

MINNESOTA DEPARTMENT OF TRANSPORTATION	TRANSMITTAL LETTER NO. (20-02)
DEVELOPED BY: Design Standards	MANUAL: Standard Plates
ISSUED BY: Office of Project Management and Technical Support, Design Support Section	DATED: March 16, 2020
SUBJECT: Standard Plates 3000, 3006, 3007, and 3014	

The following Standard Plates have been modified:

- 3000 - Reinforced Concrete Pipe
- 3006 - Gasket Joint for R.C. Pipe
- 3007 - Shear Reinforcement for Precast Drainage Structures
- 3014 - Reinforced Concrete Pipe Arch

See attached Summary of Changes for details.

INSTRUCTIONS:

- Record the transmittal letter number, date, and subject on the transmittal record sheet located in the front of the manual. The previous Transmittal Letter number issued for this manual was 20-01, dated February 5, 2020.
- Remove from the Standard Plates manual:
 - Standard Plate Index, Sheets 1-4 of 4, Numerical Index of Standard Plates
 - Standard Plate 3000L
 - Standard Plate 3006G
 - Standard Plate 3007E
 - Standard Plate 3014J
- Insert into the Standard Plates manual:
 - Standard Plate Index, Sheets 1-4 of 4, Numerical Index of Standard Plates (March 5, 2020)
 - Standard Plate 3000M, Sheets 1-6 of 6, Reinforced Concrete Pipe (March 5, 2020)
 - Standard Plate 3006H, Sheets 1-2 of 2, Gasket Joint for R.C. Pipe (March 5, 2020)
 - Standard Plate 3007F, Shear Reinforcement for Precast Drainage Structures (March 5, 2020)
 - Standard Plate 3014K, Sheets 1-3 of 3, Reinforced Concrete Pipe Arch (March 5, 2020)
- Current Standard Plates including Transmittal Letters are available on the web at <https://standardplates.dot.state.mn.us/stdplate.aspx>
- Questions regarding this transmittal should be directed to the Design Standards Unit at DesignStandards.dot@state.mn.us



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State Design Standards Engineer

Summary of Changes
Standard Plate 3000M
Reinforced Concrete Pipe
Transmittal Letter No. (20-02)

3000M 1 of 6 – Reinforced Concrete Pipe – B-Wall

General

1. The plate number has been changed from 3000L 1 of 5 to 3000M 1 of 6
2. The orientation of the table and notes have been rotated 90 degrees
3. The reinforcement amounts shown in the table have been updated to match AASHTO M170; for pipe sizes and classes that are not included in M170, a custom design was performed in accordance with the AASHTO LFRD Bridge Design Specifications, 8th edition
4. The notes and other portions of the plate have been updated to use active voice and to comply with AASHTO M170, the AASHTO LFRD Bridge Design Specifications, 8th edition, and comments from fabricators, inspection staff and hydraulic engineers
5. The 102" diameter pipe was removed from the tables as this size is not available
6. Minor grammar, clarity, and consistency fixes

3000M 2 of 6 – Reinforced Concrete Pipe – C-Wall

General

1. The plate number has been changed from 3000L 2 of 5 to 3000M 2 of 6
2. The reinforcement amounts shown in the table have been updated to match AASHTO M170; for pipe sizes and classes that are not included in M170, a custom design was performed in accordance with the AASHTO LFRD Bridge Design Specifications, 8th edition
3. The notes and other portions of the plate have been updated to use active voice and to comply with AASHTO M170, the AASHTO LFRD Bridge Design Specifications, 8th edition, and comments from fabricators, inspection staff and hydraulic engineers
4. The 102" diameter pipe was removed from the tables as this size is not available
5. The sketches have been moved to sheet 6 of 6
6. Minor grammar, clarity, and consistency fixes

3000M 3 of 6 – Reinforced Concrete Pipe – Joint Dimensions for B-Wall and C-Wall

General

1. The plate number has been changed from 3000L 3 of 5 to 3000M 3 of 6
2. The tolerance notes have been removed and the necessary tolerances for each pipe size have been included in the right side of the table
3. The notes and other portions of the plate have been updated to use active voice and to comply with AASHTO M170, the AASHTO LFRD Bridge Design Specifications, 8th edition, and comments from fabricators, inspection staff and hydraulic engineers
4. The 102" diameter pipe was removed from the tables as this size is not available
5. Minor grammar, clarity, and consistency fixes

3000M 4 of 6 – Reinforced Concrete Pipe – Quadrant Reinforcement – Special Design

General

1. The plate number has been changed from 3000L 4 of 5 to 3000M 4 of 6
2. The title of the plate changed from Reinforced Concrete Pipe – Reinforcement Information - Special Design Pipes to Reinforced Concrete Pipe – Quadrant Reinforcement – Special Design
3. This page of the plate previously included both the quadrant reinforcement and the shear reinforcement; the quadrant reinforcement is now included on sheet 4 of 6 and the shear reinforcement is included on sheet 5 of 6
4. The quadrant reinforcement design has been updated to match AASHTO M170; for pipe sizes and classes that are not included in M170
5. The notes were updated to use active voice and to comply with AASHTO M170, the AASHTO LFRD Bridge Design Specifications, 8th edition, and comments from fabricators, inspection staff and hydraulic engineers
6. The 102” diameter pipe was removed from the tables as this size is not available
7. The table was reformatted to only include quadrant reinforcement
8. Minor grammar, clarity, and consistency fixes

3000M 5 of 6 – Reinforced Concrete Pipe – Special Design – Shear Reinforcement – Installed from Inside

General

1. The plate number has been changed from 3000L 4 of 5 to 3000M 5 of 6
2. The title of the plate changed from Reinforced Concrete Pipe – Reinforcement Information - Special Design Pipes to Reinforced Concrete Pipe – Special Design - Shear Reinforcement – Installed from Inside
3. This page of the plate previously included both the quadrant reinforcement and the shear reinforcement; the quadrant reinforcement is now included on sheet 4 of 6 and the shear reinforcement is included on sheet 5 of 6
4. The shear reinforcement design has been updated to match AASHTO M170; for pipe sizes and classes that are not included in M170, a custom design was performed in accordance with the AASHTO LFRD Bridge Design Specifications, 8th edition
5. The notes were updated to use active voice and to comply with AASHTO M170, the AASHTO LFRD Bridge Design Specifications, 8th edition, and comments from fabricators, inspection staff and hydraulic engineers
6. A table for shear reinforcement of C wall pipe has been added
7. The 102” diameter pipe was removed from the tables as this size is not available
8. The Shear Lock Mat Detail was added
9. Minor grammar, clarity, and consistency fixes

3000M 6 of 6 – Reinforced Concrete Pipe – General Notes

General

1. The plate number has been changed from 3000L 5 of 5 to 3000M 6 of 6
2. The notes were updated to use active voice and to comply with AASHTO M170, the AASHTO LFRD Bridge Design Specifications, 8th edition, and comments from fabricators, inspection staff and hydraulic engineers
3. The sketches previously shown on sheet 2 of 5 have been updated and moved to this sheet
4. Minor grammar, clarity, and consistency fixes

Summary of Changes
Standard Plate 3006H
Gasket Joint for R.C. Pipe
Transmittal Letter No. (20-02)

3006H 1 of 2 – Gasket Joint for R.C. Pipe

General

1. The plate number has been changed from 3006G 1 of 2 to 3006H 1 of 2
2. Minor grammar, clarity, and consistency fixes

Table

1. The “Approx. Dia. Gasket Material Inches Not Stretched” and “Gasket Volume in Cu. In.” columns have been removed from the table
2. The table values of “0” have been changed to “-“
3. The table values of “C-Wall L1” have been updated
4. The 102” diameter pipe was removed

72” Pipe and Larger Detail

1. The L2 dimension has been removed
2. The dotted lines showing a bell and the note “Bell on 72” and 78” B-Wall Only” has been removed
3. Added subtitle “(Reinforcement Not Shown)”

Notes

1. The general note about gasket volumes has been removed
2. A new note “Furnish Gaskets in Accordance with ASTM C1619 Class C” has been added

3006H 2 of 2 – Gasket Joint for R.C. Pipe - Options

General

1. The plate number has been changed from 3006G 2 of 2 to 3006H 2 of 2
2. The title “Bell Reinforcement Options (66” and Pipe and Smaller)” has been moved from below the details to below the “Cylindrical Cage Detail” and “Expanded Bell Detail” sketches
3. Minor grammar, clarity, and consistency fixes

Cylindrical Cage Detail

1. The reinforcement has been redrawn to reflect typical fabrication methods
2. A new note “Provide Bell Cages with at Least as Many Longitudinals as the Main Cage” has been added
3. The word “Cover” has been added to the $\frac{3}{4}$ ” minimum and $1\frac{1}{4}$ ” maximum dimensions
4. Circled note ⑤ changed to circled note ②

Expanded Bell Detail

1. Name of the detail was changed from “Convolute Cage Detail” to “Expanded Bell Detail”
2. Note was changed from “Convolute Mesh Reinforcement on 12” Thru 21” Sizes Use 0.06 In2/Ft. Minimum and Extend Mesh 12” Past Start of Bell” to “When Convolute Welded Wire Reinforcement is Used for 12” Thru 21” Diameter Pipe, Use 0.06 In2/Ft. Minimum”

Optional Transition Pipe Detail

1. The reinforcement is no longer shown in this detail, but the reinforcement requirements are included in the reinforcement table

Reinforcement Table

1. The table has been moved to the lower right corner and is now titled "Transition Pipe Reinforcement"

Notes

1. The notes have been updated to use active voice and to comply with comments from fabricators, inspection staff, and hydraulic engineers

Summary of Changes
Standard Plate 3007F
Shear Reinforcement for Precast Drainage Structures
Transmittal Letter No. (20-02)

General

1. The plate number has been changed from 3007E to 3007F
2. Removed the “Stirrup Length Table”; This info is now included in standard plate 3000 and 3014
3. Throughout the plate, changed “Outer Shear Pin Bar” to “Lock Rod” and changed “Inner Shear Pin Bar” to “Element Wire”
4. Removed the “See Stirrup Length Table” note throughout and changed “Shear Steel” to “Shear Reinforcement”
5. Minor grammar, clarity, and consistency fixes

Shear Lock Alternate Detail

1. Changed the title of the detail from “Shear Lock Alternate” to “Shear Lock Alternate – Pipe”
2. Circled note ② changed to circled note ① and note ④ changed to ③
3. Changed notes regarding shear lock spacing
4. The detail has been redrawn to reflect proper placement of the reinforcement
5. Added a second detail titled “Shear Lock Alternate – Box Culverts”

J-Bar Alternate Detail

1. Circled note ③ changed to circled note ② and ② changed to ①
2. Changed notes regarding J-bar spacing

V-Bar Alternate Detail

1. Changed the note from “Inside Face of Pipe” to “Inside Face of Pipe/Box”

Notes

1. The notes and other portions of the plate have been updated to use active voice and to comply with AASHTO M170 and M206 and the AASHTO LFRD Bridge Design Specifications, 8th edition, and comments from fabricators, inspection staff and hydraulic engineers

Summary of Changes
Standard Plate 3014K
Reinforced Concrete Pipe Arch
Transmittal Letter No. (20-02)

3014K 1 of 3 – Reinforced Concrete Pipe Arch – General Notes and Dimensions

General

1. The plate number has been changed from 3014J 1 of 2 to 3014K 1 of 3
2. The plate subtitle has changed from “General Notes, Dimensions & Stirrup Requirements” to “General Notes and Dimensions”
3. The shear reinforcement table and stirrup details sketch have been moved to new sheet 3 of 3
4. The longitudinal section sketch has been enlarged and moved to the center of the sheet
5. Minor grammar, clarity, and consistency fixes

Table of Dimensions

1. Dimensions R1, R2, and R3 have been removed from the table; dimension E (Springline) has been added to the table

Notes and Basis of Design

1. The notes and other portions of the plate have been updated to use active voice and to comply with AASHTO M206, the AASHTO LFRD Bridge Design Specifications, 8th edition, and comments from fabricators, inspection staff and hydraulic engineers
2. The maximum depth of cover information has been moved to chapter 2 of the MnDOT Drainage Manual
3. Notes regarding shear reinforcement have been moved to sheet 3 of 3

3014K 2 of 3 – Reinforced Concrete Pipe Arch - Reinforcement

General

1. The plate number has been changed from 3014J 2 of 2 to 3014K 2 of 3
2. The notes and other portions of the plate have been updated to use active voice and to comply with AASHTO M206, the AASHTO LFRD Bridge Design Specifications, 8th edition, and comments from fabricators, inspection staff and hydraulic engineers
3. The formulas for A, B, and C have been removed
4. The Reinforcement Details sketch has been updated
5. A table for D-Loads for Three-Edge-Bearing Test has been added
6. Minor grammar, clarity, and consistency fixes

Table of Reinforcement Requirements

1. The reinforcement amounts have been updated to match AASHTO M206; for pipe sizes and classes that are not included in M206, a custom design was performed in accordance with the AASHTO LFRD Bridge Design Specifications, 8th edition
2. Single line reinforcement requirements were added
3. The table was reformatted to indicate the concrete strength similar to that of round pipe

3014K 3 of 3 – Reinforced Concrete Pipe Arch – Special Design – Shear Reinforcement – Installed from Inside

General

1. This is a new sheet – 3014K 3 of 3.
2. The shear reinforcement table and stirrup details sketch have been moved to this sheet from 3014J sheet 1 of 2
3. The notes and other portions of the plate have been updated to use active voice and to comply with AASHTO M206, the AASHTO LFRD Bridge Design Specifications, 8th edition, and comments from fabricators, inspection staff and hydraulic engineers
4. The Shear Lock Mat Detail was added
5. Minor grammar, clarity, and consistency fixes

Shear Reinforcement Requirements Table

1. The shear reinforcement amounts have been updated to match AASHTO M206; for pipe sizes and classes that are not included in M206, a custom design was performed in accordance with the AASHTO LFRD Bridge Design Specifications, 8th edition

STANDARD PLATES

BLANK.....	0000 SERIES
PAVEMENT	1000 SERIES
BLANK.....	2000 SERIES
CULVERTS AND APPURTENANCES	3000 SERIES
SEWER APPURTENANCES.....	4000 SERIES
EROSION CONTROL STRUCTURES	5000 SERIES
BLANK.....	6000 SERIES
CURB, CURB AND GUTTER, SIDEWALK	7000 SERIES
BARRICADES, SIGNALS, MARKERS, ETC.....	8000 SERIES
MISCELLANEOUS	9000 SERIES

PLATE NO.

