**REQUEST NO. AG 18.01:**

In reference to the Company's response to Staff Data Request ENG 10.02:

a. Is it the Company's position that it is no longer required to complete the Accelerated Main Replacement Program (AMRP) by 2030 as required by the Commission Order in Docket Numbers 09-0166/09-0167?
b. If yes, what is the Company's current projected completion date of AMRP?

**RESPONSE:**

a and b: It is Peoples Gas' intention, assuming it receives and continues to receive appropriate cost recovery, to complete the AMRP by 2030, *i.e.*, in 20 years from the 2011 inception. However, it is Peoples Gas' legal interpretation that the Commission linked its discussion of the timeline for completion of the accelerated main replacement program ("AMRP") with its approval of the cost recovery mechanism (Rider ICR). The Illinois Appellate Court reversed the Commission's approval of that cost recovery mechanism. Accordingly, it is Peoples Gas' position that the Commission language related to timing of completion of the AMRP is no longer applicable.

**ICC Docket No. 12-0512**
**The Peoples Gas Light and Coke Company's Response to**
**Attorney General Data Requests AG 18.01-18.16**
**Dated: January 3, 2013**

**REQUEST NO. AG 18.03:**

Please describe what criteria must be present in order for a main segment to be given the following MRI (Main Replacement Index) value:

a. 3.0 to 3.99
b. 4.0 to 4.99
c. 5.0 to 5.99
d. 6.0 and above

**RESPONSE:**

The same criteria can be a factor in any of the above categories. The numeric value is a result of summing the associated maintenance activities. Criteria taken into account include breaks (defined as a 100% circumferential separation of pipe), crack at taps (defined as having less than a 100% circumferential separation of pipe- cracks are usually located at service taps and on bell joint ends), pipe wall thickness based on pipe coupons, visual observation, and incidence of leak and other repairs. Each of these criteria is assigned a multiplication factor based on "Break Equivalents" which is then multiplied by the number of occurrences.

The sum of the aforementioned numerical value is then multiplied by a factor based on pipe material, operating pressure, diameter, street type and pavement cover. The result of this calculation is a value that is assigned to each segment known as the Main Ranking Index (MRI). The MRI value is rounded to the nearest quarter point, (i.e. The Uniform Main Rank Index (UMRI)) and sorted in descending order in order to identify those segments with the highest incidence of UMRI points per block.

As a simplified example: If Peoples Gas experienced a "break" on a medium pressure pipe it would be assigned a numeric value of 2.0. If Peoples Gas experienced a second "break" on that same line it would be assigned another numeric value of 2.0, bringing the total rating to 4.0.

For a complete explanation see document titled "Main Ranking System" attached to the response to Data Request AG18.08.

**ICC Docket No. 12-0512**
**The Peoples Gas Light and Coke Company's Response to**
**Attorney General Data Requests AG 18.01-18.16**
**Dated: January 3, 2013**

**REQUEST NO. AG 18.05:**

In reference to the Company's response to City of Chicago's Data Request 2.06:

a. Is it correct that five segments with an MRI greater than 6.0 were replaced in 2012?
b. If yes, on what dates were each of the segments replaced?
c. If no, has the 2013 replacement schedule been revised to include those segments?

**RESPONSE:**

**a.** No. The list is tracked on a monthly basis. Gas main segments will appear on the list as they hit the threshold and are removed from the list when they are replaced. The City of Chicago's Data Request 2.06 references Data Request AG 10.15. That data request asked for a "list of cast iron main segments and their locations that have an MRI rating greater than 6.0". The list is a snapshot of gas main segments that met the criteria at the time of the data request (October 2012).

**b.**

| | | | | |
|---|---|---|---|---|
| 2201 | W | 18TH | ST | Scheduled 2013 |
| 2124 | N | HAMLIN | AVE | Scheduled 2013 |
| 1420 | N | MONTICELLO | AVE | Retired 12/17/12 |
| 6724 | N | LEOTI | AVE | Retired 12/21/12 |
| 6614 | N | OGALLAH | AVE | Scheduled 2013 |
| 6028 | W | 64TH | ST | Retired 12/21/12 |

**c.** Yes. Please see the response to subpart (b).

**ICC Docket No. 12-0512**
**The Peoples Gas Light and Coke Company's Response to**
**Attorney General Data Requests AG 18.01-18.16**
**Dated: January 3, 2013**

**REQUEST NO. AG 18.06:**

In reference to the Company's response to City of Chicago's Data Request 2.05, what is the average number of leak repairs required before the Company decides to replace a main segment? What are the "field conditions", technical criteria or other factors that a shop manager may consider in evaluating the situation?

