

REINFORCED CONCRETE PIPE PRE-INSTALLATION INSPECTION & REPAIR MANUAL



Kentucky Transportation Cabinet
Kentucky Department of Highways
Division of Materials
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January 2014

Kentucky Transportation Cabinet

“Disclaimer Statement”

The information and photographs provided herein are intended to be used as a “guideline” for the inspection and repair of reinforced concrete pipe prior to installation. This manual is NOT a substitute for current specifications, special notes, or other official documents contained in contract proposals or scopes of work. This manual may be modified at any time by the Kentucky Transportation Cabinet to accommodate changes in policy, procedure, or specification. Questions regarding this manual can be directed to the Kentucky Transportation Cabinet, Division of Materials, Concrete and Physical Properties Section at (502) 564-3160.

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I. Standards & Specifications

- Kentucky Transportation Cabinet Department of Highways **Standard Specifications for Road and Bridge Construction** details specifications for reinforced concrete pipe
 - Section 701 – Culvert Pipe, Entrance Pipe, Storm Sewer Pipe, and Equivalents
 - Section 810 – Pipe and Pipe Arches
- Sections 701 and 810 refer to several individual AASHTO specifications
 - M170: Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (ASTM C76)
 - M206: Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe (ASTM C506 with differences)
 - M207: Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (ASTM C507 with differences)
 - M242: Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe (ASTM C655 with differences)
- **Kentucky Method 64-115: Approval Process for Producers of Culvert Pipe** details the approval process for producers of culvert pipe.
- The **List of Approved Materials** (LAM) lists the approved “Concrete Pipe Producers.”
- The standard specifications, KM 64-115 and the LAM are all available at our website: <http://transportation.ky.gov/materials/Pages/default.aspx>

The following representations and pictures in Sections III through X will use the following categories:

ACCEPT – Green

REPAIR⁽¹⁾ – Orange

REJECT⁽²⁾ – Red

QUESTIONABLE: ENGINEER’S DECISION - Blue

- (1) If the contractor/producer elects not to repair the pipe then the pipe will be rejected.
- (2) Pipe that is rejected will not be used on a KYTC project.

II. Acceptance & Repair Guidelines

Scope

Reinforced concrete pipe production is an imperfect operation and occasionally pipe comes from the mold in need of repair or outright rejection. Pipes are often damaged during handling prior to and during the installation process. This document provides guidance for the repair of reinforced concrete pipe at the manufacturing facility and at the project site. This manual provides guidance to determine whether to repair or reject reinforced concrete pipe. Repairs will be acceptable if, in the opinion of the Engineer, the repairs are sound, properly finished and cured and the repaired pipe conforms to the requirements of this document. Structural repair must be completed by the producer using materials and methods approved by the Division of Materials. Pipe repairs that only require cosmetic repair procedures may be completed by the contractor or the producer unless otherwise stated.

Producers are required to submit a plant Quality Control plan and concrete mix design(s) to the Division for review and approval as per KM 64-115.

Producers must appear on the List of Approved Materials.

General

Any repairs required beyond the scope of this document may be submitted to the Director of the Division of Materials for evaluation on a case-by-case basis. Such repair proposals should include a photograph or sketch of the affected area and a detailed repair proposal.

The QC inspector must document additional information in the plant book when a pipe is rejected. The date of manufacture, lot number, size, quantity and reason for rejection must be included. Rejected pipe or pipe requiring repair should be clearly marked in a location to prevent the defective pipe from mistakenly being shipped or installed.

Repairs to pipe should be properly finished, cured, and sound. Structural repairs to 'extra protection' pipe (Section 810.03.05) must be witnessed by the Department inspector.

II. Acceptance & Repair Guidelines

Definitions

Definitions of terms relating to concrete pipe, see AASHTO M 262.

AASHTO	American Association of State Highway and Transportation Officials
LAM	List of Approved Materials
KM	Kentucky Method
RCP	Precast reinforced concrete pipe
Division	Division of Materials
Engineer	Responsible Department Engineer
Pipe	Individual joint or section of RCP
Producer	Manufacturer included on the LAM
Spall	Damage to hardened concrete
Structural Repair	Depths 0.5 inch and greater, reinforcement steel is exposed.
Cosmetic Repair	Depth range up to 0.5 inch, reinforcing steel is not exposed.

II. Acceptance & Repair Guidelines

Acceptance

Kentucky Department of Highways **Standard Specifications for Road and Bridge Construction** details specifications for reinforced concrete pipe in Section 701 – Culvert Pipe, Entrance Pipe, Storm Sewer Pipe, and Equivalents, and in Section 810 – Pipe and Pipe Arches. These two sections refer to several individual AASHTO standards, including M170 (ASTM C76), M206 (ASTM C506), M207 (ASTM C507) and M242 (ASTM C655). KM 64-115 details the approval process for producers of culvert pipe. Cover Height Standard Drawings are numbered RDI-001 through RDI-012. The LAM lists the approved producers of concrete pipe.

The standard specifications, KM 61-115 and the LAM are all available at our website: <http://transportation.ky.gov/materials/Pages/default.aspx> .

Department guidance to the above specifications are included in this document. Other guidance or direction may be provided by the Engineer and communicated to the Producer and Contractor on an individual basis.

Rejection

Pipe shall be subject to rejection if it fails to conform to any of the specification requirements. Pipe may be rejected because of any of the following:

- Fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.
- Defects that indicate problems with proportioning, mixing, and molding, or surface defects indicating honey-combed or open texture that would adversely affect the function of the pipe or long term integrity of the pipe.
- Damaged or cracked ends, where such damage extends into the gasket surface area leading to a questionable joint seal. End cracks greater than 0.01 inch in width at any point in the gasket surface area will be a cause for rejection.
- Any continuous crack having an unloaded surface width of 0.01 inch or more and extending for a length of 12 inches or more, regardless of position in the wall of the pipe. Any continuous crack having an unloaded surface width less than 0.01 inch may be accepted at the discretion of the Engineer. Verify the 0.01 inch crack limit with a feeler gauge conforming to the requirements of AASHTO T 280.