0000 SERIES—BLANK

1000 SERIES—PAVEMENT

- 1070M Supplemental Pavement Reinforcement
- 1103K Typical Dowel Bar Assembly (2 Sheets)
- 1150R Concrete Header Joints (2 Sheets)
- 1210G Concrete Pavement Adjacent to Railway Crossing

2000 SERIES—BLANK

3000 SERIES—CULVERTS AND APPURTENANCES

- 3000M Reinforced Concrete Pipe (6 Sheets)
- 3001B Reinforced Concrete Reducer Pipe
- 3002B Reinforced Concrete Increaser Pipe
- 3006H Gasket Joint for R.C. Pipe (2 Sheets)
- 3007F Shear Reinforcement for Precast Drainage Structures
- 3014K Reinforced Concrete Pipe Arch (3 Sheets)
- 3020H Reinforced Precast Concrete Cattle Pass (60" & 72")
- 3022C Precast Concrete Safety Apron (3 Sheets)
- 3040F Corrugated Metal Pipe Culvert (Standard 2-2/3" x 1/2" Corrugation)
- 3041D Corrugated Metal Pipe (3" x 1" Corrugation)
- 3050B Design Data Structural Plate Structures (18" Corner Radius)
- 3051B Design Data Structural Plate Structures (31" Corner Radius)
- 3065C Connection between Existing Culv. & New "C" Culv. Barrel (2 Sheets)
- 3066A C.M. Extension for Box Culvert
- 3100G Concrete Apron for Reinforced Concrete Pipe
- 3110G Concrete Apron for Reinforced Concrete Pipe-Arch
- 3114H Sectional Concrete Apron for Reinforced Concrete Pipe-Arch
- 3122K Metal Apron for C.M. Pipe-Arch Culvert
- 3123J Metal Apron for C.S. Pipe
- 3124B Metal Apron Connection
- 3125A Inlet Protection for Metal Culverts (90" dia. to 96" dia.)
- 3126B Inlet Protection for Structural Plate Pipe (60" thru 96" dia. or span)
- 3127A Inlet Protection for Structural Plate Pipe (102" thru 180" dia. or span)

PLATE NO.

3128H	Metal Safety Apron & Grate (2 Sheets)
3129A	Metal Apron for Corrugated Polyethylene Pipe (Use at Entrances and Driveways)
3131C	Precast Concrete Headwall for Subsurface Drains
3132A	Grate for 1:4 Precast Concrete Aprons
3133D	Riprap at RCP Outlets
3134D	Riprap at CSP Outlets
3135A	Hand-Placed Riprap at Precast Concrete Cattle Pass
3136B	Slotted Vane Drain for P.V.C. Pipe
3137B	Slotted Drain for 12" thru 30" Dia. C.M. Pipe (Stackable)
3138B	Slotted Drain for 12" thru 30" Dia. C.M. Pipe (Not Stackable)
3139B	Riprap at Precast Concrete End Sections
3142A	Outlet Screen for C.M. & S.C. Pipes
3143C	Inspection Tees
3145G	Concrete Pipe or Precast Culvert Ties
3146C	Anti-Seepage Diaphragm (For CMP and CMP-A)
3148A	Safety Slope Metal End Section for Circular & Arched Pipes (2 Sheets)
3221C	Corrugated Steel Pipe Coupling Band (3 Sheets)

4000 SERIES—SEWER APPURTENANCES

Drainage Structure and Castings (4 Sheets)

- Structure and Casting Combinations
- Standard Casting Assemblies
- List of Castings
- List of Drainage Structures

4000J	Manhole or Catch Basin (Masonry, Field Constructed) - Design A
4002F	Manhole or Catch Basin (Masonry, Field Construction) - Design C
4003B	30" Precast Catch Basin – Design N
4005M	Manhole or Catch Basin Type A & B Cone Sections Precast - Design F
4006L	Manhole or Catch Basin Precast - Designs G and H
4007C	Precast Mechanical Joint Sewer Manhole
4008E	Catch Basin (Sectional Concrete Pipe) - Design I
4009H	Manhole or Catch Basin (Sectional Concrete Pipe) - Design J
4010H	Concrete Short Cone & Adjusting Ring (Sectional Concrete)
4011E	Precast Concrete Base
4017C	Catch Basin (Concrete Pipe and Metal Pipe) - Designs PC and PM
4018B	Manhole or Catch Basin (Reducer Cone Section Precast) Design D
4020J	Manhole or Catch Basin (For Use With or Without Traffic Loads) (2 sheets)
4021F	Precast Curb Opening Catch Basin
4022A	Manhole or Catch Basin Cover (3 ft. X 2 ft. Opening)
4024A	48" Dia. Precast Shallow Depth Catch Basin - Design SD
4025B	Drop Inlets or Catch Basins - Design DI (Concrete & Metal)
4026A	Concrete Encased Concrete Adjusting Rings
4101D	Ring Casting For Manhole or Catch Basin
4108F	Adjusting Rings for Catch Basins and Manholes
4110F	Cover Casting for Manhole (For Use in all Traffic Areas) – Casting No. 715 and 716
4125D	Catch Basin Frame Casting (For Square Grate) – Casting No. 806
4126F	Catch Basin Frame Casting – Casting No. 801
4129G	Catch Basin Frame Casting (For Square Grate) - Casting No. 802A
4132G	Catch Basin Frame Casting (For Square Grate) – Casting No. 805
4133A	Curb Box Casting for Catch Basin - Casting No. 824
4134A	Curb Box Casting for Catch Basin (For Design B Curbs) - Casting No. 825
4140D	Special Grate Castings for Catch Basin (Convex and Concave) - Casting No. 720 and 721
4143E	Stool Grate & Concrete Frame (Median Drains) - Casting No. 731
4149C	Grate Casting for Catch Basin - Casting No. 810

PLATE NO.

- 4150C Grate Casting for All Pipe Drainage Structures
- 4151B Grate Casting for Catch Basin (Square Type) - Casting No. 811
- 4152C Catch Basin Grate Casting - Casting No. 814A
- 4153A Catch Basin Grate Casting - Casting No. 815
- 4154B Catch Basin Grate Casting - Casting No. 816
- 4155A ADA Grate Inlet Casting – Casting No. 817
- 4160D Curb Box Casting for Catch Basin - Casting No. 823A and 833A
- 4161F Curb Box Casting for Catch Basin - Casting No. 821B, 822 and 831A
- 4180J Manhole or Catch Basin Step

5000 SERIES—EROSION CONTROL STRUCTURES

- 5010A Reinforced Concrete Pipe Energy Dissipator

6000 SERIES—BLANK

7000 SERIES—CURB, CURB AND GUTTER, SIDEWALK

- 7000E Integrant Curbs (Design B, Design V and Design D)
- 7020K Concrete Curb (Design B, Design V, Design S, Design DR and Design BR) (2 Sheets)
- 7038A Detectable Warning Surface Truncated Domes
- 7065C Bituminous Curb
- 7100H Concrete Curb and Gutter (Design B and Design V)
- 7102K Concrete Curb and Gutter (Design D, Design S, and Design R)
- 7105C Concrete Median (Mountable Type)
- 7107I Entrance Nose (Urban Design)
- 7108G Exit Nose (Urban Design)
- 7109C Median Nose and Island (Undivided to Divided Roadway)
- 7111J Installation of Catch Basin Castings (Concrete Curb and Gutter)
- 7112C Installation & Reinforcement of Catch Basin & Manhole Castings (Concrete Integrant Curbs)
- 7113A Concrete Approach Nose Detail

8000 SERIES—BARRICADES, SIGNALS, MARKERS, ETC.

- 8000J Channelizers
- 8002G Permanent Barricade
- 8106D Equipment Pad B
- 8107A RLF Equipment Pad Foundation Layout
- 8110E Traffic Signal Bracketing (Pole Mounted)
- 8111E Traffic Signal Bracketing (Pedestal Mounted) (3 Sheets)
- 8112I Pedestal Foundation (Traffic Control Signals)
- 8117G Precast Concrete Handhole With Vehicle Load
- 8118D Service Equipment & Pole Traffic Control Signals
- 8119C Ground Mounted Cabinet Foundation
- 8120Q Pole Foundation (PA85)
- 8121H Transformer Base and Pole Base Plate (PA85, PA90 and PA100) (2 Sheets)
- 8122F Pedestal and Pedestal Base (For Traffic Control Signals Support) (2 Sheets)
- 8123G Pole and Mast Arm Luminaires and Traffic Lights Assembly (For All Pole Types) (2 Sheets)
- 8126L Pole Foundation (PA90 and PA100)
- 8127E Light Foundation - Design E, Precast/Cast-In-Place, 40 ft. Pole or Less (2 Sheets)
- 8128E Light Foundation - Design H, Precast/Cast-In-Place, 49 ft. Pole (2 Sheets)

PLATE NO.

8129A	Shim and Washer (Traffic Control Signals and Roadway Lighting)
8130E	Saw Cut Loop Detectors (3 Sheets)
8132B	Preformed Rigid PVC Conduit Loop Detector (3 Sheets)
8133A	Pole and Mast Arm - Type BA (9 Sheets)
8134C	Pole Foundation - Type BA (4 Sheets)
8135A	Anchor Rod Assembly for Light Tower Foundation
8150C	Installation of Culvert Markers
8307S	W-Beam Guardrail & End Anchorages (Installation with Wood Posts) (4 Sheets)
8308B	Reinforced Concrete Median Barrier Type F (Non-Glare Screen Type) Design 8308 (3 Sheets)
8309B	Reinforced Concrete Median Barrier Type F & Glare Screen Design 8309 (3 Sheets)
8316C	Post Seat for Anchorage on Footing or Box Culverts
8318C	Guardrail Anchorage Plate for Bridges and BCT'S
8326D	Flexible Plastic Glare Screen
8329I	Eccentric Loader Breakaway Cable Terminal (ELT) (4 Sheets)
8330G	3-Cable Guardrail (With Wood Posts) (Assembly Details) (2 Sheets)
8331B	3-Cable Guardrail (With Steel Posts) (3 Sheets)
8332D	Anchor Bolt Cluster and Base Plate for Light Poles
8333B	3-Cable Guardrail Anchor (Anchor Details) (4 Sheets)
8337C	Temporary Portable Precast Concrete Barrier (Type "F") (3 Sheets)
8338D	W-Beam Guardrail & End Anchorages (Installation with Steel Posts) (4 Sheets)
8339A	3-Cable (Steel Posts) to W Beam (Wood Posts) Guardrail Transition
8340A	3-Cable (Steel Posts) to W Beam (Steel Posts) Guardrail Transition
8342B	High-Tension Cable Barrier Line Post Foundation (Concrete Design)
8343A	High-Tension Cable Barrier Line Post Foundation (Steel Design)
8347B	Portable Precast Concrete Barrier Anchors
8350A	Thrie Beam Anchorage Plate
8352B	Thrie Beam Wedge Plate for Single Slope Barrier
8356A	W-Beam to Thrie-Beam Transition Guardrail
8357A	Thrie Beam Guardrail
8360A	Guardrail Post Length Marking
8361A	Guardrail Steel Post (3 Sheets)
8369A	Guardrail Blockout (2 Sheets)
8400F	Pipe Railing

9000 SERIES—MISCELLANEOUS

9000E	Approaches and Entrances - Recommended Standards
9101B	Shaping and Sodding of Slopes at Box Culvert Ends
9303B	Geodetic Survey Disks (Aluminum) (2 Sheets)
9304A	Geodetic Survey Disks (Removable Type Disk)
9308A	Survey Monument Cap (2 Sheets)
9309G	PLS (Public Land Survey) Monument (2 Sheets)
9320G	Woven Wire Fence (Wood Post)
9321E	Woven Wire Fence (Steel Post)
9322K	Chain Link Fence (2 Sheets)
9323D	Barbed Wire Fence (Wood Post)
9324C	Barbed Wire Fence (Steel Post)
9350A	Mailbox Support (Swing-Away Type)