**RESPONSE:**

The number of leak repairs before the Company decides to replace a main segment is dependent on the type of repair, the condition of the main, the operating pressure of the main and the geographic location of the main. (For a complete explanation see document titled "Main Ranking System" attached to Data Request AG18.8).

For an explanation of the "field conditions", technical criteria or other factors that a shop manager may consider in evaluating the situation, see the response to Data Request AG 18.04.

**ICC Docket No. 12-0512**
**The Peoples Gas Light and Coke Company's Response to**
**Attorney General Data Requests AG 18.01-18.16**
**Dated: January 3, 2013**

**REQUEST NO. AG 18.08:**

Please provide all documentation relating to or describing the Company's practices related to the use of MRI and DIMP.

**RESPONSE:**

See attachments:

1. Main Ranking System "PGL AG 18.08 Attach 01"
2. Distribution Integrity Management Plan "PGL AG 18.08 Attach 02"

# Main Ranking System

## Overview:

The Main Ranking System was developed to identify and prioritize gas main segments as candidates for replacement. Each individual segment is evaluated, based on its maintenance history. Criteria taken into account include breaks, crack at taps, pipe wall thickness based on pipe coupons, visual observation, incidence of leak and other repairs. Each of these criteria is assigned a multiplication factor based on "Break Equivalents" which is than multiplied by the number of occurrences.

The sum of the aforementioned numerical value is then multiplied by a factor based on pipe material, operating pressure, diameter, street type and pavement cover. The result of this calculation is a value that is assigned to each segment known as the Main Ranking Index (MRI). The MRI value is rounded to the nearest quarter point, (i.e. The Uniform Main Rank Index (UMRI)) and sorted in descending order in order to identify those segments with the highest incidence of UMRI points per block.

All segments that have accumulated a UMRI rating greater than 6.0 are placed on a schedule to be retired. Segments with a UMRI value greater than 3.0 are viewed as possible replacement candidates when performing work on adjacent segments and when evaluating the extent of Public & System Improvement projects.

## Basis of Formula:

The formula used to compute the **Main Ranking Index (MRI)** per block for each main segment is as follows:

$$\mathbf{MRI = B + C + VPE + KU + RE}$$

Where:

**B** = Break equivalent based on breaks.

**C** = Break equivalent based on cracks at taps.

**VPE** = Break equivalent based on visual observations of the main.

**KU** = Break equivalent based on pipe coupon analysis on the segment.

**RE** = Break equivalent based on repairs done on the main.

**(See Appendix "A" for detailed formula criteria)**

## Definitions:

| | |
|---|---|
| **Breaks** | A Break is defined as a 100% circumferential separation of pipe. |
| **Break Equivalent** | A Break Equivalent is a weighting factor assigned to each ranking category (B, C, VPE, KU and RE) in order to achieve a comparable balance. |
| **Coupon Analysis** | A coupon analysis is a defined as a physical sample that is obtained from the gas main and evaluated in a lab for thickness and weight. |
| **Cracks at Tap** | A crack is defined as having less than a 100% circumferential separation of pipe. Cracks are usually located at service taps and on bell joint ends. |
| **MRI** | The Main Ranking Index (MRI) is a summation of main factor values (B, C, VPE, KU and RE) assigned to a main segment to indicate rank order. Higher numbers indicate greater maintenance activities. |
| **Main Ranking System** | The Main Ranking System is a computer program utilized for calculating, querying and reporting the main segment ranking index as well as identifying all associated maintenance activities that make up the rating. |
| **Repairs** | Includes all maintenance activities associated with a segment. (Excludes leak repairs captured under the Breaks and Cracks categories). |
| **UMRI** | Rounding factor (MRI rounded to the nearest quarter point). |
| **Visual Observation** | Visual inspection of a segment (Good versus Poor). This category is logged whenever maintenance is performed on a segment. |
| **Segment** | A Gas Main Segment is a unique unit of pipe identified by: year installed, pressure, size, material, in-street and square mile boundary. Since segments can range in length from one (1) foot to a mile (5,280 feet), the MRI takes this into account and recalibrates the segments based on a one block length (660 feet). |