II. Acceptance & Repair Guidelines

Structural Repair Procedures (By Producer Only)

- Areas to be repaired must be clean, sound and free of contaminants.
- Make a vertical surface along the perimeter of the damaged area.
- Remove concrete for a minimum of 1 inch behind all exposed reinforcement where at least 2 inches of continually exposed reinforcement is visible.
- Provide an aggregate fractured surface.
- Clean the repair surface.
- Apply an approved bonding agent unless the manufacturer's instructions expressly state that a bonding agent is not required. Fill the area with an approved repair material in accordance with the Manufacturer's recommendations.
- Cure the repaired area either in accordance with the manufacturer's recommendations, or, in accordance with the approved quality control plan for a minimum of 24 hours.
- Evaluate the repaired area by applying a moderate blow with a 16 ounce hammer at several locations within the repaired area.
- The repaired area should closely match both the texture and integrity of the undamaged adjacent concrete surfaces.

II. Acceptance & Repair Guidelines

Cosmetic Repair Procedures (By Producer or Contractor)

- Areas to be repaired must be clean, sound and free of contaminants.
- Provide an aggregate fractured surface.
- Saturate the repair surface with clean water to provide a SSD condition when applicable.
- Fill the area with a thoroughly mixed approved repair material in accordance with the manufacturer's recommendations, or a mortar mix.
- Cure the repaired area in accordance with the manufacturer's recommendations for a minimum of 24 hours.
- Evaluate the repaired area by applying a moderate blow with a 16 ounce hammer at several locations of the repaired area.
- The repaired area should closely match both the texture and integrity of the undamaged adjacent concrete surfaces.

II. Acceptance & Repair Guidelines

End Spalls and Damage

- Spalls/chips/damage on the bell or spigot, which do not affect the gasket surface, shall not be cause for rejection, provided the circumferential length of a single spall on the pipe end is not more than $\frac{1}{4}$ the inside diameter or the circumferential length of multiples spalls combined does not exceed $\frac{1}{2}$ of the inside pipe diameter, and reinforcing steel is not exposed.
- If the spall(s) meet the criteria above but the surface of the circumferential reinforcing steel is exposed then the pipe may be repaired in the field by others under the supervision of the Engineer. The area must be clean and sound. Asphalt mastic is to be applied to the damaged area with sufficient coverage to protect the reinforcing steel.
- If the gasket contact surface is damaged, the circumferential length of a single spall may not exceed $\frac{1}{4}$ the inside diameter or the total circumferential length of multiple spalls combined may not exceed $\frac{1}{2}$ of the inside pipe diameter. If reinforcing steel is not exposed then the pipe may be repaired in accordance with the **cosmetic repair** procedures. If the reinforcing steel is exposed then the pipe may be repaired in accordance with the **structural repair** procedures.
- Pipes with end spalls that do not meet the criteria above are to be rejected.

II. Acceptance & Repair Guidelines

Spalls, other than End Spalls

- Repairs to the inner and outer barrel will be permitted as follows:
- A spalled area that **does not** reveal the reinforcing steel may be repaired in accordance with **cosmetic repair** procedures. A spalled area that **does** reveal the reinforcing steel may be repaired in accordance with the **structural repair** procedures. The spalled area may not exceed the surface area limits in the table below. If more than one spall is present then the total surface area of the spalls combined may not exceed the surface areas limits in the table below.
- Spalling to the barrel which exceeds these limits may be rejected. Acceptance with repair will only be permitted based on a case-by-case evaluation by the Engineer.

Total Surface Area Limits (square inches)		
Pipe ID (inches)	Structural Repair	Cosmetic Repair
15	45	90
18	54	109
24	72	145
30	90	181
36	109	217
42	127	253
48	145	289
54	163	326
60	181	362
66	199	398
72	217	434
78	235	470

Total Surface Area Limits (square inches)		
Pipe ID (inches)	Structural Repair	Cosmetic Repair
84	253	506
90	271	543
96	289	579
102	307	615
108	326	651
114	344	687
120	362	723
126	380	760
132	398	796
138	416	832
144	434	868

II. Acceptance & Repair Guidelines

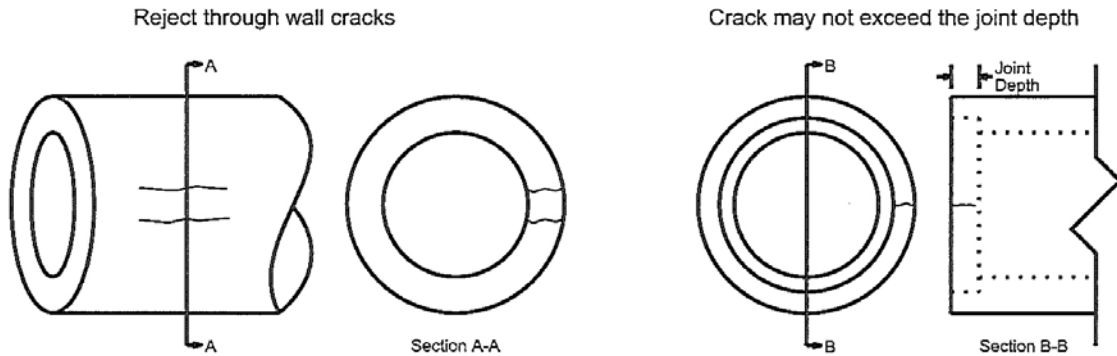
Spalls Around Lift Holes

- Minor spalls less than 2 inches from the edge of the lift hole may be repaired in accordance with **cosmetic repair** procedures. The aggregate fractured surface need not be obtained. Reinforcing steel may be visible prior to completing the repair.
- Minor spalls developed at the lift hole during installation may be repaired at the same time the lift hole is plugged. Repairs are to be made by others under the supervision of the Engineer using repair materials from the LAM.
- Major spalls greater than 2 inches on the outer barrel around the lift hole which do not expose the reinforcement may be repaired in accordance with the **cosmetic repair** procedures.
- Major spalls greater than 2 inches on the outer barrel around the lift hole which reveal the reinforcement must be repaired in accordance with the **structural repair** procedures. Major spalls must be repaired by the Producer using repair materials from the LAM.

