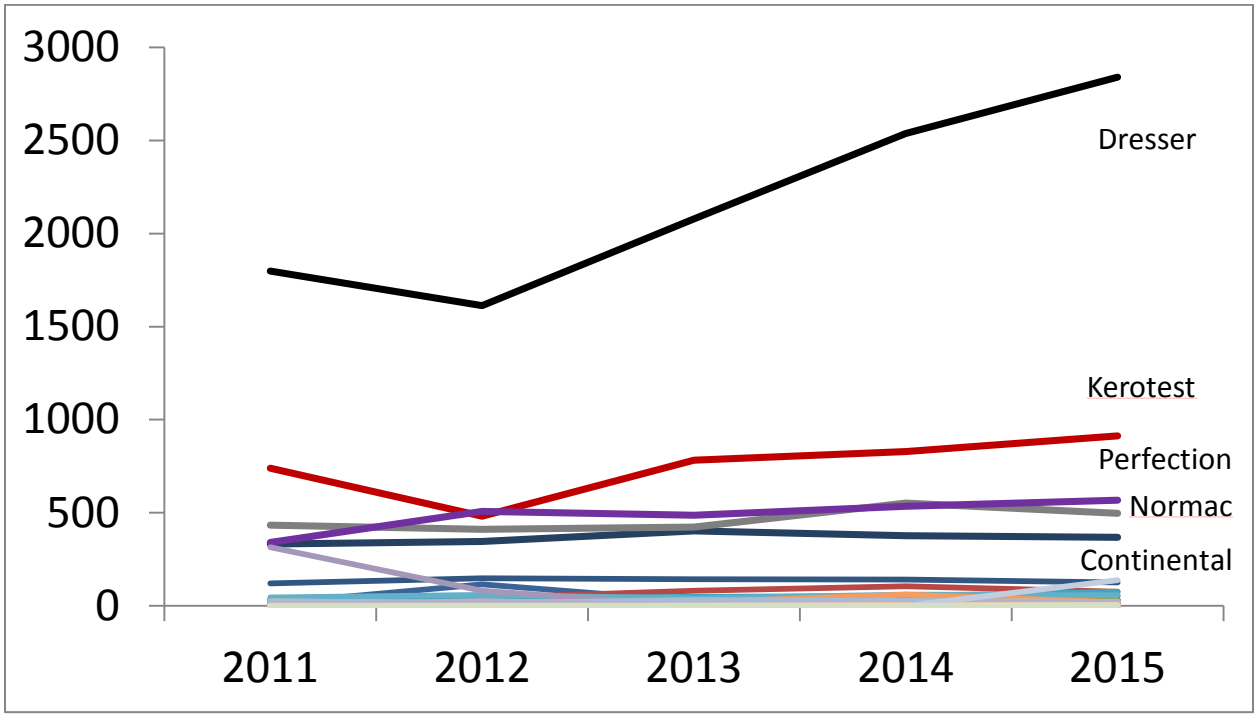
Input: Data analyzed from SAS Computer Application

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

Responsibility: MJFR 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 MJFR Team will develop observations on prospective view of those manufacturers who have an upward trend in the number of reported failures. Manufacturers with 3 or less MJFRs are put into the “Other” category and not plotted.

Figure 9 – Example of the line plot of number of failures by manufacturer by year of failure



2.7.5 Manufacturer by Leak Causes

Input: Data analyzed from SAS Computer Application

Output: Table 25 – Frequency of manufacturers by reported apparent cause of leak

Responsibility: MJFR 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 26. From this information, the MJFR Team will develop observations on manufacturers and leaks causes associated with those manufacturers. Manufacturers with 3 or less MJFRs are put into the "Other" category.

Table 26 – Manufacturers by reported apparent cause of leak, 2011-2015

Manufacturer	Corrosion	Equipment	Excavation Damage	Incorrect Operation	Material or Weld	Natural Forces	Other	Other Outside Force
AMP	7	85	4	64	453	38	20	4
Aldyl	0	3	0	0	3	1	3	0
American	0	18	0	11	3	0	3	0
Anvil Red	1	0	0	1	2	8	0	0
B K	0	8	0	0	0	0	0	0
CENTRAL PLASTICS	22	47	4	23	39	13	13	0