# Derivations of the Break Equivalents B, C, VPE, KU and RE:

## B – Break Equivalent Based on breaks:

*(Analysis includes number of breaks, operating pressure, street classification (business versus residential), and pavement coverage multiplied by a Break Equivalent Factor).*

$$B = K_1 * B_1 * MR_{20}$$

## C – Break Equivalent Based on Cracks at Taps:

*(Analysis includes number of cracks at taps, operating pressure, street classification (business versus residential), and pavement coverage multiplied by a Break Equivalent Factor.)*

$$C = K_2 * C_1 * MR_{20}$$

## VPE – Break Equivalent Based on Visual Observations of the Main:

*(Analysis is based on a visual inspection ((Poors versus Goods) (or coupon analysis if available)) and also takes into account material, operating pressure, main size, street classification (business versus residential), pavement coverage multiplied by a Break Equivalent Factor.)*

**For Low Pressure:**

If KU = 0 (coupon analysis has not been performed)
Then

$$VPE = MIN [1, MATL\_FACT * MR_{10}] * MIN [(B + C + (1 * STR\_FACT)), VP_1 + VP_2]$$

Else (coupon analysis has been performed)

$$VPE = MIN [1, MATL\_FACT * MR_{10}] * MIN [(B + C + KU + (2 * STR\_FACT)), VP_1 + VP_2]$$

**For Medium or High Pressure:**

If KU = 0 (coupon analysis has not been performed)
Then

$$VPE = MIN [(B + C + (1 * MR_{11} * STR\_FACT)), VP_1 + VP_2]$$

Else (coupon analysis has been performed)

$$VPE = MIN [(B + C + KU + (2 * MR_{11} * STR\_FACT)), VP_1 + VP_2]$$

## KU – Break Equivalent Based on Pipe Segment Coupon Analysis:

*(Analysis includes physical evaluation of material condition, operating pressure, street classification (business versus residential), and pavement coverage multiplied by a Break Equivalent Factor.)*

$$KU = K_5 * MR_5 * MR_{20}$$

## RE – Break Equivalent Based on Repairs Performed on the Main Segment:

*(Analysis is based on a visual inspection (Poors versus Goods)and also takes into account material, operating pressure, main size, street classification (business versus residential), pavement coverage and (or coupon analysis if available) multiplied by a Break Equivalent Factor.)*

$$RE = MIN [(LR + OR), (2 * MR_{20})]$$

The method of calculating LR and OR depends on the material and operating pressure of the main segment.

**If the main is low pressure, and not Cast Iron or Ductile Iron, then:**

$$LR = (K_6 * MR_6 * MR_{20} * MR_{10}), \text{ and}$$
$$OR = (K_7 * MR_7 * MR_{20} * MR_{10}).$$

**If the main is medium or high pressure, and not Cast Iron or Ductile Iron, then:**

$$LR = (K_6 * MR_6 * MR_{20}), \text{ and}$$
$$OR = (K_7 * MR_7 * MR_{20}).$$

**For Cast Iron and Ductile Iron mains LR and OR depends on operating pressure and the number of un-repaired Joints.**

**Joints:**
If the year of main installation is < 1932
then
Joints (number of joints) = (Length of main / 12),
else
Joints (number of joints) = (Length of main / 16).

**For low pressure Cast or Ductile Iron main,**

**and where** $(MR_6 + MR_7) \leq 0.5 *$ Joints
**Then,** $LR = (K_6 * MR_6 * MR_{20} * MR_{10})$,
**And,** $OR = (K_7 * MR_7 * MR_{20} * MR_{10})$.

**For medium or high pressure Cast or Ductile Iron main,**

**and where** $(MR_6 + MR_7) \leq 0.5 *$ Joints
**Then,** $LR = (K_6 * MR_6 * MR_{20})$,
**And,** $OR = (K_7 * MR_7 * MR_{20})$.

**For medium or high pressure Cast or Ductile Iron main,**

**Where:** $(MR_6 + MR_7) > 0.5 *$ Joints
**Then,** Un-repaired Joints = Joints - $(MR_6 + MR_7)$
**However**, if calculated un-repaired Joints $\leq 0$ from above formula then un-repaired joints = 0

$L_1 = MR_6 * (\text{Un-repaired Joints} / (MR_6 + MR_7))$
$R_1 = MR_7 * (\text{Un-repaired Joints} / (MR_6 + MR_7))$

**For low pressure Cast or Ductile Iron main,**

**and where** $(MR_6 + MR_7) > 0.5 *$ Joints
**Then,** $LR = (K_6 * L_1 * MR_{20} * MR_{10})$,
**And,** $OR = (K_7 * R_1 * MR_{20} * MR_{10})$.