II. Acceptance & Repair Guidelines

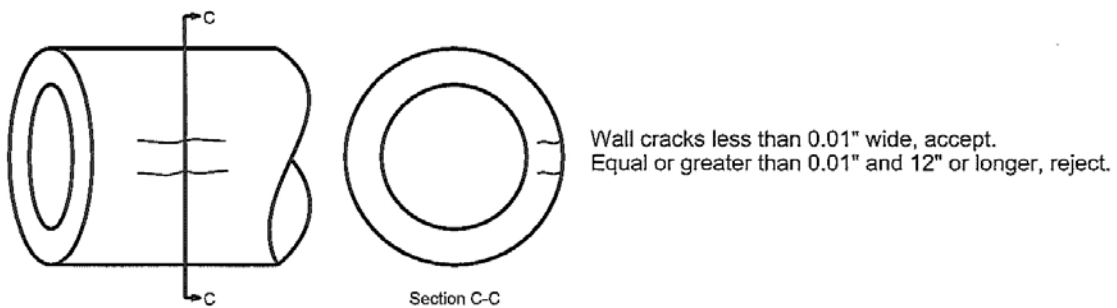
Cracks: Through Wall Cracks

- Reject pipe sections exhibiting a through wall crack, except a single end crack that does not exceed the depth of the joint. Pipe sections rejected for cracks may not be repaired.



Cracks: Non-through Wall Cracks

- Any pipes which exhibit non-through wall crack(s) having a surface width less than 0.01 inch will be accepted. Pipes exhibiting non-through wall cracks greater than or equal to 0.01 inch in width and 12 inches or more in length will be rejected. Pipe sections rejected for cracks may not be repaired.



II. Acceptance & Repair Guidelines

Manufacturing Defects

Honeycombing, consolidation, and other mixture defects:

- Pipe exhibiting honeycombing or mixture defects that **do not** expose the reinforcing steel may be repaired using the **cosmetic repair** procedures.
- Pipe exhibiting honeycombing or mixture defects that **do** expose the reinforcing steel may be repaired using the **structural repair** procedures.
- The maximum unconsolidated area allowed to be repaired may not expose reinforcing steel or exceed the surface area limits in the table below.
- Pipes with defects which exceeds these limits may be rejected. Acceptance with repair will only be permitted based on a case-by-case evaluation by the Engineer.

Total Surface Area Limits (square inches)	
Pipe ID (inches)	Cosmetic Repair
15	90
18	109
24	145
30	181
36	217
42	253
48	289
54	326
60	362
66	398
72	434
78	470

Total Surface Area Limits (square inches)	
Pipe ID (inches)	Cosmetic Repair
84	506
90	543
96	579
102	615
108	651
114	687
120	723
126	760
132	796
138	832
144	868

II. Acceptance & Repair Guidelines

Manufacturing Defects

Bug Holes:

- Very small surface voids are normally considered a cosmetic defect that does not require repair except under the following circumstances:
 - Large surface voids over 0.5 inch in diameter or clusters of bug holes covering an area larger than 100 in² and reinforcing steel is not exposed are required to be repaired using the **cosmetic repair** procedures.
 - All bug holes that expose reinforcing steel may affect the performance of the pipe and must be repaired using the **structural repair** procedures.
- Repairs are to be made by the Producer using repair materials from the LAM.

Plastic “Tear” Cracks:

Occasionally, concrete pipe develops ‘tear’ cracks at their surface during initial manufacturing/handling, prior to curing, when tensile stresses exceed the concrete strength. These cracks are predominantly located along the shoulder of the spigot joint where the pipe transitions to full wall depth, although minor cracking located on the outer barrel or the pipe end may occur less frequently.

- The concern is that the crack exposes the reinforcing steel and/or the bond between the concrete and the reinforcing steel may be compromised to an extent which is not visible.
- Shoulder or outer barrel tear cracks through the pipe wall shall be cause for rejection and are not repairable.
- For all other tear cracks, acceptance will be the Engineer’s decision based on the extent of the tear crack.
- Shoulder tear cracks or outer barrel tear cracks eligible for repair must be repaired by v-grooving along the length of the crack. Complete the repair following the structural repair procedures.
- The repair of tear cracks must be made by the Producer using repair materials from the LAM.

II. Acceptance & Repair Guidelines

Manufacturing Defects

Exposed Circumferential Steel on Pipe End:

A 0.25 inch minimum cover is required for circumferential reinforcement on pipe ends. Occasionally the surface of the circumferential steel is exposed on the pipe ends. This happens due to manufacturing error. The exposed steel must be protected. If the length of exposed steel is less than 12 inches it may be repaired in the field by others under the supervision of the Engineer. The area must be clean and sound. Asphalt mastic is to be applied to the damaged area with sufficient coverage to protect the reinforcing steel. If the exposure length is greater than 12 inches the pipe shall be rejected.