Manufacturer	Corrosion	Equipment	Excavation Damage	Incorrect Operation	Material or Weld	Natural Forces	Other	Other Outside Force
CSI/SMITH BLAIR/ROCKW	8	51	3	11	18	17	8	2
Chicago	16	140	2	33	8	11	2	0
Conino	0	3	0	3	2	1	0	0
Continental	112	331	52	571	482	132	120	25
Continental or Chicag	4	131	0	0	0	3	0	0
Dezuirk	0	1	0	0	1	2	0	0
Dezurik	0	1	0	0	0	0	0	0
Dresser	549	6167	241	538	577	2036	701	58
Drisco	2	25	4	0	6	2	1	1
Dupont	1	2	1	25	27	1	3	5
Eastern Eberhard	1	1	0	1	2	1	3	0
Flo-Control	0	1	0	0	0	16	0	0
Generic	0	25	10	2	11	3	5	0
Handley	1	39	0	16	62	7	8	1
Inner-tite	103	10	1	3	9	8	3	2
International	1	0	0	1	2	0	1	0
Kerotest	10	1594	5	150	1612	148	205	20
M0T0 Deason	0	5	0	1	0	0	1	0
MERCO	1	3	0	0	3	6	1	1
MGL	0	0	0	0	10	0	0	0
Mueller	23	132	17	18	38	90	16	3
Nordstrom	0	0	0	3	1	1	0	0
Normac	200	470	46	440	382	405	362	10
Normac or Dresser	0	2	1	0	0	0	0	0
OTHER	19	50	8	24	39	40	53	12
Perfection	80	329	26	1063	519	101	295	24
Performance	0	12	2	3	0	0	1	0
Pergeltion	0	1	0	3	0	0	0	0
Plexco	0	7	1	8	21	0	1	0
Powell	0	0	0	0	13	0	0	0
RW Lyall	11	61	31	62	51	19	17	6
RobRoy	19	4	0	46	10	16	15	0
Skinner	3	8	1	1	1	7	2	0
Spears	0	0	0	1	0	7	0	1
Telsco	20	24	1	32	14	3	8	0
UNAVAILABLE	5	142	3	74	88	74	4	4
US Poly	5	12	7	25	17	5	8	0
Unknown	1363	11050	796	1481	2384	5787	2530	195
Uponor	2	15	0	6	3	5	3	1
Wayne Mfg	12	38	0	12	30	13	7	0

2.7.6 Manufacturer by Mechanical Fitting Involved

Input: Data analyzed from SAS Computer Application

Output: Table 27 – Frequency of manufacturer by mechanical fitting involved

Responsibility: MJFR 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 27. From this information, the MJFR Team will develop observations on prospective view of those manufacturers and mechanical fitting involved associated with those manufacturers. Manufacturers with 3 or less MJFRs are put into the "Other" category.

Table 27 – Manufacturers by mechanical fitting type involved, 2011-2015

Manufacturer	Bolted	Nut Follower	Other	Stab
AMP	121	28	446	80
Aldyl	0	1	9	0
American	5	10	2	18
Anvil Red	1	11	0	0
B K	0	0	8	0
CENTRAL PLASTICS (GEO	34	33	50	44
CSI/SMITH BLAIR/ROCKW	59	43	15	1
Chicago	4	83	122	3
Conino	0	4	5	0
Continental	331	646	220	628
Continental or Chicag	0	0	138	0
Dezuirk	2	1	1	1
Dresser	1655	8358	677	177
Drisco	3	8	16	14
Dupont	3	2	58	2
Eastern Eberhard	6	3	0	0
Flo-Control	0	14	3	0
Generic	1	28	24	3
Handley	0	120	8	6
Inner-tite	1	114	21	3
International	0	5	0	0
Kerotest	62	3536	84	62
M.T. Deason	0	6	1	0
MERCO	0	5	9	1
MGL	6	0	4	0
Mueller	48	235	41	13
Nordstrom	1	1	3	0
Normac	23	2062	201	29
Normac or Dresser	0	3	0	0
OTHER	47	110	68	20

Manufacturer	Bolted	Nut Follower	Other	Stab
Perfection	105	70	213	2049
Performance	0	1	5	12
Pergeltion	0	0	0	4
Plexco	1	10	13	14
Powell	0	13	0	0
RW Lyall	70	32	79	77
RobRoy	0	68	37	5
Skinner	17	5	1	0
Spears	0	9	0	0
Telsco	2	95	4	1
UNAVAILABLE	13	235	80	66
US Poly	2	4	51	22
Unk	3076	14471	5975	2064
Uponor	1	15	14	5
Wayne Mfg	0	81	21	10

2.8 Operators submitting MJFR

The MJFR Team members will analyze the MJFR 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 MJFR Team may decide to evaluate the number of MJFR 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 by Year of Failure

Input: Data analyzed from SAS Computer Application

Output: Table 28 – Frequency of operators reporting fitting failures by year of failure

Responsibility: MJFR 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 28. From this information, the MJFR Team will develop observations on prospective view of operators and reports.