**For medium or high pressure Cast or Ductile Iron main,**

**and where** $(MR_6 + MR_7) > 0.5 *$ Joints
**Then,** $LR = (K_6 * L_1 * MR_{20})$,
**And,** $OR = (K_7 * R_1 * MR_{20})$.

# APPENDIX A

## Formula Details:

**Constants used in calculating break equivalents are:**

$K_1$ = 1.0 associated with B.

$K_2$ = 0.5 associated with C.

$K_3$ = 0.5 associated with VPE.

$K_4$ = 1.0 associated with VPE.

$K_5$ = 1.0 associated with KU.

$K_6$ = 0.1 associated with RE.

$K_7$ = 0.01 associated with RE

**Definitions of other terms and factors used in calculating break equivalents are:**

$B_1$ = Number of breaks repaired on the main segment (excludes third party damage).

$C_1$ = Number of cracks at tap repaired on the main segment (excludes third party damage).

$C_2$ = Number of pipe coupons analyzed on the main segment.

$C_3$ = Sum of thickness of all coupons taken on the main segment.

$C_4$ = Average thickness of all coupons taken on the main segment.

$C_5$ =Sum of break equivalents assigned to the main segment based on each pipe coupon analyzed

(See **Appendix B** for definition of method to assign break equivalents to coupons).

$P_1$ = Number of visually observed "poors" based on maintenance performed before 1990.

$G_1$ = Number of visually observed "goods" based on maintenance performed before 1990.

$P_2$ = Number of visually observed "poors" based on maintenance performed after 1989

$G_2$ = Number of visually observed "goods" based on maintenance performed after 1989.

$L_1$ = Number of leak repairs recorded in maintenance data (the reason for work is leak).

$R_1$ = Number of repairs recorded in maintenance data for reasons other than leak (and for work types other than test holes and internal clamping)

$MR_3$ = Factor based on the number of visual "poors" versus" goods" observed during maintenance prior to 1990.

$$MR_3 = P_1 * (P_1/ (P_1 + G_1)) \text{ providing } P_1 > 0, \text{ else } MR_3 = 0$$

$MR_4$ = Factor based on the number of visual "poors" versus" goods" observed during maintenance after 1989.

$$MR_4 = P_2 * (P_2/ (P_2 + G_2)) \text{ providing } P_2 > 0, \text{ else } MR_4 = 0$$

$MR_5$ = Factor based on pipe wall thickness from each pipe coupon taken from the main segment.

$$\text{If } (P_1 + P_2 + G_1 + G_2) > 0 \text{ and } (P_1 + P_2) / (P_1 + P_2 + G_1 + G_2) \geq 0.5$$

Then

$$MR_5 = C_5 * [(P_1 + P_2) / (P_1 + P_2 + G_1 + G_2)$$

else

$$MR_5 = 0.5 * C_5$$

$MR_6$ = Factor based on the number of leak repairs made on the main segment.

$$\text{If } (L_1 - B_1 - C_1) > 0$$

Then

$$MR_6 = L_1 - B_1 - C_1$$

Else

$$MR_6 = 0$$

**$MR_7$** = Factor based on the number of repairs made on the main segment for reasons other than leaks, and for work types other than test holes or internal clamping (planned upgrading).

If $R_1 \geq 0$
then
$MR_7 = R_1$
else
$MR_7 = 0$

**$MR_{10}$** = Factor based on the pipe diameter of the main segment.
FOR CAST IRON MAIN SEGMENTS it reflects the decreasing likelihood large diameter cast iron main will break due to increased beam strength of the pipe. Nominally shall be 6 divided by the diameter of the main in inches. However, the upper limit shall be 2.0 and the lower limit shall be 0.2. Thus the following values shall be used:
For pipe diameter less than 4" use 2.0; for 4" use 1.5; for 6" use 1.0; for 8" use 0.75; for 10" use 0.6; for 12" use 0.5; for 16" use 0.4; for 20" use 0.3; for 24" use 0.25; and for 30" and larger use 0.2.
FOR MAINS OF MATERIALS OTHER THAN CAST IRON:
For ductile iron use 0.5 time the cast iron value for the same diameter with a lower limit of 0.2.
For coated steel and polyethylene plastic use 0.4 times the cast iron value for the same diameter with a lower limit of 0.2.
Only nominal amounts of mains exist other than coated steel, polyethylene plastic, cast and ductile iron. Use 2.0 for all diameters of these mains which are primarily of only from 1 to 4 inches in diameter. (CAB, bare steel, and copper).