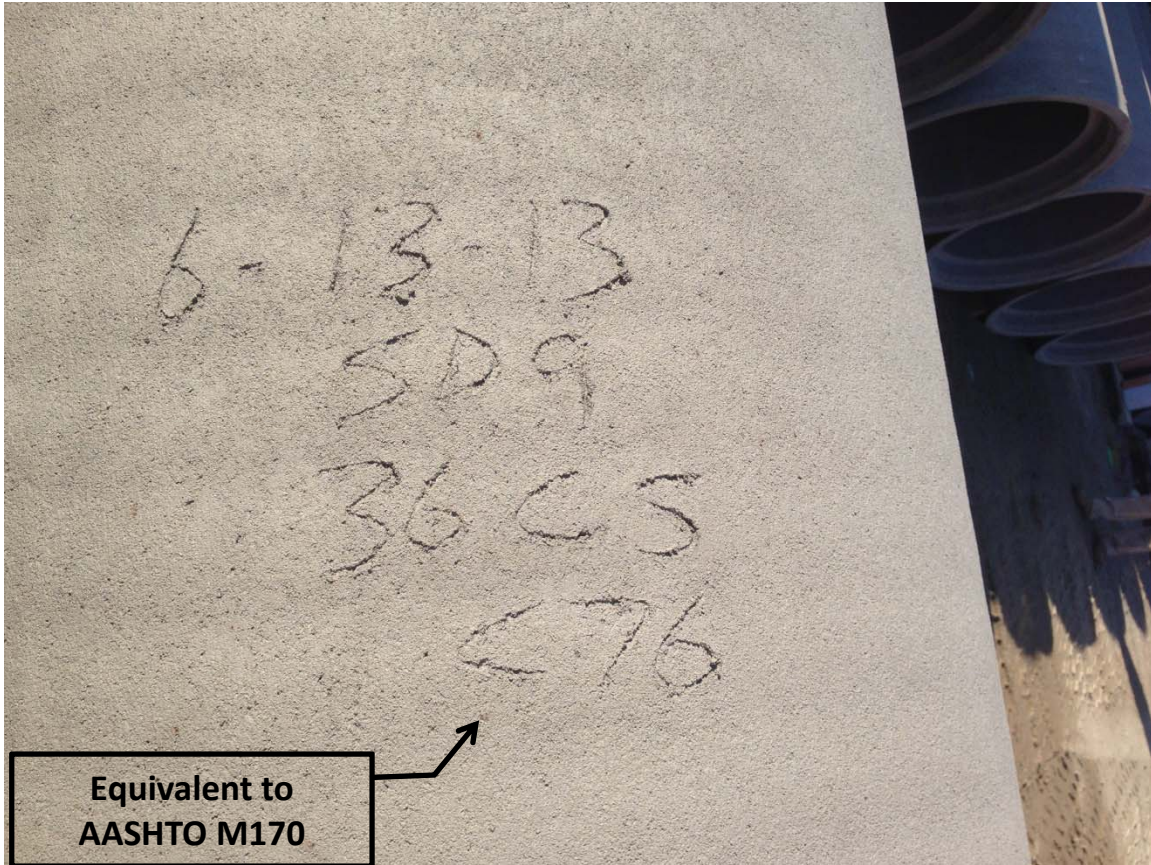
Exposed “End Tips”:

The presence of exposed longitudinal “end tips” of the reinforcing cage at the pipe ends or spacers on the pipe wall shall not be cause for rejection. If there are small air gaps around this visible steel, asphalt mastic can be applied to protect the steel or the air gaps can be repaired following the cosmetic repair procedures. An aggregate fractured surface is not required.

Cage Shadow:

Some manufacturing processes may reveal the reinforcing cage even though the section has sufficient cover. If the inspector is concerned about insufficient cover, the Producer shall be responsible for proving the cover depth by using a pachometer, coring the pipe, or another Engineer approved method. If insufficient cover does exist than the pipe shall be rejected.

III. Workmanship



Product Marking

- Markings should be legible and provided by indentation (scribing) or other approved means
- Date of manufacture
- Name of producer and plant identification
- Pipe size and pipe class
- Specification designation

ACCEPT

III. Workmanship



Lift Hole

- Lift hole was **NOT** formed, machine cast, or drilled

REJECT

III. Workmanship



Lift Hole

- Lift hole was drilled

ACCEPT

III. Workmanship



Workmanship (form work)

- Poor workmanship leaving exposed steel
- Repair may only be made by the producer using approved materials

REPAIR (Structural)

III. Workmanship



Workmanship

- Poor workmanship leaving exposed steel
- Repair may only be made by the producer using approved materials

REPAIR (Structural)

IV. Consolidation



Consolidation

- Questionable areas of consolidation
- Surface area limitations are provided in Repair Guidelines (Section II)
- Engineer's decision to accept or reject

QUESTIONABLE: ENGINEER'S DECISION

IV. Consolidation



Consolidation

- Unacceptable consolidation and quality control
- **NOT** repairable

REJECT

IV. Consolidation



Consolidation

- Questionable consolidation and quality control
- Surface area limitations are provided in Repair Guidelines (Section II)
- Engineer's decision to accept or reject
- Do not allow multiple sticks of these
- Repair may only be made by the producer using approved materials if deemed necessary

QUESTIONABLE: ENGINEER'S DECISION

IV. Consolidation



Consolidation

- Questionable consolidation and quality control
- Surface area limitations are provided in Repair Guidelines (Section II)
- Engineer's decision to accept or reject
- Do not allow multiple sticks of these
- Repair may only be made by the producer using approved materials if deemed necessary

QUESTIONABLE: ENGINEER'S DECISION

IV. Consolidation



Consolidation

- Unacceptable consolidation and quality control
- **NOT** repairable

REJECT

IV. Consolidation



Bug Hole

- Unacceptable consolidation and quality control
- See Repair Guidelines (Section II)

REPAIR (Cosmetic)

V. Surface Tears



Surface Tear

- Surface tears are non-load induced defects in the pipe
- Do not allow multiple sticks of these
- Engineer's decision to accept or reject
- The example above is considered **ACCEPTABLE**

QUESTIONABLE: ENGINEER'S DECISION

V. Surface Tears



Surface Tear

- Reinforcing steel may be exposed
- Extent of damage may not be entirely visible
- Engineer's decision to accept or reject based on depth of tear
- Do not allow multiple sticks of these
- Repair may only be made by the producer using approved materials if deemed necessary