INTERNAL DIAMETER OF PIPE (INCHES)	WEIGHT PER LINEAR FOOT OF PIPE	MINIMUM WALL THICKNESS	CLASS I		CLASS II		CLASS III		CLASS IV		CLASS V			
			D - LOAD TO PRODUCE A 0.01" CRACK (LBS./LIN. FT./FT. OF DIA.)											
			800		1000		1350		2000		3000			
			D - LOAD TO PRODUCE ULTIMATE LOAD (LBS./LIN. FT./FT. OF DIA.)											
1200		1500		2000		3000		3750						
CONCRETE 4000 PSI ④		CONCRETE 4000 PSI ④		CONCRETE 4000 PSI ④		CONCRETE 4000 PSI ④		CONCRETE 6000 PSI						
T MINIMUM REINFORCEMENT SQUARE INCHES PER LINEAR FOOT OF BARREL														
D	POUNDS	INCHES	INNER CAGE	OUTER CAGE	INNER CAGE	OUTER CAGE	INNER CAGE	OUTER CAGE	INNER CAGE	OUTER CAGE	INNER CAGE	OUTER CAGE		
12	92	2	— ⑥	—	0.07 ②	—	0.07 ②	—	0.07	—	0.10	—		
15	127	2 1/4	— ⑥	—	0.07 ②	—	0.07 ②	—	0.10	—	0.14	—		
18	168	2 1/2	— ⑥	—	0.07 ②	—	0.07 ②	—	0.14	—	0.19	—		
21	214	2 3/4	— ⑥	—	0.07 ②	—	0.07 ②	—	0.20	—	0.24	—		
24	265	3	— ⑥	—	0.07 ②	—	0.07 ②	—	0.27	—	0.30	—		
27	322	3 1/4	— ⑥	—	0.13	—	0.16	—	0.31	—	0.38	0.23		
30	384	3 1/2	— ⑥	—	0.14	—	0.18	—	0.35	—	0.41	0.25		
33	452	3 3/4	— ⑥	—	0.15	—	0.20	—	0.27	0.16	0.46	0.28		
36	524	4	— ⑥	—	0.12 ③	0.07	0.17 ③	0.10	0.30	0.18	0.50	0.30		
42	685	4 1/2	— ⑥	—	0.15	0.09	0.21	0.13	0.35	0.21	0.60	0.36		
48	867	5	— ⑥	—	0.18	0.11	0.24	0.14	0.42 ⑤	0.25	0.73 ⑤	0.44 ⑤		
54	1070	5 1/2	— ⑥	—	0.22	0.13	0.29	0.17	0.50 ⑤	0.30	⑦	⑦		
60	1296	6	0.21	0.13	0.25	0.15	0.34	0.20	CONCRETE 5000 PSI		⑦	⑦		
66	1542	6 1/2	0.25	0.15	0.31	0.19	0.41 ⑤	0.25	0.69 ⑤	0.41 ⑤	⑦	⑦		
72	1810	7	0.29	0.17	0.35	0.21	0.49 ⑤	0.29	0.79 ⑤	0.47 ⑤	0.96 ①⑤	0.58 ⑤		
78	2098	7 1/2	0.32	0.19	0.40 ⑤	0.24	0.57 ⑤	0.34	0.71 ①⑤	0.43 ⑤	1.05 ①⑤	0.63 ⑤		
84	2410	8	0.37	0.22	0.46 ⑤	0.28	0.64 ⑤	0.38	0.76 ①⑤	0.46 ⑤	1.14 ①⑤	0.68 ⑤		
90	2740	8 1/2	0.41 ⑤	0.25	0.51 ⑤	0.31	CONCRETE 5000 PSI		0.82 ①⑤	0.49 ⑤	1.23 ①⑤	0.74 ⑤		
96	3090	9	0.46 ⑤	0.28	0.57 ⑤	0.34	0.69 ⑤	0.41 ⑤	0.87 ①⑤	0.52 ⑤	1.32 ①⑤	0.79 ⑤		
108	3860	10	CONCRETE 5000 PSI		CONCRETE 5000 PSI		1.08 ⑤	0.65 ⑤	0.98 ①⑤	0.59 ⑤	1.50 ①⑤	0.90 ⑤		


NOTES:

SEE SHEETS 3 THROUGH 6 FOR ADDITIONAL INFORMATION ON PIPE SECTIONS AND GENERAL NOTES.

STANDARD PLATE 3006, GASKET JOINT FOR R.C. PIPE, MAY BE FURNISHED IN LIEU OF 3000 PIPE. THE GASKET IS REQUIRED.

WHEN CONNECTING 3000 TO 3006 STANDARD PLATE PIPES, USE A TRANSITION SECTION OF NOMINAL LAYING LENGTH WITH A 3000 JOINT ON ONE END AND A 3006 GASKET JOINT ON THE OTHER END AND HAVING THE TONGUE AND GROOVE CONFIGURATION NECESSARY TO CONNECT THE PIPES.

- ① CLASS IV PIPE 78" OR MORE IN DIAMETER AND CLASS V PIPE 72" OR MORE IN DIAMETER ARE SPECIAL DESIGNS IN ACCORDANCE WITH 3236 AND REQUIRE SHEAR REINFORCEMENT. FOR SHEAR REINFORCEMENT, SEE SHEET 5 OF 6.
- ② FOR THESE CLASSES AND SIZES, THE MINIMUM PRACTICAL STEEL REINFORCEMENT IS SPECIFIED.
- ③ AS AN ALTERNATIVE, SINGLE-CAGE REINFORCEMENT MAY BE USED. THE REINFORCEMENT AREA IN SQUARE INCHES PER LINEAR FOOT IS 0.20 $in^2/LIN. FT.$ FOR CLASS 2, AND 0.30 $in^2/LIN. FT.$ FOR CLASS 3.
- ④ THE REQUIRED STRENGTH INCREASES TO 5000 PSI FOR LARGER SIZE PIPE. SEE BELOW.
- ⑤ FOR PIPES 48" AND LARGER, AS AN ALTERNATIVE FOR DESIGNS REQUIRING BOTH INNER AND OUTER CAGES, IF THE REQUIRED REINFORCEMENT FOR EITHER CAGE MEETS OR EXCEEDS 0.40 $in^2/LIN. FT.$, QUADRANT REINFORCEMENT MAY BE USED AS SHOWN ON SHEET 4 OF 6. THESE ARE SPECIAL DESIGNS IN ACCORDANCE WITH 3236.
- ⑥ USE CLASS 2 AS THE MINIMUM CLASS OF PIPE.
- ⑦ USE "C" WALL PIPE.

APPROVED MARCH 5, 2020

 STATE DESIGN ENGINEER

STATE OF MINNESOTA
 DEPARTMENT OF TRANSPORTATION
REINFORCED CONCRETE PIPE
 B WALL

SPECIFICATION
 REFERENCE
 2501
 2503

STANDARD
 PLATE
 NO.
3000M
 1 OF 6

INTERNAL DIA. OF PIPE (INCHES)	WEIGHT PER LINEAR FOOT OF PIPE	WALL THICKNESS	CLASS II		CLASS III		CLASS IV		CLASS V		
			D - LOAD TO PRODUCE A 0.01 INCH CRACK (LBS./LIN. FT./FT. OF DIA.)								
			1000		1350		2000		3000		
			D - LOAD TO PRODUCE ULTIMATE LOAD (LBS./LIN. FT./FT. OF DIA.)								
			1500		2000		3000		3750		
CONCRETE 4000 PSI (4)		CONCRETE 4000 PSI (4)		CONCRETE 4000 PSI (4)		CONCRETE 6000 PSI					
MINIMUM REINFORCEMENT SQUARE INCHES PER LINEAL FOOT OF BARREL											
D	POUNDS	INCHES	INNER CAGE	OUTER CAGE	INNER CAGE	OUTER CAGE	INNER CAGE	OUTER CAGE	INNER CAGE	OUTER CAGE	
12	140	2¾	0.07 (2)	—	0.07 (2)	—	0.07 (2)	—	0.07 (2)	—	
15	180	3	0.07 (2)	—	0.07 (2)	—	0.07 (2)	—	0.07 (2)	—	
18	230	3¼	0.07 (2)	—	0.07 (2)	—	0.07 (2)	—	0.10	—	
21	280	3½	0.07 (2)	—	0.07 (2)	—	0.07 (2)	—	0.10	—	
24	340	3¾	0.07 (2)	—	0.07	—	0.07	0.07	0.12	0.07	
27	410	4	0.07 (2)	—	0.08	—	0.08	0.07	0.14	0.08	
30	480	4¼	0.07 (2)	—	0.10	—	0.09	0.07	0.18	0.11	
33	510	4½	0.07 (2)	—	0.12	—	0.11	0.07	0.23	0.14	
36	630	4¾	0.07 (3)	0.07	0.08 (3)	0.07	0.14	0.08	0.27	0.16	
42	810	5¼	0.10	0.07	0.12	0.07	0.20	0.12	0.36	0.22	
48	1010	5¾	0.14	0.08	0.16	0.10	0.26	0.16	0.47 (5)	0.28	
54	1230	6¼	0.17	0.10	0.21	0.13	0.34	0.20	0.58 (5)	0.35	
60	1470	6¾	0.22	0.13	0.25	0.15	0.41 (5)	0.25	0.70 (5)	0.42 (5)	
66	1740	7¼	0.25	0.15	0.31	0.19	0.51 (5)	0.31	0.84 (5)	0.50 (5)	
							CONCRETE 5000 PSI				
72	2010	7¾	0.30	0.18	0.36	0.22	0.61 (5)	0.37	0.99 (5)	0.59 (5)	
78	2330	8¼	0.35	0.21	0.42 (5)	0.25	0.71 (5)	0.43 (5)	0.85 (1)(5)	0.51 (5)	
84	2640	8¾	0.41 (5)	0.25	0.50 (5)	0.30	0.85 (5)	0.51 (5)	0.94 (1)(5)	0.56 (5)	
							CONCRETE 5000 PSI				
90	3000	9¼	0.48 (5)	0.29	0.59 (5)	0.35	0.74 (1)(5)	0.44 (5)	1.03 (1)(5)	0.62 (5)	
96	3370	9¾	0.55 (5)	0.33	0.70 (5)	0.42 (5)	0.79 (1)(5)	0.47 (5)	1.12 (1)(5)	0.67 (5)	
							CONCRETE 5000 PSI				
108	4170	10¾	0.70 (5)	0.42 (5)	0.99 (5)	0.59 (5)	0.90 (1)(5)	0.54 (5)	1.30 (1)(5)	0.78 (5)	


NOTES:

SEE SHEET 3 THROUGH 6 FOR ADDITIONAL INFORMATION ON C WALL PIPE SECTIONS AND GENERAL NOTES.

STANDARD PLATE 3006, GASKET JOINT FOR R.C. PIPE, MAY BE FURNISHED IN LIEU OF 3000 PIPE. THE GASKET IS REQUIRED.

WHEN CONNECTING 3000 TO 3006 STANDARD PLATE PIPES, USE A TRANSITION SECTION OF NOMINAL LAYING LENGTH WITH A 3000 JOINT ON ONE END AND A 3006 GASKET JOINT ON THE OTHER END AND HAVING THE TONGUE AND GROOVE CONFIGURATION NECESSARY TO CONNECT THE PIPES.

- ① CLASS IV PIPE 90" OR MORE IN DIAMETER AND CLASS V PIPE 78" OR MORE IN DIAMETER ARE SPECIAL DESIGNS IN ACCORDANCE WITH 3236 AND REQUIRE SHEAR REINFORCEMENT. FOR SHEAR REINFORCEMENT, SEE SHEET 5 OF 6.
- ② FOR THESE CLASSES AND SIZES, THE MINIMUM PRACTICAL STEEL REINFORCEMENT IS SPECIFIED.
- ③ AS AN ALTERNATIVE, FOR CLASS II AND III, A SINGLE CAGE REINFORCEMENT MAY BE USED. THE REQUIRED REINFORCEMENT IS 0.16 in²/LIN. FT. FOR CLASS II, AND 0.20 in²/LIN. FT. FOR CLASS III.
- ④ THE REQUIRED STRENGTH INCREASES TO 5000 PSI FOR LARGER SIZE PIPE. SEE BELOW.
- ⑤ FOR PIPES 48" AND LARGER, AS AN ALTERNATIVE FOR DESIGNS REQUIRING BOTH INNER AND OUTER CAGES, IF THE REQUIRED REINFORCEMENT FOR EITHER CAGE EXCEEDS 0.40 in²/LIN. FT., QUADRANT REINFORCEMENT MAY BE USED AS SHOWN ON SHEET 4 OF 6. THESE ARE SPECIAL DESIGNS IN ACCORDANCE WITH 3236.