Table 28 – Operators reporting by year of failure

Operator Name	2011	2012	2013	2014	2015
ALABAMA GAS CORPORATION	48	48	55	41	29
ALEXANDER CITY MUNICIPA	0	0	0	3	2
ALLIANT ENERGY - INTERS	0	7	7	6	8
AMEREN ILLINOIS COMPANY	136	141	171	192	351
AMERENUE	1	2	1		12
APPALACHIAN NATURAL GAS	0	0	0	2	0
ARKANSAS WESTERN GAS CO	1	1	0	0	0
ATLANTA GAS LIGHT CO	140	82	59	132	62
ATMOS ENERGY CORPORATIO	771	594	646	627	865
ATMOS PIPELINE - TEXAS	0	11	51	0	0
AUSTELL NATURAL GAS SYS	1	0	0	0	0
AUSTIN UTILITIES	0	0	1	0	0
AVISTA CORP	19	37	32	52	53
BALTIMORE GAS & ELECTRI	13	15	13	10	9
BANGOR GAS CO LLC	1	5	0	0	0
BERKSHIRE GAS CO	5	4	17	20	33
BLACK HILLS ENERGY	4	6	6	8	5
BLACKSTONE GAS CO	0	1	2	0	1
BOSTON GAS CO	5	2	2	1	2
BRADY MUNICIPAL GAS COR	0	6	6	1	0
BRENHAM UTILITY, CITY O	3	1	2	5	3
CALERA MUNICIPLE GAS SY	2	0	0	0	0
CARTERSVILLE GAS DEPT,	2	4	1	1	0
CASTROVILLE UTILITY SYS	0	1	0	293	0
CEDAR FALLS MUNICIPAL U	0	0	0	1	0
CENTERPOINT ENERGY RESO	39	160	266	328	302
CENTERVILLE, TOWN OF	2	0	0	1	0
CENTRAL FLORIDA GAS COR	0	0	3	0	0
CENTRAL HUDSON GAS & EL	25	27	30	15	7
CHAMBERSBURG GAS DEPT	0	0	0	1	0
CHATTANOOGA GAS CO	30	33	25	41	43
CHELSEA GAS AUTH	0	0	0	0	1
CHESAPEAKE UTILITIES CO	0	15	8	0	3
CHESAPEAKE UTILITY CORP	7	0	0	0	0
CHEYENNE LIGHT FUEL & P	0	1	4	0	1
CHIRENO MUNICIPAL GAS,	0	0	0	0	7
CIRCLE PINES UTILITY	3	0	0	0	0

Operator Name	2011	2012	2013	2014	2015
CITIZENS GAS & COKE UTI	190	236	376	228	211
CITY OF BENSON	0	0	0	1	3
CITY OF CALERA NATURAL	0	1	1	1	0
CITY OF ROCKPORT	4	1	1	6	3
COLORADO SPRINGS, CITY	6	7	7	10	4
COLUMBIA GAS OF KENTUCK	13	30	64	64	50
COLUMBIA GAS OF MARYLAN	14	20	18	37	34
COLUMBIA GAS OF MASSACH	91	44	95	86	104
COLUMBIA GAS OF OHIO IN	359	239	353	448	388
COLUMBIA GAS OF PENNSYL	52	74	89	117	59
COLUMBIA GAS OF VIRGINI	45	60	117	140	142
COMMUNITY NATURAL GAS I	2	0	0	0	0
CONNECTICUT NATURAL GAS	16	17	40	52	48
CONSOLIDATED EDISON CO	412	352	417	418	579
CONSUMERS ENERGY CO	368	397	470	448	671
CONSUMERS GAS UTILITY C	0	1	0	0	0
CORINTH GAS DEPT, CITY	0	0	0	7	13
CORNING MUNICIPAL UTILI	1	1	3	2	1
CORPUS CHRISTI, CITY OF	10	14	6	5	2
COVINGTON GAS DEPT, CIT	0	3	0	0	0
CPS ENERGY	360	224	254	10	414
CULLMAN - JEFFERSON CO	1	0	0	0	0
DALTON WATER LIGHT & SI	0	1	0	0	0
DANVILLE, CITY OF	1	1	1	0	4
DECATUR UTILITIES - GAS	0	1	0	0	0
DELMARVA POWER & LIGHT	1	1	1	6	6
DELTA NATURAL GAS CO IN	0	0	0	0	1
DOMINION EAST OHIO	76	63	62	51	39
DOMINION HOPE	12	19	19	19	18
DTE GAS COMPANY	0	0	8	3	3
DUBLIN, CITY OF	4	0	0	0	0
DUKE ENERGY KENTUCKY	1	10	11	3	6
DUKE ENERGY OHIO	26	78	26	39	23
DUPO GAS SYSTEM, VILLAG	0	0	0	1	0
EASTERN NATURAL GAS CO	7	2	0	0	0
EASTON UTILITIES COMMIS	0	0	0	3	1
ELIZABETHTOWN GAS CO	31	21	37	14	20
ELK RIVER PUBLIC UTIL D	0	0	0	2	0
ELKTON GAS SERVICE - DI	0	0	0	0	1
ENERGY NORTH NATURAL GA	6	4	12	62	73
ENERGY WEST MONTANA	7	1	1	3	2
ENSTAR NATURAL GAS CO	14	13	2	16	6
ENTERGY GULF STATES	4	0	8	24	68