QUESTIONABLE: ENGINEER'S DECISION

V. Surface Tears



Surface Tear

- Surface tear
- Concrete may have delaminated from reinforcing steel
- Reinforcing steel may be exposed
- Extent of damage may not be entirely visible

REJECT

V. Surface Tears



Surface Tear

- Reinforcing steel may be exposed
- Extent of damage may not be entirely visible
- Engineer's decision to accept or reject based on depth of tear
- Do not allow multiple sticks of these
- Repair may only be made by the producer using approved materials if deemed necessary

QUESTIONABLE: ENGINEER'S DECISION

V. Surface Tears



End Tear

- Potentially exposes reinforcing steel and weakens the bell
- Crack does not go all the way through pipe wall or interfere with gasket surface
- Engineer's decision to accept or reject based on depth of tear
- Do not allow multiple sticks of these
- Repair may only be made by the producer using approved materials if deemed necessary

QUESTIONABLE: ENGINEER'S DECISION

V. Surface Tears



End Tear

- Multiple end tears
- Potentially exposes reinforcing steel and weakens the bell
- This tear goes all the way through the wall but does not interfere with the gasket surface
- Engineer's decision to accept or reject based on depth of tear
- Repair may only be made by the producer using approved materials if deemed necessary

QUESTIONABLE: ENGINEER'S DECISION

VI. Bell and Spigot



End Damage

- Spigot damage due to rough handling
- Damage length is less than $\frac{1}{4}$ of the inside diameter
- The gasket contact surface is damaged and must be repaired
- Reinforcement steel is exposed
- Repair may only be made by the producer using approved materials

REPAIR (Structural)

VI. Bell and Spigot



End Damage

- Spigot damage due to rough handling
- Damage length is less than $\frac{1}{4}$ of the inside diameter
- The gasket contact surface is damaged and must be repaired
- Repair may only be made by the producer using approved materials

REPAIR (Structural)

VI. Bell and Spigot



End Damage

- Bell damage due to rough handling
- Damage length is less than $\frac{1}{4}$ of the diameter
- The gasket contact surface is damaged and must be repaired
- Reinforcement steel is exposed
- Repair may only be made by the producer using approved materials

REPAIR (Structural)

VI. Bell and Spigot



End Damage

- Bell damage due to rough handling
- Damage length of combined areas is greater than $\frac{1}{2}$ of the diameter
- The gasket contact surface is damaged
- Reinforcement steel is exposed

REJECT

VI. Bell and Spigot



End Damage

- Bell damage due to rough handling
- Gasket contact surface is not damaged
- Damage length of single area is greater than $\frac{1}{4}$ of the diameter
- Steel exposure is greater than 12 inches

REJECT

VI. Bell and Spigot



End Damage

- Bell damage due to rough handling
- Gasket contact surface is not damaged
- Steel exposure is less than 12 inches
- Surface area must be clean and sound before repair
- Repairable by others under supervision of Engineer
- Repair in the field using approved materials
- See Repair Guidelines (Section II)

REPAIR (Cosmetic)

VI. Bell and Spigot



End Damage

- Bell damage due to rough handling
- Damage length is less than $\frac{1}{4}$ of the inside diameter
- Reinforcement steel is exposed
- The gasket contact surface is damaged and must be repaired
- Repair may only be made by the producer using approved materials

REPAIR (Structural)

VI. Bell and Spigot

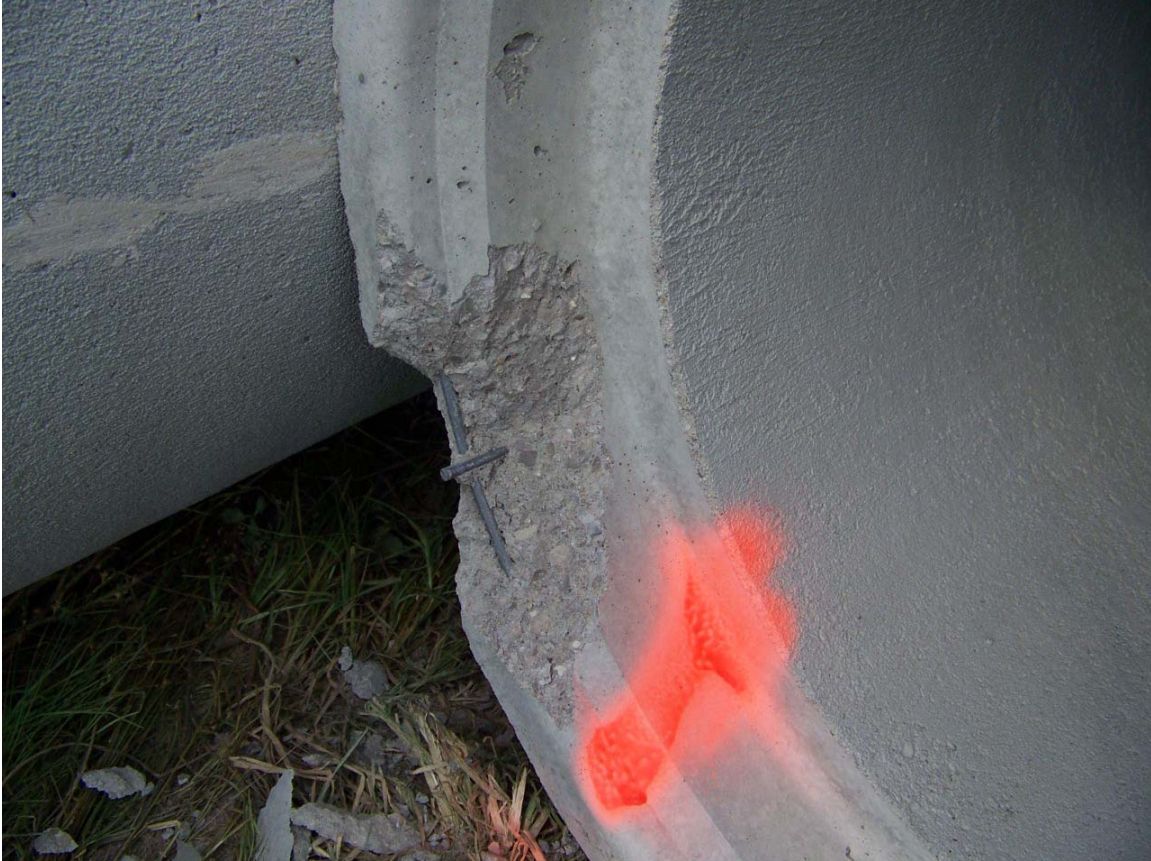


End Damage

- Bell damage due to rough handling
- Damage length is less than $\frac{1}{4}$ of the inside diameter
- The gasket contact surface is damaged and must be repaired
- Repair may only be made by the producer using approved materials