APPROVED MARCH 5, 2020

 STATE DESIGN ENGINEER

STATE OF MINNESOTA
 DEPARTMENT OF TRANSPORTATION
REINFORCED CONCRETE PIPE
 C WALL

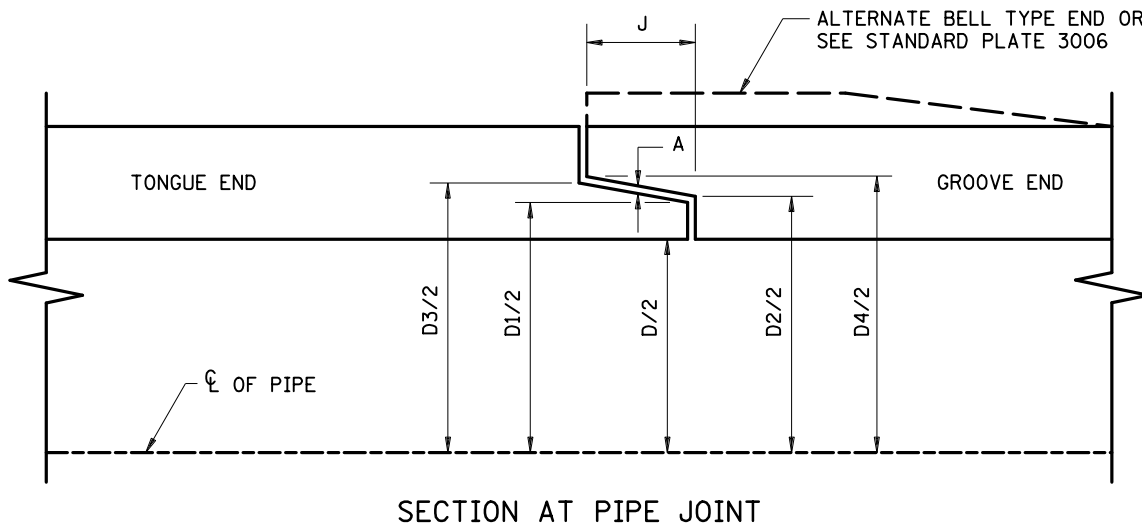
SPECIFICATION
 REFERENCE
 2501
 2503

STANDARD
 PLATE
 NO.
3000M
 2 OF 6

INTERNAL DIAMETER OF PIPE IN INCHES	CROSS SECTION WATER AREA	J (LENGTH OF JOINT)	A (NOMINAL)	D1	D2	D3	D4	TOLERANCES IN DIMENSIONS (PLUS OR MINUS)				
								INTERNAL DIAMETER	D1, D2, D3, & D4	WALL THICKNESS		J
										B WALL	C WALL	
D	SQ. FT.	INCHES										
12	0.79	1 ³ / ₄	3 ³ / ₁₆	13 ¹ / ₄	13 ⁵ / ₈	13 ³ / ₈	14 ¹ / ₄	1/4	3/16	3/16	3/16	1/4
15	1.23	2	3/16	16 ¹ / ₂	16 ⁷ / ₈	17 ¹ / ₄	17 ⁵ / ₈	5/16	3/16	3/16	3/16	1/4
18	1.77	2 ¹ / ₄	3/16	19 ⁵ / ₈	20	20 ³ / ₈	20 ³ / ₄	5/16	3/16	3/16	3/16	1/4
21	2.40	2 ¹ / ₂	3/16	22 ⁷ / ₈	23 ¹ / ₄	23 ³ / ₄	24 ¹ / ₈	3/8	3/16	3/16	3/16	1/4
24	3.14	2 ³ / ₄	3/16	26	26 ³ / ₈	27	27 ³ / ₈	3/8	3/16	3/16	3/16	1/4
27	3.98	3	3/16	29 ¹ / ₄	29 ⁵ / ₈	30 ¹ / ₄	30 ⁵ / ₈	3/8	3/16	3/16	3/16	1/4
30	4.91	3 ¹ / ₄	3/16	32 ³ / ₈	32 ³ / ₄	33 ¹ / ₂	33 ⁷ / ₈	3/8	3/16	3/16	3/16	1/4
33	5.94	3 ¹ / ₂	1/4	35 ¹ / ₂	36	36 ³ / ₄	37 ¹ / ₄	3/8	1/4	3/16	1/4	1/4
36	7.07	3 ³ / ₄	1/4	38 ³ / ₄	39 ¹ / ₄	40	40 ¹ / ₂	3/8	1/4	3/16	1/4	1/4
42	9.62	4	1/4	45 ⁵ / ₈	45 ⁵ / ₈	46 ¹ / ₂	47	7/16	1/4	1/4	1/4	1/4
48	12.57	4 ¹ / ₄	1/4	51 ¹ / ₂	52	53	53 ¹ / ₂	1/2	1/4	1/4	5/16	1/4
54	15.90	4 ¹ / ₂	1/4	57 ⁷ / ₈	58 ³ / ₈	59 ³ / ₈	59 ⁷ / ₈	9/16	1/4	1/4	5/16	1/4
60	19.63	5	1/4	64 ¹ / ₄	64 ³ / ₄	66	66 ¹ / ₂	5/8	1/4	5/16	5/16	1/4
66	23.76	5 ¹ / ₂	1/4	70 ⁵ / ₈	71 ¹ / ₈	72 ¹ / ₂	73	11/16	1/4	5/16	3/8	1/4
72	28.27	6	1/4	77	77 ¹ / ₂	79	79 ¹ / ₂	3/4	1/4	3/8	3/8	1/4
78	33.18	6 ¹ / ₂	1/4	83 ³ / ₈	83 ⁷ / ₈	85 ⁵ / ₈	86 ¹ / ₈	13/16	1/4	3/8	7/16	1/4
84	38.48	7	1/4	89 ³ / ₄	90 ¹ / ₄	92 ¹ / ₈	92 ⁵ / ₈	7/8	1/4	3/8	7/16	1/4
90	44.18	7	1/4	95 ³ / ₄	96 ¹ / ₄	98 ¹ / ₈	98 ⁵ / ₈	15/16	1/4	7/16	7/16	1/4
96	50.27	7	1/4	102 ¹ / ₈	102 ⁵ / ₈	104 ¹ / ₂	105	1	1/4	7/16	1/2	1/4
108	63.62	7 ¹ / ₂	1/4	115 ¹ / ₂	116	118	118 ¹ / ₂	1 ¹ / ₈	1/4	1/2	9/16	1/4

NOTE:

LAYING LENGTH: DO NOT UNDERRUN THE LAYING LENGTH BY MORE THAN 1/2".



APPROVED MARCH 5, 2020

Rom S. Smith
STATE DESIGN ENGINEER

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

**REINFORCED CONCRETE PIPE
JOINT DIMENSIONS FOR B-WALL AND C-WALL**

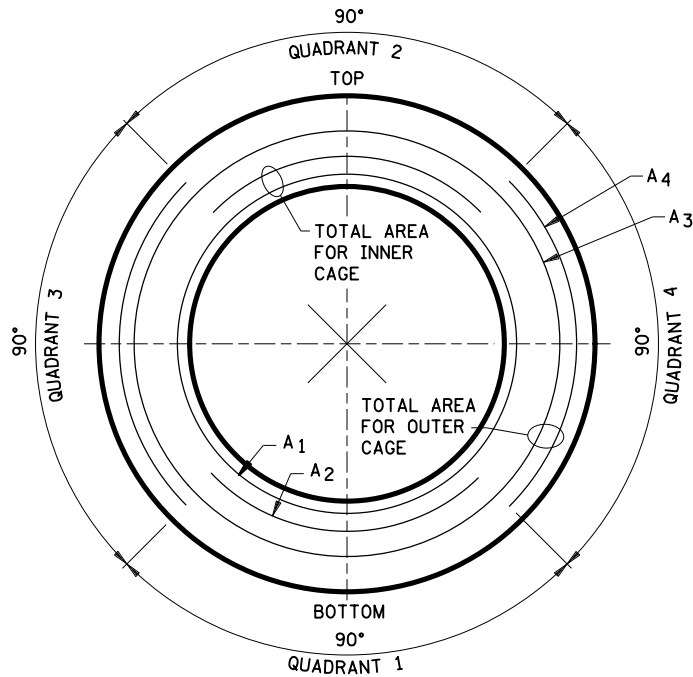
SPECIFICATION
REFERENCE

2501
2503

STANDARD
PLATE
NO.

3000M

3 OF 6



CROSS SECTION FOR QUADRANT REINFORCEMENT

INTERNAL DIAMETER OF PIPE	B WALL		C WALL	
	QUADRANT REINFORCEMENT LENGTH		QUADRANT REINFORCEMENT LENGTH	
	LENGTH OF 90° ARC	LENGTH OF 90° ARC	LENGTH OF 90° ARC	LENGTH OF 90° ARC
	A ₂	A ₄	A ₂	A ₄
48"	40"	44"	40"	46"
54"	44"	50"	44"	51"
60"	49"	55"	49"	57"
66"	54"	61"	54"	62"
72"	59"	66"	59"	68"
78"	63"	72"	63"	73"
84"	68"	77"	68"	79"
90"	73"	83"	73"	84"
96"	77"	88"	77"	90"
108"	87"	99"	87"	101"

QUADRANT REINFORCEMENT NOTES:

SEE SHEET 1 OR 2 FOR INNER AND OUTER CAGE REINFORCEMENT.
 FOR PIPE 48" AND LARGER, AS AN ALTERNATIVE FOR DESIGNS REQUIRING BOTH INNER AND OUTER CAGES, IF THE REQUIRED REINFORCEMENT FOR EITHER CAGE MEETS OR EXCEEDS 0.40 in²/LF, QUADRANT REINFORCEMENT MAY BE USED.

A₁ + A₂ = TOTAL INNER CAGE REINFORCEMENT.
 A₃ + A₄ = TOTAL OUTER CAGE REINFORCEMENT.

A₁ = REINFORCING OF FULL CIRCULAR INNER CAGE.
 A₂ = REINFORCING OF INNER LAP SECTION, 90° MINIMUM ARC.
 A₃ = REINFORCING OF FULL CIRCULAR OUTER CAGE.
 A₄ = REINFORCING OF OUTER LAP SECTION, 90° MINIMUM ARC.

PROVIDE FULL CIRCULAR CAGES WITH AN AREA EQUAL TO AT LEAST 50% OF THE REQUIRED TOTAL AREA.

GENERAL NOTES:

USE OF QUADRANT REINFORCEMENT REQUIRES ADDITIONAL FABRICATION CONTROLS. SEE SPEC. 3236 AND PROJECT SPECIAL PROVISIONS.

POINT OR INDENT LEGIBLE MARKS AT ONE END OF EACH SECTION ON THE INSIDE AND OUTSIDE OF OPPOSITE WALLS DESIGNATING THE CENTER OF THE VERTICAL AXIS OF THE QUADRANT REINFORCEMENT.

MARK OR STENCIL THE TOP OF THE PIPE ON BOTH THE INSIDE AND OUTSIDE SURFACES.

APPROVED MARCH 5, 2020

Rom S. [Signature]
 STATE DESIGN ENGINEER

STATE OF MINNESOTA
 DEPARTMENT OF TRANSPORTATION
REINFORCED CONCRETE PIPE
 QUADRANT REINFORCEMENT
SPECIAL DESIGN

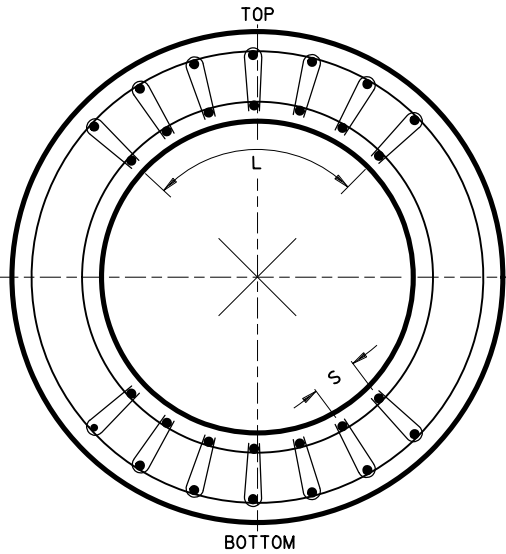
SPECIFICATION REFERENCE

2501
 2503

STANDARD PLATE NO.

3000M

4 OF 6



CROSS SECTION FOR SHEAR REINFORCEMENT

SHEAR REINFORCEMENT NOTES:

SHEAR LOCK MATS MUST BE INSTALLED FROM INSIDE OF PIPE AS SHOWN ON THIS SHEET.

AMP = STIRRUP AMPLITUDE MEASURED FROM FACE OF ELEMENT WIRE TO TIP OF LOOP WIRE (INCHES).

A_r = MINIMUM RADIAL REINFORCING REQUIRED IN SQUARE INCHES PER SQUARE FOOT OF PIPE OVER A MINIMUM ARC LENGTH L, AT TOP AND BOTTOM OF PIPE.

L = MINIMUM ARC LENGTH OF STIRRUPS MEASURED AT INNER CAGE CENTERED ON CENTERLINE OF PIPE (INCHES).