Operator Name	2011	2012	2013	2014	2015
ENTERGY NEW ORLEANS, IN	3	5	3	6	7
ENTEX, A NORAM ENERGY C	198	45	0	0	0
EQUITABLE GAS COMPANY,	0	17	32	0	0
EQUITABLE RESOURCES (A.	10	0	0	0	0
ESSEX COUNTY GAS CO	0	2	0	0	0
FAIRBANKS NATURAL GAS	0	0	0	1	0
FAIRFIELD MUNICIPAL GAS	2	1	0	0	0
FAIRHOPE GAS SYSTEM, CI	0	1	0	0	0
FALFURRIAS UTILITY BOAR	0	18	6	43	11
FALLS CITY UTILITIES	0	1	0	0	0
FAYETTEVILLE PUBLIC UTI	0	0	2	0	0
FITCHBURG GAS & ELECTRI	2	9	18	10	9
FLORENCE GAS DEPT, CITY	3	1	0	0	0
FLORIDA CITY GAS	1	0	0	0	2
FLORIDA PUBLIC UTILITIE	6	10	7	6	10
FORT HILL NATURAL GAS A	0	0	0	0	5
GAINESVILLE REGIONAL UT	1	0	0	0	0
GREAT PLAINS NATURAL GA	4	1	0	0	2
GREATER MINNESOTA GAS I	0	0	0	0	1
GREENVILLE UTILITIES CO	2	1	9	3	7
GREENWOOD COMMISSION OF	2	9	2	2	3
GUYMON MUNICIPAL GAS CO	0	1	0	0	0
HALLS GAS DEPT, TOWN OF	1	0	0	0	0
HALSTEAD GAS DEPT, CITY	0	1	0	0	0
HAMILTON GAS DEPT, CITY	8	8	10	1	2
HASTINGS UTILITIES	2	0	0	0	1
HAWAI`IGAS	0	0	11	29	1
HAWAII GAS	0	0	0	0	1
HAWARDEN GAS DEPT, CITY	1	2	2	1	0
HOLYOKE GAS & ELECTRIC	0	1	9	16	14
HUMBOLDT UTILITIES - GA	13	17	9	4	7
HUNTSVILLE GAS SYSTEM	13	9	13	15	26
INDIANA GAS CO INC	87	66	61	95	97
INDIANA NATURAL GAS COR	0	0	0	0	1
INTERMOUNTAIN GAS CO	9	4	3	9	10
JACKSON ENERGY AUTHORIT	44	19	31	13	10
KANSAS GAS SERVICE	89	68	62	0	0
KANSAS GAS SERVICE COMP	0	8	18	90	110
KEYSPAN ENERGY DELIVERY	1	0	0	0	0
KEYSTONE RURAL GAS DIST	2	1	2	0	0
KINGS MOUNTAIN NATURAL	0	0	0	2	0
KNG ENERGY INC	2	0	0	1	4
KNOXVILLE UTILITIES BOA	6	7	12	16	11