REPAIR (Structural)

VI. Bell and Spigot



End Damage

- Bell damage due to rough handling
- Damage length is less than $\frac{1}{4}$ of the inside diameter
- Reinforcement steel is exposed
- The gasket contact surface is damaged and must be repaired
- Repair may only be made by the producer using approved materials

REPAIR (Structural)

VI. Bell and Spigot

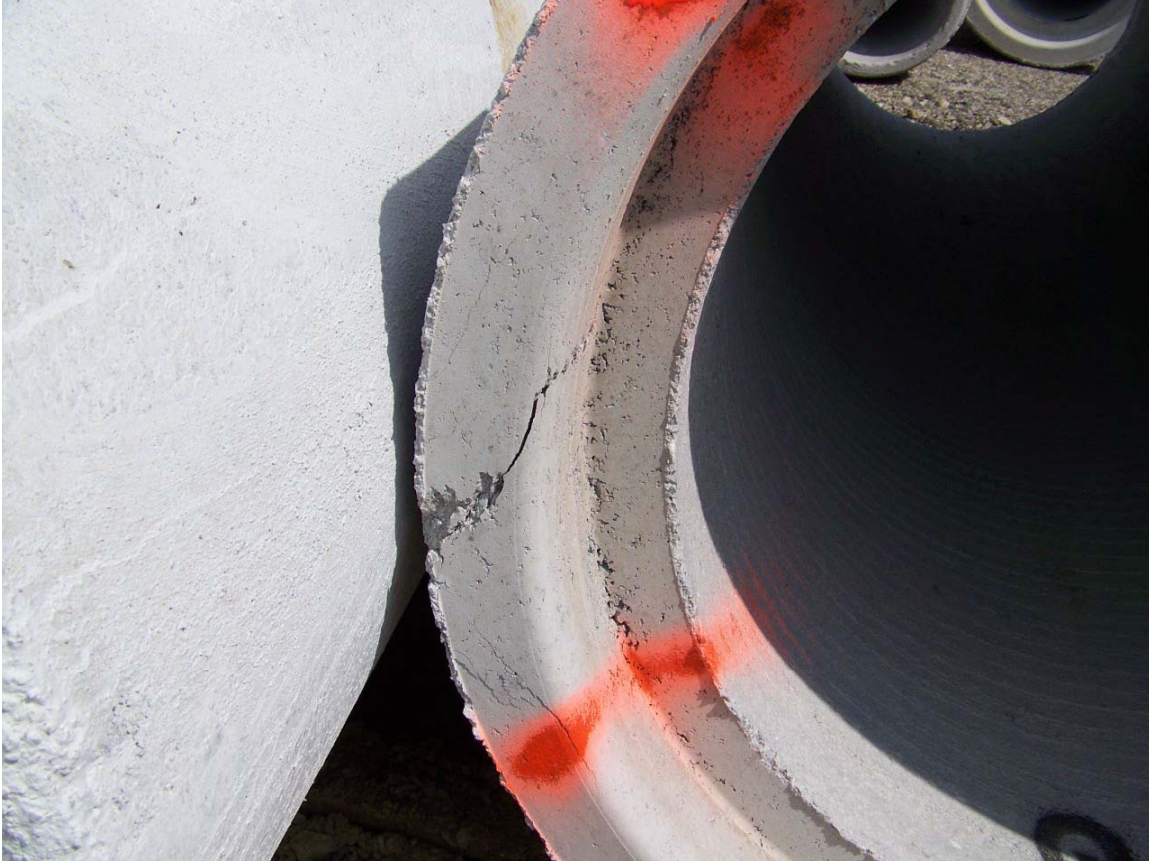


End Damage

- Bell damage due to rough handling
- Cracking goes into the gasket contact surface and the bell is weakened to an unknown extent
- Repair may only be made by the producer using approved materials

QUESTIONABLE: ENGINEER'S DECISION

VI. Bell and Spigot



End Damage

- Bell damage due to rough handling
- Cracking goes into the gasket contact surface and the bell is weakened to an unknown extent
- Repair may only be made by the producer using approved materials

QUESTIONABLE: ENGINEER'S DECISION

VII. Cracks



Crack

- A crack passing through the wall (visible on both interior and exterior surfaces) is cause for **REJECTION** and is **NOT REPAIRABLE**.
- Any continuous crack having a surface width of 0.01" or more and extending for a length of 12" or more, regardless of position in the wall of the pipe is cause for **REJECTION** and is **NOT REPAIRABLE**.
- This pipe is **ACCEPTABLE**.