S = MAXIMUM SPACING OF ROWS OR RADIAL REINFORCING AT INNER CAGE (INCHES).

S IS BASED ON SECTION 12.10.4.2.6 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 8TH EDITION, WHERE S IS NOT TO EXCEED $0.75\phi_v d$; WHERE ϕ_v IS 0.9 IN ACCORDANCE WITH AASHTO SECTION 12.5.5. THE MAXIMUM STIRRUP SPACING HAS BEEN ROUNDED UP FROM THE CALCULATED VALUE TO THE NEAREST $1/2$ ".

PIN ALL SHEAR REINFORCEMENT. PROVIDE ELEMENT BAR WITH A MINIMUM DIAMETER OF 0.19" AND A LOCK ROD OF THE SAME DIAMETER.

SECURE LOCK RODS PLACED ON THE INSIDE OF THE OUTER CAGE NO MORE THAN 6" FROM END OF EACH LOCK ROD AT 12" MAXIMUM SPACING.

SET INSIDE CIRCUMFERENTIAL REINFORCEMENT COVER BY USING A 1" CHAIR FOR THE CIRCUMFERENTIAL REINFORCEMENT.

POINT OR INDENT LEGIBLE MARKS AT ONE END OF EACH SECTION ON THE INSIDE AND OUTSIDE OF OPPOSITE WALLS DESIGNATING THE CENTER OF SHEAR REINFORCEMENT.

MARK OR STENCIL THE TOP OF THE PIPE ON BOTH THE INSIDE AND OUTSIDE SURFACES.

SEE STANDARD PLATE 3007 FOR ADDITIONAL DETAILS.

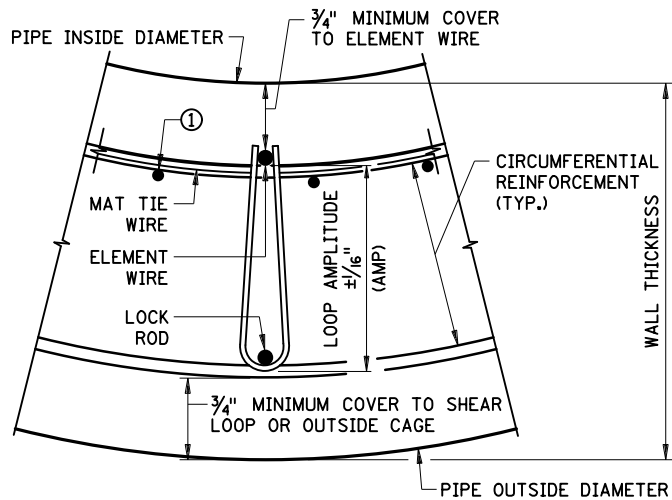
① WHEN SHEAR LOCK MAT ALTERNATE IS USED, LOCATE THE LONGITUDINALS ON THE INNER CAGE AS SHOWN.

INTERNAL DIAMETER OF PIPE	WALL THICKNESS	AMPLITUDE	SHEAR REINFORCEMENT					
			CLASS IV			CLASS V		
			A_r	L	S	A_r	L	S
D	T	AMP	A_r	L	S	A_r	L	S
72"	7"	5"	—	—	—	0.47	58	3.5
78"	7 1/2"	5 1/2"	0.40	49	4.0	0.48	63	4.0
84"	8"	6"	0.41	53	4.5	0.49	67	4.5
90"	8 1/2"	6 1/2"	0.42	58	4.5	0.50	74	4.5
96"	9"	7"	0.42	62	5.0	0.51	78	5.0
108"	10"	8"	0.43	71	5.5	0.52	89	5.5

SHEAR REINFORCEMENT B WALL

INTERNAL DIAMETER OF PIPE	WALL THICKNESS	AMPLITUDE	SHEAR REINFORCEMENT					
			CLASS IV			CLASS V		
			A_r	L	S	A_r	L	S
D	T	AMP	A_r	L <td>S</td> <td>A_r</td> <td>L</td> <td>S</td>	S	A_r	L	S
78"	8 1/4"	6 1/4"	—	—	—	0.46	51	4.5
84"	8 3/4"	6 3/4"	—	—	—	0.47	57	4.5
90"	9 1/4"	7 1/4"	0.39	42	5.0	0.48	62	5.0
96"	9 3/4"	7 3/4"	0.40	46	5.5	0.49	68	5.5
108"	10 3/4"	8 3/4"	0.41	57	6.0	0.50	79	6.0

SHEAR REINFORCEMENT C WALL



SHEAR LOCK MAT DETAIL (PINNED ON INSIDE)

APPROVED MARCH 5, 2020

Rom S. J.
STATE DESIGN ENGINEER

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION
REINFORCED CONCRETE PIPE
SPECIAL DESIGN
SHEAR REINFORCEMENT - INSTALLED FROM INSIDE

SPECIFICATION REFERENCE

2501
2503

STANDARD PLATE NO.

3000M
5 OF 6

REINFORCEMENT:

USE REINFORCEMENT STEEL CONFORMING TO AASHTO M170, EXCEPT AS SHOWN.

LAP CIRCUMFERENTIAL REINFORCEMENT AT LEAST 20 DIAMETERS FOR DEFORMED BARS AND DEFORMED COLD-WORKED WIRE, AND AT LEAST 40 DIAMETERS FOR PLAIN BARS AND COLD-DRAWN WIRE. ADDITIONALLY, USE A LAP WITH LONGITUDINAL WIRE INCLUDED ON EACH SIDE OF THE LAP. ASSEMBLE ALL CIRCULAR AND LONGITUDINAL REINFORCEMENT AND SECURELY FASTEN SO AS TO MAINTAIN REINFORCEMENT IN EXACT SHAPE AND CORRECT POSITION WITHIN THE FORM.

REINFORCEMENT WILL BE CONSIDERED AS MEETING THE DESIGN REQUIREMENTS IF THE AREA, COMPUTED ON THE BASIS OF NOMINAL AREA OF THE WIRE OR BARS USED, EQUALS OR EXCEEDS THE ABOVE REQUIREMENT. ACTUAL AREA OF THE REINFORCING USED MAY VARY FROM THE NOMINAL AREA ACCORDING TO PERMISSIBLE VARIATIONS OF THE STANDARD SPECIFICATIONS FOR THE REINFORCING. IF REBAR IS USED INSTEAD OF WELDED WIRE REINFORCING, INCREASE THE STEEL AREAS SHOWN BY 8%.

PROVIDE COVER OVER THE CIRCUMFERENTIAL STEEL AS SHOWN ON THIS PLATE, BUT IN NO CASE LESS THAN $\frac{3}{4}$ " AS MEASURED TO THE INSIDE WALL SURFACE OR THE OUTSIDE WALL SURFACE, EXCEPT IN THE TONGUE AND GROOVE. REINFORCING STEEL MAY BE OMITTED FROM EITHER THE TONGUE OR GROOVE ENDS OF PIPE WITH A SINGLE CAGE. PROVIDE REINFORCEMENT IN BELL ENDS WHEN STANDARD PLATE 3006 JOINTS ARE USED.

DO NOT EXCEED 4" CENTER-TO-CENTER SPACING OF ADJACENT RINGS OF CIRCUMFERENTIAL REINFORCEMENT IN A CAGE UP TO AND INCLUDING PIPE HAVING A 4" WALL THICKNESS, NOR EXCEED THE WALL THICKNESS FOR LARGE PIPE, AND IN NO CASE EXCEED 6". MAINTAIN CONTINUITY OF THE CIRCUMFERENTIAL REINFORCING STEEL DURING THE MANUFACTURE OF THE PIPE. ANY CIRCUMFERENTIAL REINFORCING THAT IS CUT MUST BE REPLACED WITH AT LEAST ONE-HALF OF THE STEEL AREA ON EACH SIDE OF THE CUT WIRE.

CIRCUMFERENTIAL REINFORCEMENT: A LINE OF CIRCUMFERENTIAL REINFORCEMENT FOR ANY GIVEN TOTAL AREA MAY BE COMPOSED OF TWO LAYERS FOR PIPE WITH WALL THICKNESSES OF LESS THAN 7" OR THREE LAYERS FOR PIPE WITH WALL THICKNESSES OF 7" OR GREATER. DO NOT SEPARATE THE LAYERS BY MORE THAN THE THICKNESS OF ONE LONGITUDINAL BAR PLUS $\frac{1}{4}$ ". FASTEN MULTIPLE LAYERS TOGETHER TO FORM A SINGLE CAGE. ALL OTHER SPECIFICATION REQUIREMENTS SUCH AS LAPS, WELDS, AND TOLERANCES OF PLACEMENT IN THE WALL OF THE PIPE, ETC., APPLY TO THIS METHOD OF FABRICATION OF A LINE OF REINFORCEMENT.

GENERAL NOTES:

COMPUTE THE STRENGTH TEST REQUIREMENTS IN POUNDS-FORCE PER LINEAL FOOT OF PIPE UNDER THE THREE-EDGE-BEARING METHOD BY MULTIPLYING THE INTERNAL DIAMETER OF THE PIPE IN FEET BY THE D-LOADS (EXPRESSED IN POUND-FORCE PER LINEAL FOOT OF DIAMETER) TO PRODUCE THE 0.01" CRACK AND THE ULTIMATE LOAD SPECIFIED ON SHEETS 1 AND 2 OF THIS STANDARD PLATE.

SEE STANDARD PLATE 3145 FOR PIPE TIE REQUIREMENTS.

NO MORE THAN TWO LIFT HOLES ARE PERMITTED IN ANY SECTION OF PIPE. FURNISH AND INSTALL TAPERED CONCRETE PLUGS TO CLOSE LIFT HOLES.

PERFORM GASKET LUBRICATION PER MANUFACTURER'S RECOMMENDATIONS.

REFER TO MnDOT DRAINAGE MANUAL FOR ALLOWABLE FILL HEIGHTS.

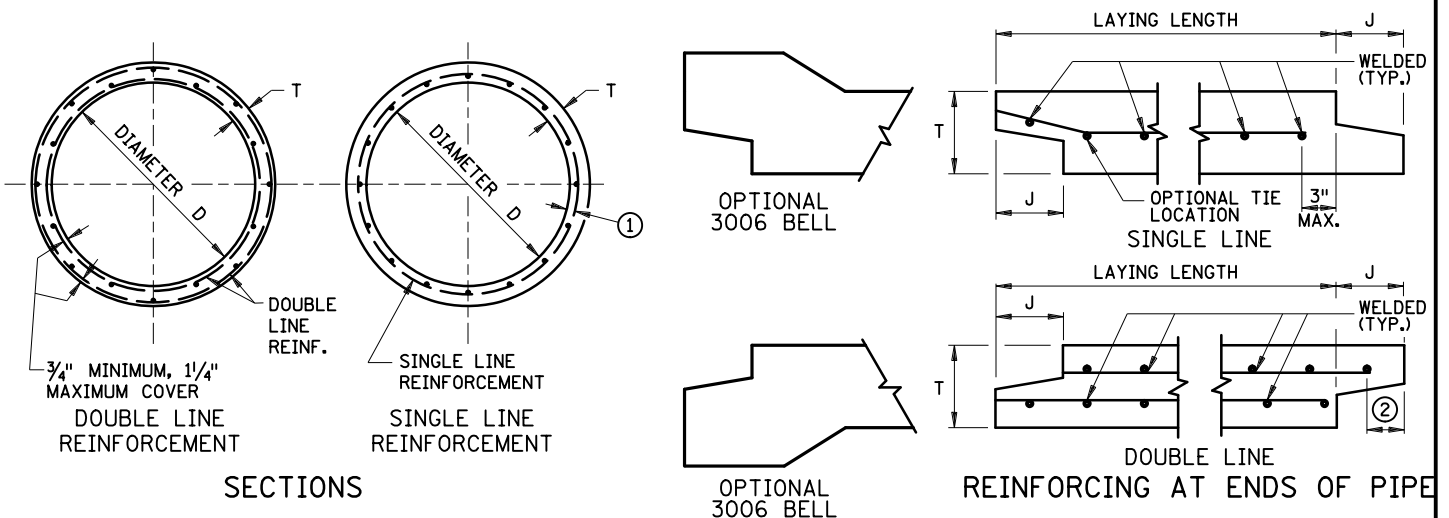
LAYING LENGTH:

LAYING LENGTH IS DEFINED AS THE TOTAL PIPE SECTION LENGTH MINUS THE TONGUE LENGTH J. THE MINIMUM LAYING LENGTH IS 6' FOR DIAMETERS 108" OR LESS, EXCEPT THAT TWO 4' LENGTHS ARE PERMITTED IN A LINE OF PIPE TO MAKE A REQUIRED LENGTH. THE MINIMUM LAYING LENGTH IS 4' FOR DIAMETERS GREATER THAN 108". FOR ALL DIAMETERS OF PIPE, ONE SECTION OF ANY ODD LENGTH GREATER THAN 4 FEET IS PERMITTED IN EACH LINE OR REACH OF PIPE TO MAKE THE REQUIRED LENGTH. PLACE PIPE SECTIONS SHORTER THAN THE NOMINAL LENGTH NEAR THE MIDDLE OF THE LINE OR AS REQUIRED BY THE ENGINEER.