Operator Name	2011	2012	2013	2014	2015
LACLEDE GAS CO	181	11	91	128	261
LAKE APOPKA NATURAL GAS	4	2	0	1	6
LAKE PARK MUNICIPAL UTI	1	0	0	0	0
LANCASTER MUNICIPAL GAS	10	4	5	5	4
LAS CRUCES, CITY OF	1	4	1	1	0
LAURENS COMMISSION OF P	0	0	0	2	1
LAWRENCEBURG GAS DEPT,	16	10	8	9	6
LAWRENCEVILLE, CITY OF	0	1	1	9	40
LEBO MUNICIPAL GAS SYST	1	0	0	0	0
LEFORS GAS DEPT, CITY O	0	1	0	0	0
LEWISBURG GAS DEPARTMEN	3	0	1	5	2
LEXINGTON GAS SYSTEM	7	8	5	6	11
LIBERTY UTILITIES MASSA	0	0	8	11	12
LITTLE RIVER MUNICIPAL	0	0	1	0	0
LIVE OAK GAS DEPT, CITY	0	1	0	0	0
LONG BEACH GAS DEPT, CI	9	7	7	6	6
LOUISVILLE GAS & ELECTR	167	174	207	186	135
LUMBERPORT - SHINNSTON	0	0	0	0	1
LYTLE MUNICIPAL SYSTEM	0	1	0	0	0
MADISON GAS & ELECTRIC	2	2	3	0	0
MADISON, CITY OF	5	9	0	0	0
MAINE NATURAL GAS	0	0	0	1	0
MARIANNA, CITY OF	1	1	2	1	1
MARSHALL COUNTY GAS DIS	5	7	11	5	2
MEMPHIS LIGHT GAS & WAT	106	247	546	423	202
METROPOLITAN UTILITIES	4	2	0	3	4
MICHIGAN CONSOLIDATED G	2	5	0	0	0
MICHIGAN GAS UTILITIES	19	30	29	42	19
MIDAMERICAN ENERGY COMP	41	58	38	36	22
MIDDLEBOROUGH GAS & ELE	5	0	0	1	70
MIDWEST NATURAL GAS COR	2	0	3	0	0
MIDWEST NATURAL GAS INC	1	0	0	0	0
MINNESOTA ENERGY RESOUR	1	1	0	1	1
MISSISSIPPI RIVER GAS L	2	1	0	0	0
MISSOURI GAS ENERGY	1	1	0	0	19
MOBILE GAS SERVICE CORP	15	8	14	18	10
MONROE NATURAL GAS DEPT	0	0	1	0	0
MONTANA - DAKOTA UTILIT	23	23	20	50	46
MOULTON MUNICIPAL GAS S	0	0	1	0	0
MOULTRIE GAS DEPT, CITY	1	0	0	0	0
MOUNTAINEER GAS CO	7	5	5	0	1
MT CARMEL PUBLIC UTILIT	0	1	0	0	0
NATIONAL FUEL GAS DISTR	62	97	135	184	146

Operator Name	2011	2012	2013	2014	2015
NATIONAL GAS & OIL CORP	23	21	67	200	74
NAVASOTA, CITY OF	0	4	2	0	0
NEW ALBANY GAS SYSTEM	5	0	0	0	0
NEW ENGLAND GAS COMPANY	3	5	1	0	0
NEW JERSEY NATURAL GAS	20	34	47	61	51
NEW MEXICO GAS COMPANY	116	84	77	53	51
NEW YORK STATE ELECTRIC	0	23	34	19	14
NGO TRANSMISSION, INC.	0	0	0	2	0
NIAGARA MOHAWK POWER CO	8	4	2	9	24
NORTH SHORE GAS CO	4	4	1	0	1
NORTHERN ILLINOIS GAS C	780	425	350	273	178
NORTHERN INDIANA PUBLIC	139	127	274	509	617
NORTHERN STATES POWER C	86	43	81	69	48
NORTHERN UTILITIES INC	1	0	0	3	0
NORTHERN UTILITIES, INC	0	0	0	2	0
NORTHWEST ALABAMA GAS D	0	1	2	7	9
NORTHWEST NATURAL GAS C	20	27	9	8	7
NORTHWESTERN ENERGY LLC	13	5	5	4	2
NORWICH DEPT OF PUBLIC	0	1	0	3	2
NSTAR GAS COMPANY	0	1	0	11	15
NV Energy	13	18	52	35	18
OHIO GAS CO	3	2		1	1
OKLAHOMA NATURAL GAS CO	15	8	23	13	14
ORANGE & ROCKLAND UTILI	0	0	48	96	137
ORWELL NATURAL GAS CO	0	0	0	0	1
PACIFIC GAS & ELECTRIC	229	288	295	219	407
PALO ALTO, CITY OF	1	2	0	0	0
PASCAGOULA NATURAL GAS	0	0	2	5	1
PECO ENERGY CO	7	15	5	3	2
PENSACOLA, ENERGY SERVI	4	26	7	1	0
PEOPLES GAS LIGHT & COK	68	107	138	90	43
PEOPLES GAS SYSTEM INC	8	9	16	11	24
PEOPLES NATURAL GAS COM	21	20	36	49	401
PEOPLES TWP LLC	3	4	3	1	0
PHILADELPHIA GAS WORKS	248	203	425	626	606
PIEDMONT NATURAL GAS CO	3	58	89	136	222
POWELL CLINCH UTIL DIST	0	2	3	8	3
PRESQUE ISLE ELECTRIC &	1	2	1	1	2
PUBLIC SERVICE CO OF CO	139	95	112	148	109
PUBLIC SERVICE CO OF NO	11	7	24	37	51
PUBLIC SERVICE ELECTRIC	71	38	64	178	154
PUGET SOUND ENERGY	38	42	20	36	21
QUESTAR GAS COMPANY	33	45	1	1	1