QUESTIONABLE: ENGINEER'S DECISION

VII. Cracks



Multiple Cracks

- Often pipe is too small to determine if cracking passes through the wall (visible on both interior and exterior surfaces)
- Crack widths are less than 0.01 inches
- Do not allow multiple sticks of these
- Engineer's decision to accept or reject
- This pipe is to be **REJECTED**

QUESTIONABLE: ENGINEER'S DECISION

VII. Cracks



Spigot Crack

- Crack extends all the way through and the entire depth of the joint
- **NOT** repairable

REJECT

VII. Cracks

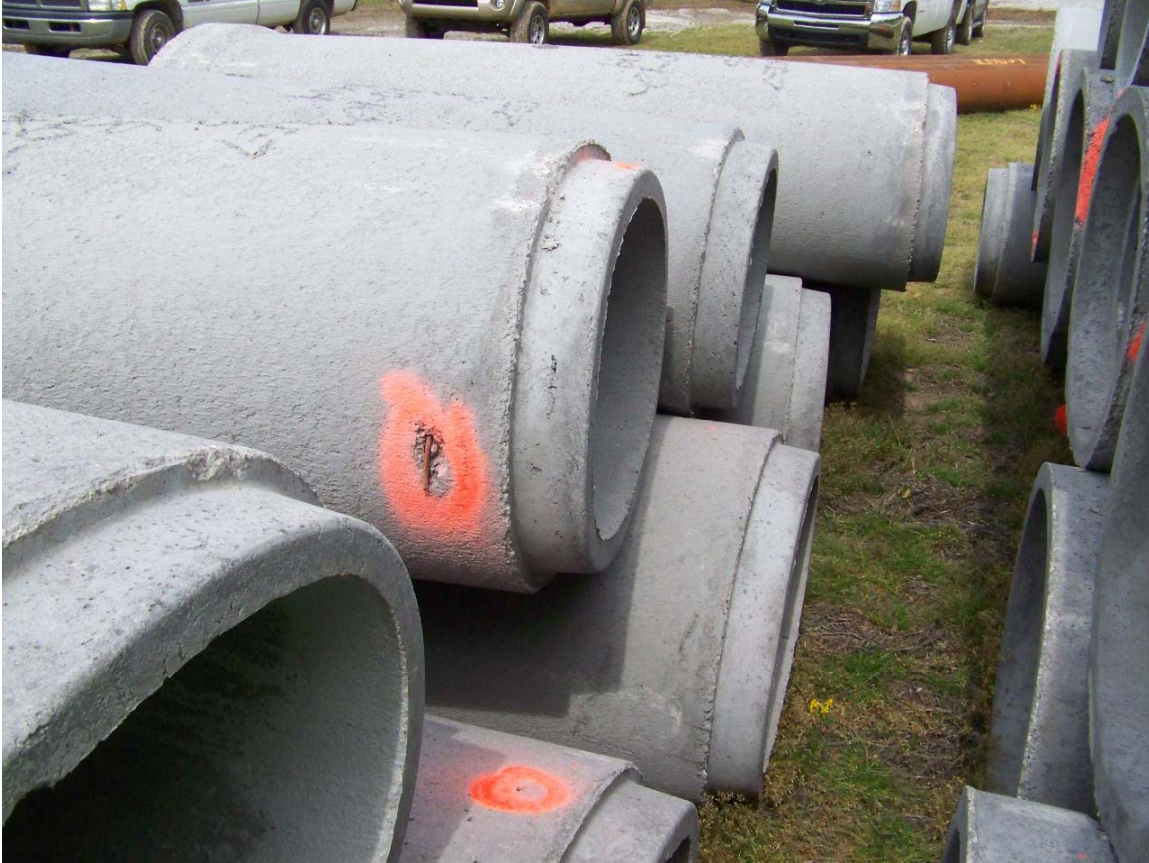


Spigot Crack

- Crack goes the entire depth of the spigot
- Crack is not visible on the interior of the pipe
- Crack width does not exceed 0.01 inch
- Do not allow multiple sticks of these
- Engineer's decision to accept or reject
- This pipe is considered **ACCEPTABLE**

QUESTIONABLE: ENGINEER'S DECISION

VIII. Exposed Steel and Insufficient Cover



Exposed Steel

- In no case shall the cover over the circumferential reinforcement be less than 0.5 inches as measured to any surface other than the pipe ends
- **NOT** repairable

REJECT

VIII. Exposed Steel and Insufficient Cover



Exposed Steel

- In no case shall the cover over the circumferential reinforcement be less than 0.5 inches as measured to any surface other than the pipe ends
- **NOT** repairable

REJECT

VIII. Exposed Steel and Insufficient Cover



Exposed Steel

- A 0.25 inch minimum cover is required for circumferential reinforcement on pipe ends but this occasionally happens due to manufacturing error.
- Do not allow multiple sticks of these
- Exposure length is less than 12 inches
- Repairable by others under supervision of Engineer
- Repair in the field using approved materials
- See Repair Guidelines (Section II)

REPAIR (Apply Mastic)

VIII. Exposed Steel and Insufficient Cover



Exposed Steel

- A 0.25 inch minimum cover is required for circumferential reinforcement on pipe ends but this occasionally happens due to manufacturing error.
- Do not allow multiple sticks of these
- Exposure length is less than 12 inches
- Repairable by others under supervision of Engineer
- Repair in the field using approved materials
- See Repair Guidelines (Section II)

REPAIR (Apply Mastic)

VIII. Exposed Steel and Insufficient Cover



Exposed Steel

- A 0.25 inch minimum cover is required for circumferential reinforcement on pipe ends but this occasionally happens due to manufacturing error.
- Do not allow multiple sticks of these
- Exposure length is less than 12 inches
- Repairable by others under supervision of Engineer
- Repair in the field using approved materials
- See Repair Guidelines (Section II)

REPAIR (Apply Mastic)

VIII. Exposed Steel and Insufficient Cover



Insufficient Cover

- In no case shall the cover over the circumferential reinforcement be less than 0.5 inches as measured to any surface other than the pipe ends (Pipe ends require a minimum 0.25 inches of cover)
- Shown is the end of the longitudinal reinforcement
- The same minimum cover of the longitudinal reinforcement is required and KYTC considers it essential.
- The bar end is not the problem. It's appearance indicates a lack of cover which is **UNACCEPTABLE**.