BASIS OF DESIGN:

CONCRETE STRENGTHS AND REINFORCEMENT REQUIREMENTS ARE IN ACCORDANCE WITH AASHTO M170. FOR PIPE SIZES AND CLASSES THAT ARE NOT INCLUDED IN M170, A CUSTOM DESIGN FOR THE 3 EDGE BEARING TEST WAS PERFORMED IN ACCORDANCE WITH THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 8TH EDITION, SECTION 12.10.4.2, WITH HL-93 LIVE LOAD EXCLUDING LANE LOAD. ASSUMED SOIL UNIT WEIGHT OF 120 PCF.

- ① 35 TO 50 PERCENT OF T, EXCEPT WHEN WALL THICKNESS IS LESS THAN $2\frac{1}{2}$ ", THEN $\frac{3}{4}$ " OF COVER IS REQUIRED.
- ② MAXIMUM END COVER ON LAST CIRCUMFERENTIAL IS LESSER OF $\frac{1}{2}$ THE LENGTH OF THE JOINT OR 3". MINIMUM END COVER TO THE LAST CIRCUMFERENTIAL IS $\frac{1}{2}$ " IN THE GROOVE END AND $\frac{1}{4}$ " IN THE TONGUE END.



APPROVED MARCH 5, 2020

Rom S. Smith
STATE DESIGN ENGINEER

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE PIPE
GENERAL NOTES

SPECIFICATION
REFERENCE

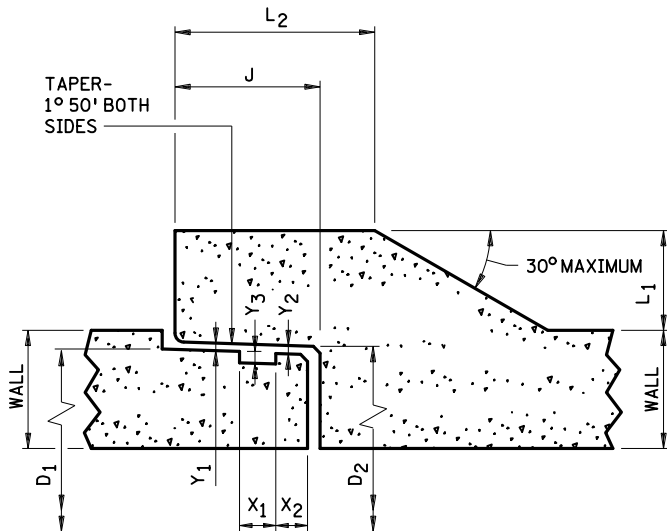
2501
2503

STANDARD
PLATE
NO.

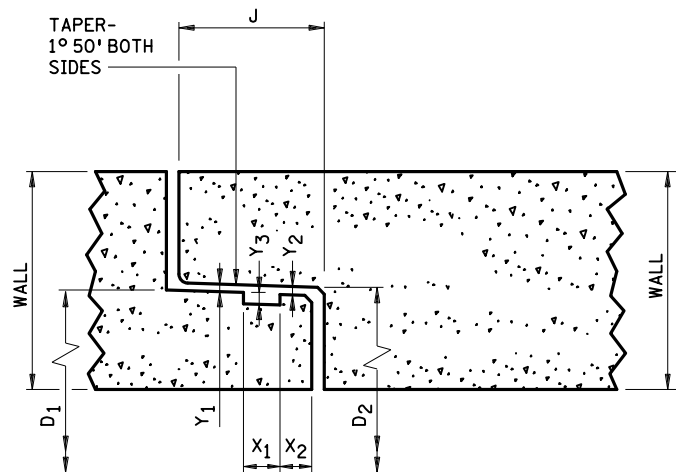
3000M

6 OF 6

DIAMETER D	LENGTH OF JOINT J	D ₁	D ₂	MINIMUM L ₂	B-WALL L ₁	C-WALL L ₁	X ₁	X ₂	Y ₁	Y ₂	Y ₃
INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES	INCHES
12	3 ⁵ / ₈	15.223	15.331	5	2	1 ¹ / ₄	1	7 ¹ / ₈	0.062	0.090	0.313
15	3 ⁵ / ₈	18.723	18.831	4 ³ / ₄	2 ³ / ₁₆	1 ⁷ / ₁₆	1	7 ¹ / ₈	0.062	0.090	0.313
18	3 ⁵ / ₈	22.098	22.206	5	2 ³ / ₈	1 ⁵ / ₈	1	7 ¹ / ₈	0.062	0.090	0.313
21	3 ⁷ / ₈	25.600	25.724	5 ¹ / ₄	2 ⁹ / ₁₆	1 ³ / ₁₆	1	7 ¹ / ₈	0.062	0.090	0.313
24	3 ⁷ / ₈	28.975	29.099	5 ¹ / ₂	2 ³ / ₄	2	1	7 ¹ / ₈	0.062	0.090	0.313
27	4	32.476	32.608	5 ¹ / ₂	2 ³ / ₄	2	1	7 ¹ / ₈	0.062	0.090	0.313
30	4	35.976	36.108	5 ¹ / ₂	2 ³ / ₄	2	1	7 ¹ / ₈	0.062	0.090	0.313
33	4 ¹ / ₈	39.476	39.616	5 ³ / ₄	2 ⁷ / ₈	2 ¹ / ₈	1	7 ¹ / ₈	0.062	0.090	0.313
36	4 ¹ / ₈	42.976	43.116	6	3 ¹ / ₈	2 ³ / ₈	1	7 ¹ / ₈	0.062	0.090	0.313
42	4 ⁵ / ₈	50.021	50.183	6 ³ / ₄	3 ³ / ₄	3	1 ³ / ₁₆	1	0.067	0.129	0.376
48	4 ³ / ₄	57.023	57.193	7 ¹ / ₄	4 ¹ / ₈	3 ³ / ₈	1 ³ / ₁₆	1	0.067	0.129	0.376
54	5	63.007	63.192	7 ¹ / ₂	3 ⁵ / ₈	2 ⁷ / ₈	1 ³ / ₁₆	1	0.067	0.129	0.376
60	5	69.007	69.192	7 ¹ / ₂	3 ¹ / ₈	2 ³ / ₈	1 ³ / ₁₆	1	0.067	0.129	0.376
66	5	75.007	75.192	7 ¹ / ₂	2 ³ / ₄	2	1 ³ / ₁₆	1	0.067	0.129	0.376
72	5 ¹ / ₄	79.250	79.400	—	—	—	1 ³ / ₁₆	1 ¹ / ₄	0.093	0.190	0.376
78	5 ¹ / ₄	86.250	86.400	—	—	—	1 ³ / ₁₆	1 ¹ / ₄	0.093	0.190	0.376
84	5 ¹ / ₄	91.500	91.650	—	—	—	1 ³ / ₁₆	1 ¹ / ₄	0.093	0.190	0.376
90	5 ¹ / ₄	97.750	97.900	—	—	—	1 ³ / ₁₆	1 ¹ / ₄	0.093	0.190	0.376
96	5 ¹ / ₄	104.250	104.400	—	—	—	1 ³ / ₁₆	1 ¹ / ₄	0.093	0.190	0.376
108	6 ³ / ₈	117.250	117.400	—	—	—	1 ³ / ₁₆	1 ¹ / ₄	0.130	0.190	0.376



66" PIPE AND SMALLER ①
REINFORCEMENT NOT SHOWN



72" PIPE AND LARGER
REINFORCEMENT NOT SHOWN

NOTES:

SEE STANDARD PLATE 3000 FOR PIPE DESIGN.

THE ENGINEER MAY APPROVE A CHANGE IN THE SIZE OF THE NOTCH AND GASKET. A WRITTEN REQUEST FOR APPROVAL OF SUCH CHANGE IS REQUIRED.

TOLERANCES IN DIMENSIONS:

JOINT DIMENSIONS ARE NOMINAL AND SUBJECT TO REASONABLE MANUFACTURING TOLERANCES. FABRICATE THE TONGUE AND GROOVE SUCH THAT WHEN THE PIPE IS JOINTED WITH THE GASKET IN PLACE A PROPER FIT IS OBTAINED. FINAL ACCEPTANCE OF THE PIPE WILL BE AT THE JOB SITE AFTER EFFECTIVE JOINTING HAS BEEN OBTAINED.

DIMENSIONS SHOWN ARE DESIGN DIMENSIONS, INSPECTION MEASUREMENTS WILL BE MADE TO THE NEAREST 1/8".

FURNISH GASKETS IN ACCORDANCE WITH ASTM C1619 CLASS C.

① SEE SHEET 2 OF 2 FOR OPTIONAL BELL REINFORCEMENT, CLEARANCES, AND NOTES.

APPROVED MARCH 5, 2020

Rom S. Smith
STATE DESIGN ENGINEER

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

GASKET JOINT FOR R.C. PIPE

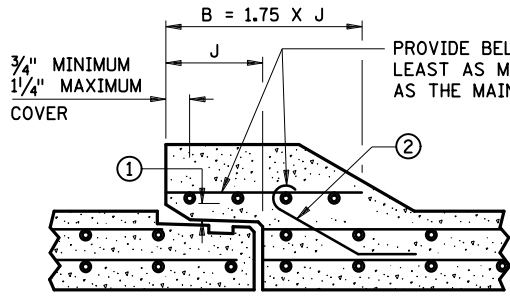
SPECIFICATION
REFERENCE

2501
2503

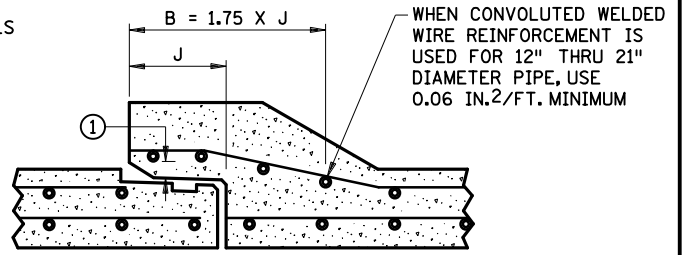
STANDARD
PLATE
NO.

3006H

1 OF 2

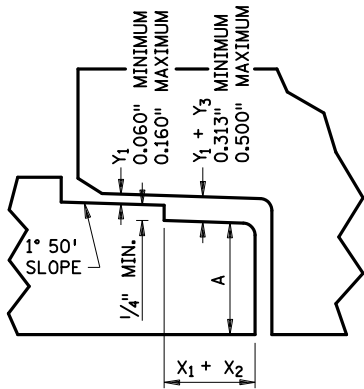


CYLINDRICAL CAGE DETAIL

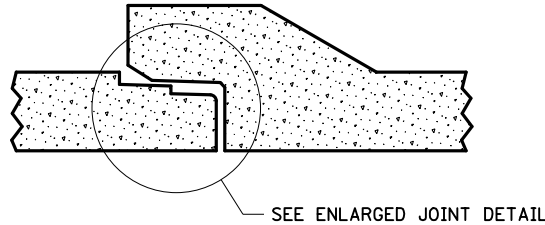


EXPANDED BELL DETAIL

BELL REINFORCEMENT OPTIONS
66" PIPE AND SMALLER



ENLARGED JOINT DETAIL



OPTIONAL TONGUE DETAIL
REINFORCEMENT NOT SHOWN

INT. DIA. PIPE	X ₁ + X ₂	SPIGOT THICKNESS A
12"	1.75"	1.15"
15"		1.50"
18"		1.70"
21"		1.95"
24"		2.15"
27"		2.40"
30"		2.65"
33"		2.90"
36"		3.15"
48"	1.75"	3.15"

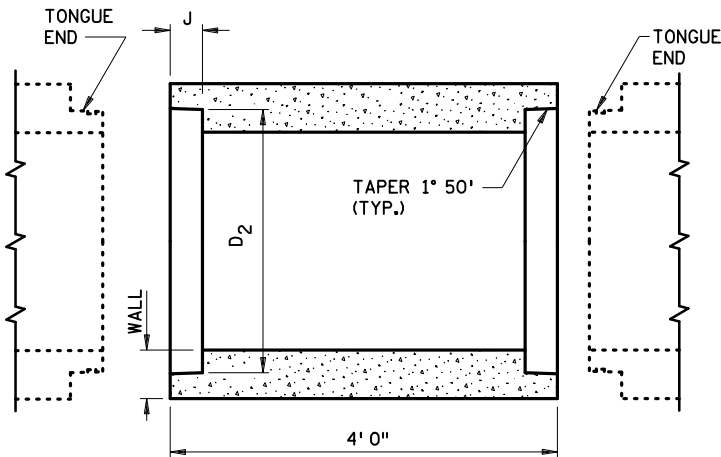
NOTES:

PROVIDE A BELL CAGE AT LEAST AS WIDE AS DIMENSION B.