Operator Name	2011	2012	2013	2014	2015
RANTOUL, VILLAGE OF	0	0	0	1	0
RELIANT ENERGY ARKLA, D	56	0	0	0	0
REMSEN MUNICIPAL UTILIT	0	0	1	0	0
RICHMOND, CITY OF	41	47	52	53	66
ROANOKE GAS CO	10	16	27	31	30
ROBSTOWN GAS SYSTEM, CI	2	0	0	0	0
ROCHESTER GAS & ELECTRI	0	11	28	11	13
Rock Energy Cooperative	0	0	0	0	1
ROCKY MOUNT MUNICIPAL S	4	0	0	2	1
ROZEL MUNICIPAL GAS SYS	1	1	0	0	1
SAN DIEGO GAS & ELECTRI	0	2	4	6	2
SANDPIPER ENERGY	0	0	0	1	4
SAVANNAH PUBLIC UTILITY	3	1	0	0	0
SEMCO ENERGY GAS COMPAN	50	49	33	54	54
SEVIER COUNTY UTIL DIST	0	2	1	0	3
SHELBY GAS DEPT, CITY O	0	0	0	0	1
SOMERSET GAS SERVICE	4	2	11	2	4
SOURCEGAS ARKANSAS INC.	0	0	5	5	4
SOURCEGAS LLC	5	1	6	3	4
SOUTH ALABAMA GAS DISTR	7	0	0	0	0
SOUTH CAROLINA ELECTRIC	101	77	50	40	59
SOUTH JERSEY GAS CO	26	36	30	59	78
SOUTHEASTERN NATURAL GA	1	0	0	0	0
SOUTHERN CALIFORNIA EDI	0	0	1	1	0
SOUTHERN CALIFORNIA GAS	0	23	27	28	22
SOUTHERN CONNECTICUT GA	15	7	20	22	24
SOUTHERN INDIANA GAS &	121	93	91	146	201
SOUTHERN PUBLIC SERVICE	1	0	0	0	0
SOUTHWEST GAS CORP	116	178	192	113	249
SOUTHWESTERN VIRGINIA G	2	6	10	4	4
SPRINGFIELD GAS SYSTEM	0	2	0	0	0
SPRINGFIELD, CITY UTILI	56	40	72	75	92
ST CROIX VALLEY NATURAL	0	0	0	0	5
SUBURBAN NATURAL GAS CO	1	0	0	0	0
SUGAR HILL NATURAL GAS	2	0	0	0	0
SUPERIOR WATER LIGHT &	0	7	3	0	0
SWEENY GAS SYSTEM, CITY	0	0	6	1	0
SWEETWATER BOARD OF PUB	0	0	0	1	1
SYCAMORE GAS COMPANY	4	8	4	4	5
TALLAHASSEE, CITY OF	29	0	0	0	0
TEAVEE OIL & GAS INC	0	0	1	0	0
TEXAS GAS SERVICE COMPA	92	145	129	155	99
THE EMPIRE DISTRICT GAS	3	1	1	0	0