REJECT

VIII. Exposed Steel and Insufficient Cover



Insufficient Cover

- In no case shall the cover over the circumferential reinforcement be less than 0.5 inches as measured to any surface other than the pipe ends (Pipe ends require a minimum 0.25 inches of cover)
- Shown is the end of the longitudinal reinforcement
- The same minimum cover of the longitudinal reinforcement is required and KYTC considers it essential.
- The bar end is not the problem. It's appearance indicates a lack of cover which is **UNACCEPTABLE**.

REJECT

VIII. Exposed Steel and Insufficient Cover



Insufficient Cover

- Cage shadow
- **MAY** be an indicator there is insufficient cover over reinforcing steel
- May be necessary to utilize destructive or non-destructive testing to evaluate cover
- See Repair Guidelines (Section II)
- Engineer's decision to accept or reject
- This pipe was forensically evaluated and was considered **ACCEPTABLE**

QUESTIONABLE: ENGINEER'S DECISION

IX. Material Handling



Material Handling

- When using a fork apparatus to transport pipe care should be taken to ensure the pipe does not bounce causing cracks, damaged ends, etc.
- When using a fork apparatus the interior surface may become slightly scratched. This is normal and not a cause for rejection.

IX. Material Handling



Material Handling

- Alternating the bells and spigots during loading/transport helps ensure the ends will not be damaged.
- Secure pipes with straps through the barrel to prevent rolling.
- Use strap guards to protect contact points between pipe and strap/chain. These are especially important when securing the pipe with a chain through the barrel.

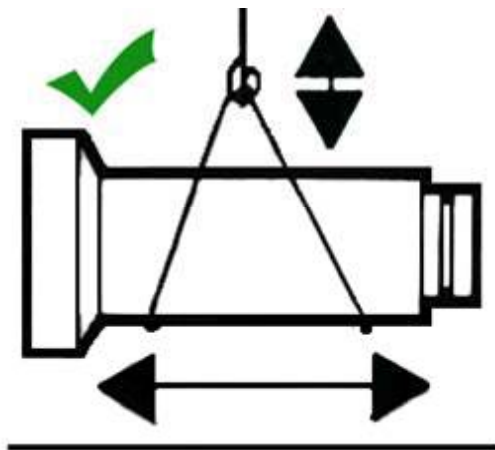
IX. Material Handling



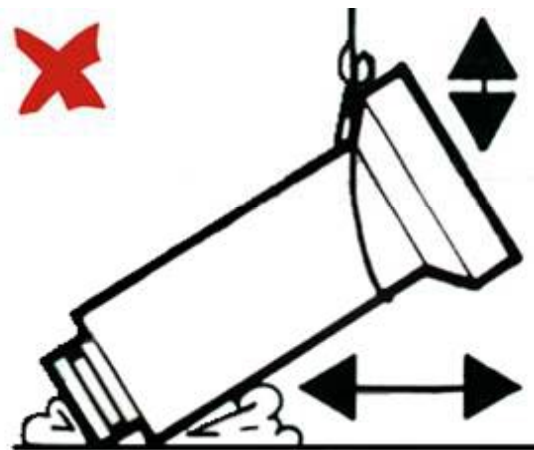
Material Handling

- Pipes should be unloaded on a dry level area
- When pipes are unloaded they should not be allowed to collide. This could damage the ends of the pipe. Blocks should be placed at each end of the pipe to prevent them from colliding during unloading.
- Pipes with bells should be supported with timbers on both ends to prevent point loads which may damage the ends of pipe during storage

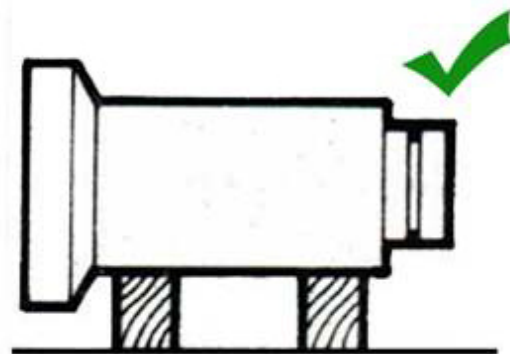
IX. Material Handling



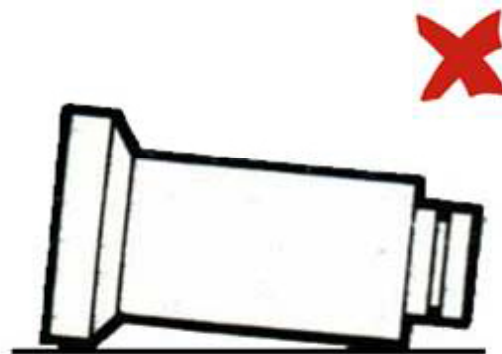
Balance



Do Not Drag



Support on Barrel



Support on Bell

X. Repair Examples



Repairs

- Before and after photos of an acceptable spigot repair
- Repairs are only allowed by the producer using approved materials

ACCEPT

X. Repair Examples



Repairs

- Proper bell repair
- Repairs are only allowed by the producer using approved materials

ACCEPT

X. Repair Examples



Repairs

- Proper bell repair
- Repairs are only allowed by the producer using approved materials

ACCEPT

X. Repair Examples



Repairs

- Allowable surface tear repair
- Repairs are only allowed by the producer with approved materials

ACCEPT

X. Repair Examples



Repairs

- Before and after photos of an **ACCEPTABLE** repair of the exposed circumferential reinforcement at the pipe end
- Gasket contact surface is not damaged
- Repairable by others under supervision of Engineer
- Repair in the field using approved materials
- See Repair Guidelines (Section II)

ACCEPT

X. Repairs Examples



Sawed End from Damaged Bell

- Longitudinal steel is allowed to be exposed on the ends
- Circumferential steel exposure on the end is less than 12 inches and must be repaired as per the Repair Guidelines (Section II)
- **Acceptable pending repair** to the exposed circumferential steel
- This is a good use for pipe with damaged ends if they can be used in other structures

ACCEPT