FOR DOUBLE CAGE PIPE, PROVIDE REINFORCEMENT AT LEAST EQUAL IN AREA TO THAT OF THE OUTSIDE CAGE OR LINE FOR BELLS, AND THE INSIDE CAGE OR LINE FOR SPIGOTS. FOR SINGLE CAGE PIPE, PROVIDE REINFORCEMENT IN THE BELL AT LEAST EQUAL IN AREA TO THAT OF THE CAGE.

SEE SHEET 1 FOR ALL DIMENSIONS OTHER THAN BELL REINFORCEMENT.

- ① LOCATE REINFORCING IN BELL FROM 3/4" TO 1 1/4" FROM INNER FACE OF BELL.
- ② USE A MINIMUM OF THREE NO. 3 HOOK TIES EQUALLY SPACED WITH A MAXIMUM SPACING OF 24".



OPTIONAL TRANSITION PIPE
CONNECT TONGUE END TO TONGUE END

TRANSITION PIPE REINFORCEMENT							
INTERNAL DIAMETER	12"	15"	18"	21"	24"	27"	30"
WALL	4"	4 3/8"	4 7/8"	5 1/4"	5 3/4"	6"	6 1/4"
INSIDE REINFORCEMENT (IN ² / LIN. FT.)	0.08	0.08	0.10	0.12	0.12	0.14	0.18
OUTSIDE REINFORCEMENT (IN ² / LIN. FT.)	—	—	—	0.08	0.08	0.08	0.11

APPROVED MARCH 5, 2020

Rom S
STATE DESIGN ENGINEER

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

GASKET JOINT FOR R.C. PIPE
OPTIONS

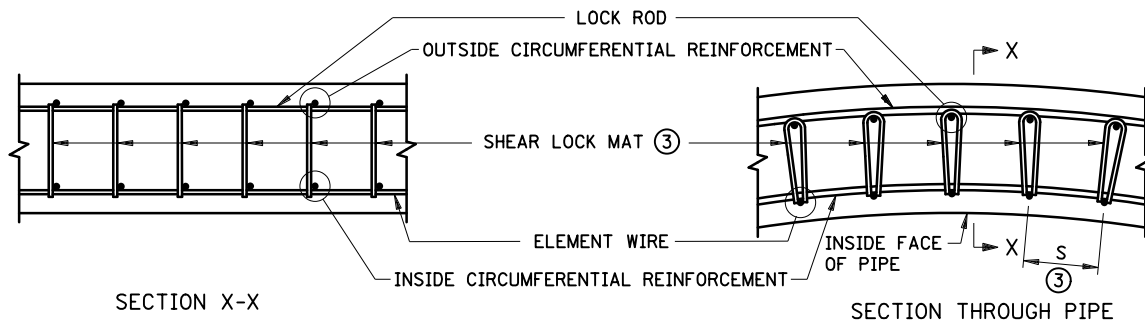
SPECIFICATION
REFERENCE

2501
2503

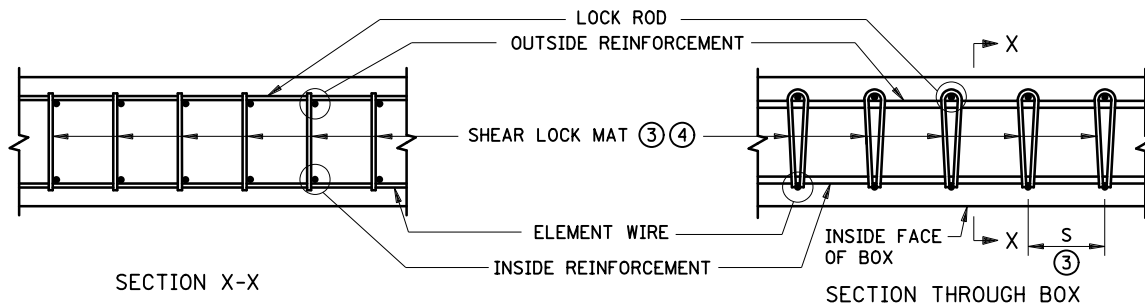
STANDARD
PLATE
NO.

3006H

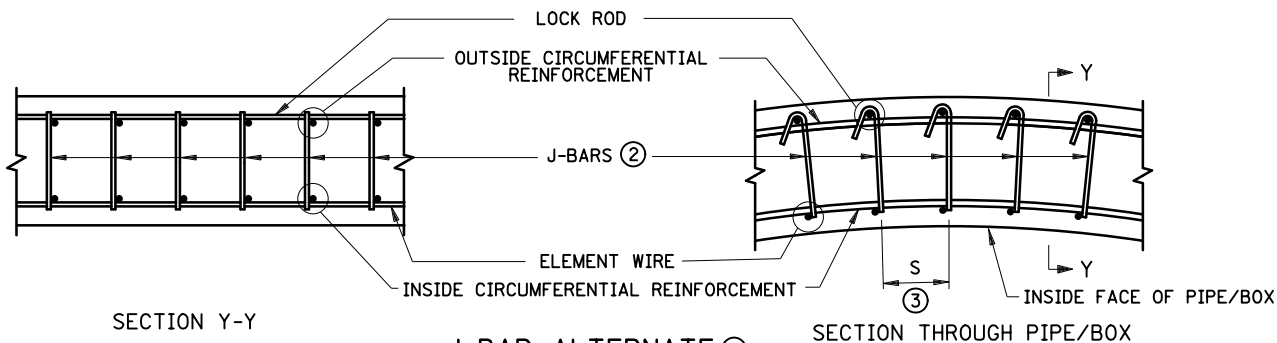
2 OF 2



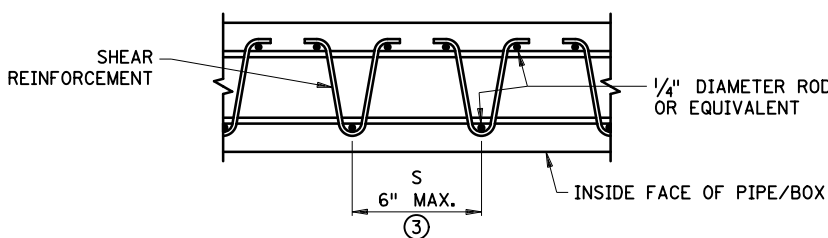
SHEAR LOCK ALTERNATE - PIPE ①



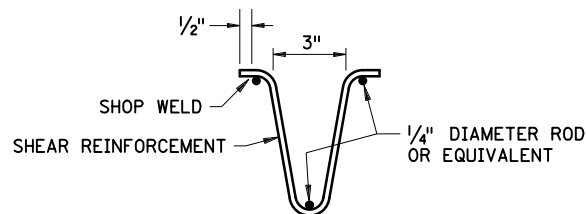
SHEAR LOCK ALTERNATE - BOX CULVERTS ①



J-BAR ALTERNATE ①



V-BAR ALTERNATE



V-BAR DETAIL

NOTES:

S = MAXIMUM SPACING OF ROWS OR RADIAL REINFORCING AT INNER CAGE. REFER TO STANDARD PLATES 3000, 3014, OR THE PRECAST BOX CULVERT STANDARDS FOR REINFORCEMENT CLEARANCES, SHEAR REINFORCEMENT AREAS, AMPLITUDE, AND SPACING.

USE SHEAR REINFORCEMENT IN CONFORMANCE WITH THE APPLICABLE REQUIREMENTS OF AASHTO M32. USE GRADE 60 REINFORCING BARS IN CONFORMANCE WITH SPEC. 3301.

ANCHOR SHEAR REINFORCEMENT IN CONFORMANCE WITH SECTION 12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS.

PIN ALL SHEAR REINFORCEMENT. FOR SHEAR LOCK MAT AND J-BAR ALTERNATES, PROVIDE ELEMENT WIRE WITH A MINIMUM DIAMETER OF 0.19" AND A LOCK ROD OF THE SAME DIAMETER. FOR THE V-BAR ALTERNATE USE ROD WITH A MINIMUM DIAMETER OF 0.25".

OTHER FORMS OF SHEAR REINFORCEMENT WILL BE CONSIDERED FOR APPROVAL UPON WRITTEN REQUEST.

- ① STIRRUPS MAY BE SPLICED A MINIMUM OF ONE OVERLAP AT OR NEAR ϕ OF PIPE.
- ② THE J BAR ALTERNATE CAN BE FABRICATED FROM WELDED WIRE REINFORCEMENT OR AS APPROVED BY THE ENGINEER. BEND THE WIRE TO FORM A 140 DEGREE OR GREATER HOOK.
- ③ AS MEASURED ALONG THE INNER CAGE.
- ④ FOR BOX CULVERTS, SHEAR LOCK MATS MAY BE INSTALLED FROM THE INSIDE OR OUTSIDE AT FABRICATORS OPTION.

APPROVED MARCH 5, 2020

Rom S. [Signature]
STATE DESIGN ENGINEER

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

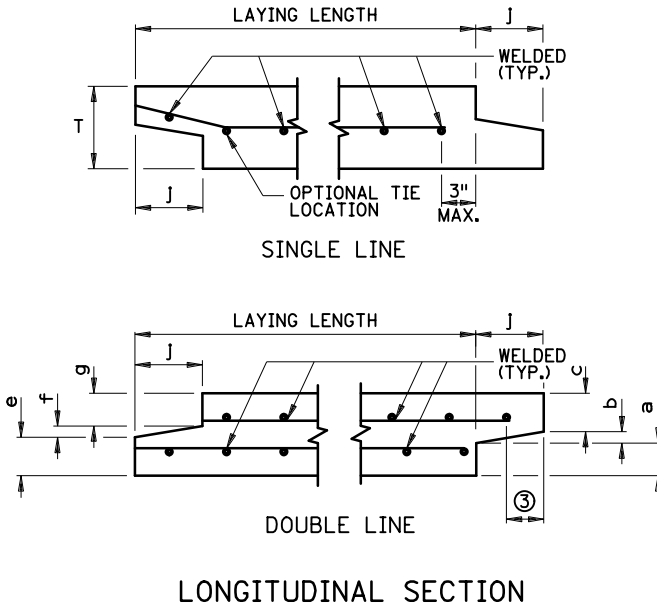
**SHEAR REINFORCEMENT FOR
PRECAST DRAINAGE STRUCTURES**

SPECIFICATION
REFERENCE
2501
2503

STANDARD
PLATE
NO.
3007F

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TABLE OF DIMENSIONS														
NOMINAL SPAN	EQUIVALENT DIAMETER ①	WATER AREA	RISE	SPAN	MINIMUM WALL THICKNESS (T)	DIMENSION REQUIREMENTS IN INCHES								APPROXIMATE WEIGHT PER FOOT
						a	b	c	j	e	f	g	E ②	
22	18	1.7	13 1/2	22	2 1/2	1 3/8	3/8	3/4	2	1 1/8	3/8	1	6	170
28	24	2.8	18	28 1/2	3 1/2	1 5/8	1/2	1 3/8	3	1 3/8	1/2	1 5/8	5 5/16	315
36	30	4.4	22 1/2	36 1/4	4	1 13/16	5/8	1 9/16	3 1/2	1 9/16	5/8	1 13/16	7 11/16	445
44	36	6.4	26 5/8	43 3/4	4 1/2	2	3/4	1 3/4	4	1 3/4	3/4	2	8 9/16	595
51	42	8.8	31 3/16	51 1/8	4 1/2	2	3/4	1 3/4	4	1 3/4	3/4	2	10 1/16	685
58	48	11.4	36	58 1/2	5	2 1/4	3/4	2	5	2	3/4	2 1/4	11 5/8	875
65	54	14.0	40	65	5 1/2	2 1/2	3/4	2 1/4	5	2 1/4	3/4	2 1/2	13	1065
73	60	17.7	45	73	6	3 5/16	3/4	1 5/16	5	2 3/4	3/4	2 1/2	14 11/16	1305
88	72	25.6	54	88	7	3 13/16	1	2 3/16	6	3 1/4	1	2 3/4	17	1820
102	84	34.6	62	102	8	4 1/8	1	2 7/8	6	3 1/2	1	3 1/2	18 11/16	2410
115	90	44.5	72	115 1/2	8 1/2	4 1/4	1	3 1/4	7	3 3/4	1	3 3/4	22 7/8	2915
122	96	51.7	77 1/2	122 3/8	9	4 1/2	1	3 1/2	7	4	1	4	23 11/16	3290
138	108	66.0	87 1/8	138 1/2	10	5	1	4	7	4 1/2	1	4 1/2	25 3/16	4125
154	120	81.8	96 7/8	154	11	5 1/2	1	4 1/2	7	5	1	5	29 1/4	5055
169	132	99.1	106 1/2	168 3/4	10	5	1	4	7	4 1/2	1	4 1/2	32 5/16	4975



NOTES:


- ① EQUIVALENT DIAMETER EQUALS DIAMETER OF CIRCULAR PIPE WITH APPROXIMATELY EQUIVALENT CROSS-SECTION AREA.
- ② SPRINGLINE DIMENSION, SEE SHEET 2 OF 3.
- ③ MAXIMUM END COVER ON LAST CIRCUMFERENTIAL IS LESSER OF 1/2 THE LENGTH OF THE JOINT OR 3". MINIMUM END COVER TO THE LAST CIRCUMFERENTIAL IS 1/2" IN THE GROOVE END AND 1/4" IN THE TONGUE END.