**$MR_{11}$** = Factor based on the operating pressure of the main segment.
Use 1.0 for low pressure mains ($\leq$ 12" W.C.)
Use 2.0 for medium pressure mains (> 12" W.C. and < 25 PSIG)
Use 3.0 for high pressure mains ($\geq$ 25 PSIG)

**$MR_{12}$** = Factor based on the street type in which the main segment is laid.
Use 1.0 for residential streets
Use 1.2 for business streets

**$MR_{13}$** = Factor based on the. percent of pavement cover between the main and buildings.
Use 1.0 for mains with < 50% paving from main to building.
Use 1.2 for mains with $\geq$ 50% paving from main to building.
Use 1.0 for mains where percent paving is not established (the field is blank).

**$MR_{14}$** = Factor to adjust main segment length to a per block basis.
Shall be 660 feet divided by the length of the main segment in feet, providing that the result is less than 1.0, else shall be 1.0.

**$MR_{20}$** = $MR_{11} * MR_{12} * MR_{13} * MR_{14}$

**$VP_1$** = $K_3 * MR_3 * MR_{20}$

**$VP_2$** = $K_4 * MR_4 * MR_{20}$

**STR_FACT** = $MR_{12} * MR_{13}$

**MATL_FACT** = 2.0 for ductile iron mains and 1.0 for every other main material

# APPENDIX B

## DEFINITION OF PIPE COUPON THICKNESS POINTS BASED ON WALL THICKNESS OF COUPONS FOR CAST AND DUCTILE IRON MAINS

The minimum tolerable wall thickness for selected diameter cast and ductile iron mains is based on 2'-0" of frost and a buried depth of 3'-6". The minimum wall thickness varies with material, diameter and beam length. For a given material and diameter, the minimum wall thickness varies with the length of pipe between supporting blocking. Since PGL purchased cast iron in 12' lengths prior to 1932 and 16' lengths after 1931 the table below specifies minimum wall thickness for cast iron in both lengths as well as for ductile iron pipe in 16' lengths. The minimum values for wall thickness for pipe sizes and material were derived based on ring crushing failure and beam loading equations.

TABLE NO.1
FOR CAST AND DUCTILE IRON MAINS

MINIMUM TOLERABLE WALL THICKNESS IN INCHES

| NOMINAL MAIN DIAMETER | PRE-1932 CAST IRON (11' SPANS) | POST-1931 CAST IRON (14' SPANS) | ALL DUCTILE IRON (14' SPANS) |
|---|---|---|---|
| 4" | 0.340" | NA | NA |
| 6" | 0.333" | 0.329". | 0.089" |
| 8" | 0.240" | 0.237" | 0.075" |
| 10" | 0.191" | 0.189" | NA |
| 12" | 0.217" | 0.191". | 0.110" |
| 16" | 0.286" | 0.251" | 0.145" |
| 20" | 0.355" | 0.312" | 0.180" |
| 24" | 0.422" | 0.372" | 0.214" |
| 30" | 0.520" | 0.458" | 0.263" |
| 36" | 0.623" | 0.548" | 0.315" |
| 48" | 0.827" | 0.727" | 0.418" |

NA = Nominal or no appreciable main of that diameter and type exists in PGLC system.

Cast iron pipe was manufactured to various standards over the approximately 100 years it was installed by PGL. While some pipe purchased prior to 1929 had even thicker walls than 1929 bell and spigot pipe (such as pipe purchased prior to 1900), the dimension standards, including wall thickness for 1929 bell and spigot pipe in 12 foot lengths is conservatively used as the typical standard for all pipe purchased prior to

1932 and is listed in the Table NO.2 below. Also listed is the 1952 standard wall thickness for cast iron mechanical joint pipe. While the date of transition to the thinner wall of the 1952 standard is not known, it is conservatively assumed that all cast iron pipe purchased after 1931 was made to the 1952 standard.