Operator Name	2011	2012	2013	2014	2015
THE GAS COMPANY	16	20	1	0	0
TRUSSVILLE, UTILITIES B	1	5	7	0	0
UGI CENTRAL PENN GAS, I	5	9	1	2	9
UGI PENN NATURAL GAS	199	115	105	152	169
UGI UTILITIES, INC	143	140	209	315	351
UNION OIL & GAS INC	0	1	7	6	1
UNION UTILITY DEPT, CIT	3	0	0	0	1
UNISOURCE ENERGY SERVIC	3	13	12	6	7
VALLEY ENERGY, INC.	2	1	46	40	10
VECTREN ENERGY DELIVERY	44	17	33	70	99
VERMONT GAS SYSTEMS INC	5	16	4	8	19
VILLAGE OF MORTON	1	0	0	0	0
VIRGINIA NATURAL GAS	16	41	116	228	220
WALLER, CITY OF	0	0	1	0	0
WALNUT MUNICIPLE GAS SY	1	2	1	1	1
WASHINGTON GAS LIGHT CO	238	298	471	890	985
WATERTOWN MUNICIPAL GAS	0	0	0	1	0
WATERVILLE GAS & OIL CO	2	1	4	4	2
WE ENERGIES	12	0	0	0	0
WEST POINT GAS SYSTEM	0	0	2	0	0
WEST TEXAS GAS INC	0	0	4	0	1
WILLMUT GAS & OIL CO -	4	3	1	3	3
WILSON GAS DEPT, CITY O	0	11	4	6	11
WISCONSIN ELECTRIC POWE	0	1	0	46	28
WISCONSIN GAS CO	7	0	0	0	0
WISCONSIN GAS LLC DBA W	0	38	219	356	258
WISCONSIN PUBLIC SERVIC	4	4	1	3	0
YANKEE GAS SERVICES CO	140	121	177	231	165
YORK COUNTY NATURAL GAS	0	0	1	0	0

3.0 Future Analysis Ideas and Concepts

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, and more line plots have been used in this year's report with 5-years' worth of data having been collected.

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. Now that this threshold is met, the MJFR is still a surveillance system, and the information collection activity will continue for another 3 years. The largest limitation facing MJFR 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 MJFR 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 from submitted MJFRs with varying manufacturer names describing the same manufacturer. The MJFR Team has mapped names together when appropriate.

3.2 Updates

Data submitted for 2015 shows similar trends to the previous years of data. Tables with aggregated views of data replaced some tables that appeared in last year's report. These removed tables did not appear to add any additional information that could not be gathered from an aggregate view of the data. At this time no other additional analysis has been identified for inclusion.

In the future, the Team plans on including a historical list of updates or changes to the form, updates to the electronic submittal process, discussion of advisory bulletins pertaining to MJFR, etc.

Rulemaking is in progress to change the name of the Mechanical Fitting Failure Report to Mechanical Joint Failure Report to represent that the hazardous leak occurred within a joint connection of pipe and the apparent cause of leakage may not be due to equipment failure of the fitting.

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: MJFR Team

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

Following MJFR 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 MJFR Team

4.1 Overview of Analysis

Analysis of the MJFR data received to date is consistent with what was expected when we initiated this information collection activity and is consistent with other data sources (e.g., data from Gas Distribution annual reports). Data submitted for 2015 shows similar trends to previous 5 years of data collection, and trends in the data are within acceptable variance.

In summary, the majority of mechanical joint failures resulting in a hazardous leak involve nut-follower, coupling type fittings. In 2015, data analysis provides the following:

- Equipment failure is the leading reported cause of leaks (42%), and Natural forces is second (18%)
- Majority of leaks occur outside (99%), belowground (90%) involving service-to-service connections (62%)
- Steel fittings (62%) are involved the majority of reports, and plastic fittings are second (25%)
- Valves are involved in 13% of reported failures in 2015.

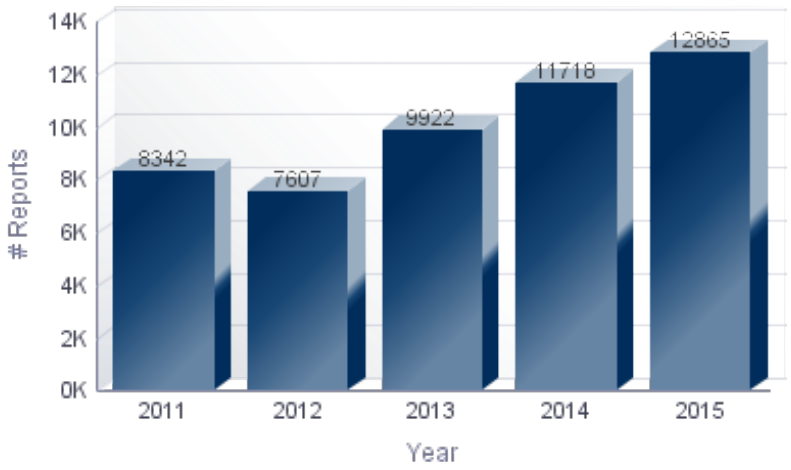
For the most part, we are seeing what was expected when we initiated this information collection activity with mechanical joint failures involving:

- Mostly steel, mostly couplings, mostly belowground, and the number of reports being 10,000-15,000/year
- Average time to failure by fitting material type of mechanical fittings in 2015 for steel is 46 years and for plastic is 26 years