TABLE NO.2
DIMENSION STANDARDS FOR CAST IRON PIPE IN INCHES

| | 1929 BELL & SPIGOT PIPE(1) | | | 1952 MECHANICAL JOINT PIPE(2) | | |
|---|---|---|---|---|---|---|
| Nominal Diameter | Pipe O.D. | Pipe I.D. | Wall Thickness | Pipe O.D. | Pipe I.D. | Wall Thickness |
| 4" | 4.800 | 4.000 | 0.400 | 4.800 | 4.040 | 0.380 |
| 6" | 6.900 | 6.040 | 0.430 | 6.900 | 6.080 | 0.410 |
| 8" | 9.050 | 8.150 | 0.450 | 9.050 | 8.230 | 0.410 |
| 10" | 11.100 | 10.120 | 0.490 | 11.100 | 10.220 | 0.440 |
| 12" | 13.200 | 12.120 | 0.540 | 13.200 | 12.240 | 0.480 |
| 16" | 17.400 | 16.160 | 0.620 | 17.400 | 16.400 | 0.500 |
| 20" | 21.600 | 20.240 | 0.680 | 21.600 | 20.440 | 0.570 |
| 24" | 25.800 | 24.280 | 0.760 | 25.800 | 24.540 | 0.630 |
| 30" | 31.740 | 30.040 | 0.850 | 32.000 | 30.300 | 0.850 |
| 36" | 37.960 | 36.060 | 0.950 | 38.300 | 36.560 | 0.870 |
| 48" | 50.500 | 47.980 | 1.260 | 50.800 | 48.680 | 1.060 |
| Also commonly found in PGL's pre-1929 pipe is: | | | | | | |
| 24" | 25.500 | 24.00 | 0.75 | | | |

NOTES:

(1) Use the 1929 standard for original wall thickness of cast iron pipe installed prior to 1932.

(2) Use the 1952 standard for original wall thickness of cast iron pipe installed after 1931.

For ductile iron pipe standard dimensions are given in the Table No.3 below based on ASA Standard 21.50 dated May 10, 1965.

TABLE NO.3
DIMENSIONS STANDARDS FOR DUCTILE IRON PIPE IN INCHES (1)

| NOMINAL DIAMETER | PIPE O.D. | PIPE I.D. | WALL THICKNESS |
|---|---|---|---|
| 4" | 4.80 | 4.29 | 0.29 |
| 6" | 6.90 | 6.28 | 0.31 |
| 8" | 9.05 | 8.39 | 0.33 |
| 10" | 11.10 | 10.40 | 0.35 |
| 12" | 13.20 | 12.46 | 0.37 |
| 16" | 17.40 | 16.66 | 0.37 |
| 20" | 21.60 | 20.82 | 0.39 |
| 24" | 25.80 | 24.98 | 0.41 |
| 30" | 32.00 | 31.06 | 0.47 |
| 36" | 38.30 | 37.24 | 0.53 |
| 48" | 50.80 | 49.50 | 0.65 |

NOTES:

(1) This standard is for pipe laid without blocking on un-tamped fill. It is based on a depth of cover of 5' and a working pressure of 250 PSIG, or more, for diameters up to 36" and to 200 PSIG for 48". It is also based on pipe minimum tensile yield strength of 60,000 PSI and minimum yield strength of 42,000 PSI. While PGL laid pipe on blocking, the standard above is believed typical of the pipe dimensions used for operating pressures of 25 PSIG or less, that were far below those pressures covered in the standard for pipe of these wall thicknesses.

According to ASA Standard 21.50, for ductile iron pipe a variation in manufacturing of pipe wall thickness of up to -.05" was acceptable in pipe up to 8" in diameter, a variation of up to -.06" for 12" diameter, and a variation of up to -.07" for 16" through 36" diameter pipe. For purpose of wall thickness loss computations, it is assumed all pipe met wall thickness specifications listed in Table No. 3 when manufactured.

**Main Rank Index (MRI)** points assigned on the basis of pipe coupons shall be determined by the wall thickness of the coupon relative to the minimum tolerable levels that are listed in Table No.1, and to the amount of pipe wall loss. For cast iron coupons, the original wall thickness will be based on Table No.2 data values. For cast iron pipe installed prior to 1932, the 1929 standard for original wall thickness shall be used from Table No.2 to compute pipe wall loss; and for pipe installed after 1931, the 1952 standard for original wall thickness shall be used from Table No.2 to compute pipe wall loss. For ductile iron pipe coupons, the original wall thickness shall be based on data values from Table No.3 to compute pipe wall loss.

Values for the pipe coupon **MRI** points are determined based on the following five conditions:

1. If the remaining pipe wall is greater than, or equal to, the value specified in Table No.1, plus 50% of the difference between the original value from Table No.2 for cast iron (or Table No.3 for ductile iron) less the appropriate value in Table No.1, then pipe coupon **MRI** points = zero (0) break equivalents.

2. If the remaining pipe wall is greater than, or equal to, the appropriate value specified in Table No.1, but by less than 50% of the difference between the original value given in Table No.2 for cast iron (or in Table No.3 for ductile iron), then pipe coupon **MRI** points = 0.2 break equivalents.