Communication of Performance Data is through the DIMP web page. To view MJFR data, go to: http://primis.phmsa.dot.gov/dimp/perfmeasures.htm
Total Report Submitted Numbers (03/31/2015):

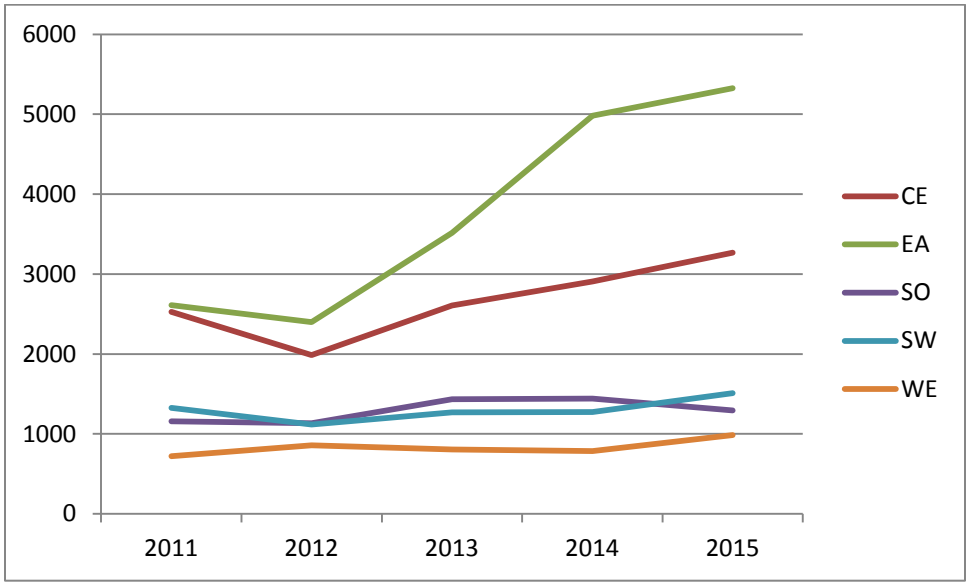
MJFRs submitted in 2011 – 8,342
MJFRs submitted in 2012 – 7,607
MJFRs submitted in 2013 – 9,920
MJFRs submitted in 2014 – 11,718
MJFRs submitted in 2015 - 12,855

Figure 10 – Graphic representation of MJFR by year, as of 09/18/2016



To further break down the rising trend in the number of submitted MJFRs, we looked at the MJFR data by PHMSA Regions (see Figure 11 below). The data by PHMSA Regions shows upward trends in Central and Eastern Regions. The PHMSA Regions cover great distances both east to west and north to south. Differences in climate and stratigraphy in PHMSA Regions make drawing conclusions based on PHMSA Regions difficult at best. The MJFR Team thinks the state-by-state data is more meaningful for drawing conclusions as a particular state's data could lead investigation into installation age and other particular meaningful variables. We also draw the reader's attention to Tables 17-20 on the MJFR failure data by state and Table 28 for the operators reporting MJFRs by the year of the failure. The same number of operators are submitting MJFRs in 2015 as in previous years, and the data analysis does not provide a specific reason for the upward trend in the number of MJFRs submitted. The MJFR data should be discretely evaluated on a state-by-state and operator-by-operator level during regulatory inspections and during periodic evaluations (§192.1007(f)) performed in distribution integrity management programs by operators to meet regulatory requirements.

Figure 11 – MJFR data submitted by PHMSA Region per year



Mechanical Joint Failures are being identified in many Operators' DIMPs as a significant threat requiring risk mitigation measures. The rate of hazardous leaks repaired involving a mechanical fitting for 2015 is the number of MFFR (12865) divided by the total number of hazardous leaks reported as eliminated/repaired in 2015 (213,684) which is 6% (up from 4.3 % in 2011). This percentage of hazardous leaks eliminated/repaired that involve a mechanical fitting is rising as shown below.

Table 29 - The percentage of hazardous leaks eliminated/repaired that involve a mechanical fitting is rising as shown below (as of 07/18/2016) from http://primis.phmsa.dot.gov/dimp/perfmeasures.htm

	2011	2012	2013	2014	2015	Total
Number of MJFR submitted	8,342.00	7,607.00	9,920.00	11,718.00	12,855.00	50,442.00
Hazardous Leaks eliminated/repaired	192,011.00	187,416.00	191,129.00	206,067.00	213,684.00	990,307.00
% MJFR of Total Hazardous Leaks eliminated/repaired	4.30	4.10	5.20	5.70	6.00	5.50