3. If the remaining pipe wall is less than the appropriate value specified in Table No.1, but greater than, or equal to, 75% of the Table No.1 value, then pipe coupon **MRI** points = 1.0 break equivalent.

4. If the remaining pipe wall is less than 75% of the appropriate value specified in Table No.1, but greater than, or equal to, 50% of the Table No.1 value, then pipe coupon **MRI** points = 2.0 break equivalents.

5. If the remaining pipe wall is less than 50% of the appropriate value specified in Table No.1, then pipe coupon **MRI** points = 4.0 break equivalents.

Two examples of application of the pipe coupon thickness point algorithm are:

1. A pre-1932 6" cast iron pipe coupon is found to have an average wall thickness of 0.100 inches. Table No.1 specifies a minimum wall thickness of 0.333" for 12' lengths of 6" pre- 1932 cast iron pipe. A 6" coupon of 0.100 inches is less than 50% of the specified Table No.1 value. Therefore, based on condition 5 above, assign a **MRI** of 4.0 break equivalents to the main segment based on coupon thickness.

2. A post-1931 6" cast iron pipe coupon is found to have an average thickness of 0.380 inches. This is greater, by an amount of 0.051", than the 0.329" minimum for 14' lengths specified in Table No.1 for 6" post-1931 cast iron pipe. Using the

1952 standard from Table No.2, the original pipe wall thickness was 0.41 inches, or 0.030" less than the original pipe wall thickness. As determined by condition 1 above, assign the pipe coupon **MRI** points equivalent to zero break equivalents.

Table NO.4 attached gives the break equivalents determined from the above equations for ranges of coupon thickness from the various diameters of cast and ductile iron main.

CAST AND DUCTILE IRON PIPE DEFICIENCY POINTS BASED ON BREAK EQUIVALENTS ASSIGNED TO PIPE COUPONS

| NOMINAL DIAMETER | ORIGINAL WALL THICKNESS IN INCHES | MINIMUM THICKNESS | BREAK EQUIVALENTS ASSIGNED FOR REMAINING AVERAGE COUPON WALL THICKNESS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 4 POINTS | | 2 POINTS | | 1 POINTS | | 0.2 POINTS | | 0POINTS | |
| | | | WALL THICKNESS | | WALL THICKNESS | | WALL THICKNESS | | WALL THICKNESS | | WALL THICKNESS | |
| | | | FROM | TO | FROM | TO | FROM | TO | FROM | TO | FROM | TO |
| FOR CAST IRON PIPE INSTALLED PRIOR TO 1932 IN 12' LENGTHS (11' span between blocking) | | | | | | | | | | | | |
| 4 | 0.400 | 0.340 | 0.000 | 0.169 | 0.170 | 0.254 | 0.255 | 0.338 | 0.339 | 0.369 | 0.370 | >.370 |
| 6 | 0.430 | 0.333 | 0.000 | 0.166 | 0.167 | 0.249 | 0.250 | 0.321 | 0.332 | 0.381 | 0.382 | >.382 |
| 8 | 0.450 | 0.240 | 0.000 | 0.119 | 0.120 | 0.179 | 0.180 | 0.238 | 0239 | 0.344 | 0.345 | >.345 |
| 10 | 0.490 | 0.191 | 0.000 | 0.095 | 0.096 | 0.142 | 0.143 | 0.189 | 0.190 | 0.340 | 0.341 | >.341 |
| 12 | 0.540 | 0.217 | 0.000 | 0.108 | 0.109 | 0.162 | 0.163 | 0.215 | 0.216 | 0.378 | 0.379 | >.379 |
| 16 | 0.620 | 0286 | 0.000 | 0.142 | 0.143 | 0214 | 0.215 | 0284 | 0.285 | 0.452 | 0.453 | >.453 |
| 20 | 0.680 | 0.355 | 0.000 | 0.177 | 0.178 | 0.265 | 0.266 | 0.353 | 0.354 | 0.517 | 0.518 | >.518 |
| 24 | 0.760 | 0.422 | 0.000 | 0.210 | 0.211 | 0.316 | 0.317 | 0.420 | 0.421 | 0.590 | 0.591 | >.592 |
| 30 | 0.850 | 0.520 | 0.000 | 0259 | 0.260 | 0.389 | 0.390 | 0.518 | 0.519 | 0.684 | 0.665 | >.685 |
| 36 | 0.950 | 0.623 | 0.000 | 0.311 | 0.312 | 0.467 | 0.468 | 0.621 | 0.622 | 0.786 | 0.787 | >.788 |
| 48 | 1260 | 0.827 | 0.000 | 0.413 | 0.414 | 0.619 | 0.620 | 0.825 | 0.826 | 1.043 | 1.044 | >1.045 |
| FOR CAST IRON PIPE INSTALLED AFTER 1931 IN 16' LENGTHS (14' span between blocking) | | | | | | | | | | | | |
| 4 | 0.380 | NA | 0.000 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 6 | 0.410 | 0.329 | 0.000 | 0.164 | 0.165 | 0.246 | 0.247 | 0.327 | 0.328 | 0.369 | 0.370 | > 370 |
| 8 | 0.410 | 0.237 | 0.000 | 0.118 | 0.119 | 0.177 | 0.178 | 0.235 | 0.236 | 0.323 | 0.324 | > 324 |
| 10 | 0.440 | 0.189 | 0.000 | 0.094 | 0.095 | 0.141 | 0.142 | 0.187 | 0.188 | 0.314 | 0.315 | > 315 |
| 12 | 0.480 | 0.191 | 0.000 | 0.094 | 0.095 | 0.142 | 0.143 | 0.189 | 0.190 | 0.334 | 0.335 | > 335 |
| 16 | 0.500 | 0.251 | 0.000 | 0.125 | 0.126 | 0.187 | 0.188 | 0.249 | 0250 | 0.375 | 0.376 | >.376 |
| 20 | 0.570 | 0.312 | 0.000 | 0.155 | 0.156 | 0.233 | 0.234 | 0.310 | 0.311 | 0.440 | 0.441 | > 441 |
| 24 | 0.630 | 0.372 | 0.000 | 0.185 | 0.186 | 0.278 | 0279 | 0.371 | 0.372 | 0.500 | 0.501 | >.501 |
| 30 | 0.850 | 0.458 | 0.000 | 0.228 | 0.229 | 0.343 | 0.344 | 0.456 | 0.457 | 0.653 | 0.654 | > 654 |
| 36 | 0.870 | 0.548 | 0.000 | 0273 | 0.274 | 0.410 | 0.411 | 0.546 | 0.547 | 0.708 | 0.709 | > 704 |
| 48 | 1.060 | 0.727 | 0.000 | 0.363 | 0.364 | 0.544 | 0.545 | 0.725 | 0.726 | 0.894 | 0.895 | >.895 |
| FOR DUCTILE IRON PIPE INSTALLED IN 16' LENGTHS (14' span between blocking) | | | | | | | | | | | | |
| 4 | 0.290 | NA | 0.000 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 6 | 0.310 | 0.089 | 0.000 | 0.044 | 0.045 | 0.066 | 0.067 | 0.068 | 0.089 | 0.199 | 0.200 | > 200 |
| 8 | 0.330 | 0.075 | 0.000 | 0.037 | 0.038 | 0.055 | 0.056 | 0.073 | 0.074 | 0.202 | 0.203 | > 203 |
| 10 | 0.350 | NA | 0.000 | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| 12 | 0.370 | 0.110 | 0.000 | 0.054 | 0.055 | 0.082 | 0.083 | 0.108 | 0.109 | 0.239 | 0.240 | > 240 |
| 16 | 0.370 | 0.145 | 0.000 | 0.072 | 0.073 | 0.108 | 0.109 | 0.143 | 0.144 | 0.257 | 0.258 | > 258 |
| 20 | 0.390 | 0.180 | 0.000 | 0.089 | 0.090 | 0.134 | 0.135 | 0.178 | 0.179 | 0.284 | 0.285 | > 285 |
| 24 | 0.410 | 0.214 | 0.000 | 0.106 | 0.107 | 0.160 | 0.161 | 0.212 | 0.213 | 0.311 | 0.312 | > 312 |
| 30 | 0.470 | 0.263 | 0.000 | 0.131 | 0.132 | 0.196 | 0.197 | 0.261 | 0.262 | 0.366 | 0.367 | > 367 |
| 36 | 0.530 | 0.315 | 0.000 | 0.157 | 0.158 | 0.235 | 0236 | 0.313 | 0.314 | 0.422 | 0.423 | > 423 |
| 48 | 0.650 | 0.418 | 0.000 | 0.208 | 0.209 | 0.313 | 0.314 | 0.416 | 0.417 | 0.533 | 0.534 | > 534 |