GENERAL NOTES:

LAYING LENGTHS: 22" TO 122" NOMINAL SPAN (6' & 8'), 138" NOMINAL SPAN (4' & 6'), 154" & 169" NOMINAL SPAN (4' & 5').
 SEE MnDOT DRAINAGE MANUAL FOR ALLOWABLE FILL HEIGHTS.
 SEE STANDARD PLATE 3014 SHEET 2 OF 3 FOR CROSS SECTION SKETCH.
 SEE STANDARD PLATE 3007 FOR ADDITIONAL DETAILS.

BASIS OF DESIGN:

CONCRETE STRENGTHS AND REINFORCEMENT REQUIREMENTS ARE IN ACCORDANCE WITH AASHTO M206. FOR PIPE SIZES AND CLASSES THAT ARE NOT INCLUDED IN M206, A CUSTOM DESIGN WAS PERFORMED IN ACCORDANCE WITH THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 8TH EDITION, SECTION 12.10.4.2, WITH HL-93 LIVE LOAD EXCLUDING LANE LOAD. ASSUMED SOIL UNIT WEIGHT OF 120 PCF.

APPROVED MARCH 5, 2020

 STATE DESIGN ENGINEER

STATE OF MINNESOTA
 DEPARTMENT OF TRANSPORTATION
REINFORCED CONCRETE PIPE ARCH
 GENERAL NOTES AND DIMENSIONS

SPECIFICATION REFERENCE
 2501
 2503

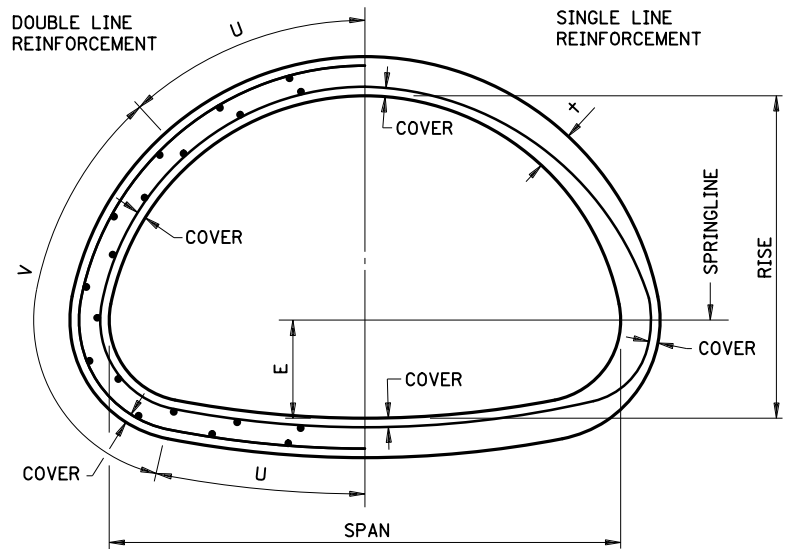
STANDARD PLATE NO.
3014K
 1 OF 3

TABLE OF REINFORCEMENT REQUIREMENTS																				
NOMINAL SPAN	EQUIVALENT DIAMETER ①	CONCRETE 4000 PSI ④																		
		As, CONTINUOUS BASIC REINFORCEMENT						As, ADDITIONAL REINFORCEMENT						SINGLE LINE REINFORCEMENT						
		INNER CAGE			OUTER CAGE			U - INNER CAGE			V - OUTER CAGE									
		IIA	IIIA	IVA	IIA	IIIA	IVA	DIMENSION	IIA	IIIA	IVA	DIMENSION	IIA	IIIA	IVA	IIA	IIIA	IVA		
IN.	IN.																			
22	18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.11	0.14	0.26
28	24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.16	0.21	0.32
36	30	0.09	0.12	0.18	0.07	0.09	0.14	13"	0.09	0.12	0.18	29"	0.07	0.09	0.13	0.18	0.24	0.36	0.44	0.54
44	36	0.11	0.15	0.22	0.09	0.12	0.17	15"	0.11	0.15	0.22	34"	0.09	0.12	0.16	0.21	0.30	0.44	0.54	0.64
51	42	0.13	0.18	0.27	0.10	0.14	0.21	17"	0.13	0.18	0.27	39"	0.10	0.14	0.22	0.26	0.36	0.54	0.64	0.74
58	48	0.15	0.22	②	0.12	0.17	②	22"	0.15	0.21	②	48"	0.12	0.17	②	0.30	0.44	②	②	②
65	54	0.18	0.24	②	0.14	0.19	②	24"	0.18	0.24	②	54"	0.14	0.19	②	0.36	0.48	②	②	②
CONCRETE 5000 PSI																				
73	60	0.21	0.28	②	0.17	0.21	②	28"	0.21	0.27	②	60"	0.17	0.21	②	0.42	0.56	②	②	②
88	72	0.26	0.36	0.57③	0.20	0.27	0.43③	33"	0.26	0.36	0.57③	72"	0.20	0.27	0.43③	0.52	0.72	—	—	—
102	84	0.32	0.44	0.67③	0.24	0.34	0.50③	39"	0.32	0.44	0.67③	84"	0.24	0.34	0.50③	0.64	0.88	—	—	—
115	90	0.39	0.52③	0.84③	0.30	0.39③	0.63③	43"	0.39	0.52③	0.84③	96"	0.30	0.39③	0.63③	—	—	—	—	—
122	96	0.42	0.56③	0.90③	0.32	0.42③	0.67③	46"	0.42	0.56③	0.90③	102"	0.32	0.42③	0.67③	—	—	—	—	—
138	108	0.49③	0.66③	②	0.37③	0.50③	②	52"	0.49③	0.66③	②	114"	0.37③	0.50③	②	—	—	—	—	②
154	120	0.55③	0.77③	②	0.41③	0.57③	②	58"	0.55③	0.77③	②	126"	0.41③	0.57③	②	—	—	—	—	②
169	132	0.82③	②	②	0.61③	②	②	62"	0.82③	②	②	132"	0.61③	②	②	—	—	—	②	②

As = CIRCUMFERENTIAL REINFORCEMENT AREA IN SQUARE INCHES PER LINEAL FOOT OF PIPE BARREL IN EACH CONTINUOUS BASIC CAGE AND SUPPLEMENTAL REINFORCEMENT DESIGNATED "U" AND "V".
 U = HALF BAR OR WELDED WIRE REINFORCEMENT LENGTH MEASURED ALONG CENTERLINE OF PIPE WALL FROM VERTICAL CENTERLINE OF PIPE.
 V = FULL BAR OR WELDED WIRE REINFORCEMENT LENGTH MEASURED ALONG CENTERLINE OF PIPE WALL AND POSITIONED EQUIDISTANT WITH RESPECT TO ENDS OF "U" REINFORCEMENT.

D-LOADS FOR THREE-EDGE-BEARING TEST		
CLASS	0.01-IN CRACK	ULTIMATE
IIA	1000	1500
IIIA	1350	2000
IVA	2000	3000

NOTE: TEST LOAD IN POUNDS PER LINEAL FOOT EQUALS D-LOAD x INSIDE SPAN IN FEET. REFER TO SPEC. 3236 FOR ADDITIONAL LOAD BEARING TEST REQUIREMENTS.



NOTES:

- IF REINFORCEMENT BARS ARE USED IN LIEU OF WELDED WIRE REINFORCEMENT, USE REINFORCEMENT BARS IN CONFORMANCE WITH SPEC. 3301, $f_y = 60$ KSI, AND INCREASE THE REQUIRED REINFORCEMENT BY 8%.
- THE MINIMUM COVER FOR REINFORCEMENT IS $\frac{3}{4}$ ", AND THE MAXIMUM IS $1" + 10\%$ OF THE WALL THICKNESS OR $\frac{1}{2}"$, WHICHEVER IS GREATER.
- DO NOT EXCEED A SPACING OF 4" FOR THE CENTER TO CENTER SPACING OF ADJACENT RINGS OF CIRCUMFERENTIAL REINFORCEMENT FOR 30" EQUIVALENT DIAMETER AND SMALLER PIPE. FOR LARGER PIPE, DO NOT EXCEED THE WALL THICKNESS OR 6", WHICHEVER IS LESS. DO NOT DESTROY THE CONTINUITY OF THE CIRCUMFERENTIAL REINFORCEMENT DURING THE MANUFACTURE OF THE PIPE.
- REFER TO AASHTO M206 FOR ADDITIONAL PIPE DIMENSIONS AND GEOMETRY.

- ① EQUIVALENT DIAMETER = DIAMETER OF CIRCULAR PIPE WITH APPROXIMATELY EQUIVALENT CROSS-SECTION AREA.
- ② NOT AVAILABLE IN THIS SIZE/CLASS COMBINATION.
- ③ CLASS IIA PIPE 138" OR MORE IN DIAMETER, CLASS IIIA PIPE 115" OR MORE IN DIAMETER, AND CLASS IVA PIPE 88" OR MORE IN DIAMETER ARE SPECIAL DESIGNS IN ACCORDANCE WITH 3236 AND REQUIRE SHEAR REINFORCEMENT. SEE SHEET 3 OF 3.
- ④ THE REQUIRED STRENGTH INCREASES TO 5000 PSI FOR LARGER SIZE PIPE, SEE BELOW.

APPROVED MARCH 5, 2020

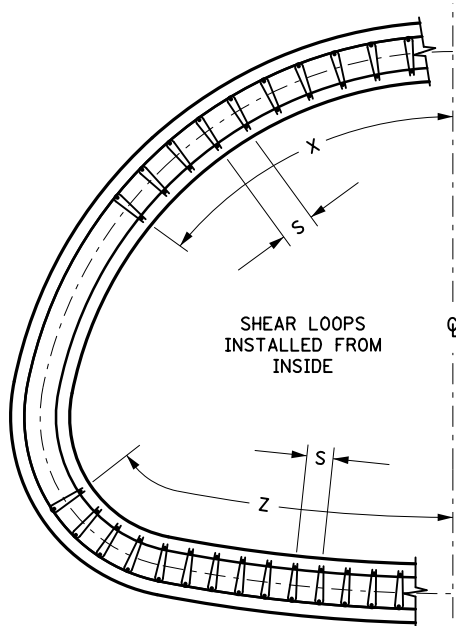
 STATE DESIGN ENGINEER

STATE OF MINNESOTA
 DEPARTMENT OF TRANSPORTATION
REINFORCED CONCRETE PIPE ARCH
 REINFORCEMENT

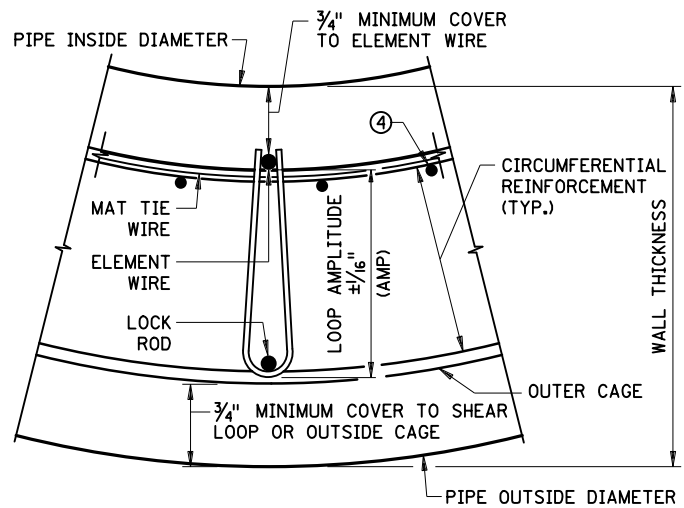
SPECIFICATION REFERENCE
 2501
 2503

STANDARD PLATE NO.
3014K
 2 OF 3

SHEAR REINFORCEMENT REQUIREMENTS ③												
NOMINAL SPAN	EQUIVALENT DIAMETER ①	WALL THICKNESS	AMPLITUDE (AMP)	TOP				BOTTOM				
				S	X	A _r		S	Z	A _r		
						IIIA	IVA			IIA	IIIA	IVA
IN.	IN.	IN.	IN.	IN.	IN.			IN.	IN.			
88	72	7"	5"	3.5	36	—	0.39	3.5	42	—	—	0.27
102	84	8"	6"	4.5	42	—	0.39	4.5	49	—	—	0.26
115	90	8½"	6½"	4.5	47	0.19	0.43	4.5	54	—	0.12	0.30
122	96	9"	7"	5	52	0.19	0.42	5	55	—	0.11	0.29
138	108	10"	8"	5.5	59	0.19	②	5.5	62	0.06	0.12	②
154	120	11"	9"	6	65	0.19	②	6	69	0.07	0.12	②
169	132	10"	8"	5.5	71	②	②	5.5	74	0.07	②	②



SHEAR LOCK MAT
INSTALLED FROM INSIDE



SHEAR LOCK MAT DETAIL
PINNED ON INSIDE

NOTES:

SHEAR LOCK MATS MUST BE INSTALLED FROM INSIDE OF PIPE AS SHOWN ON THIS SHEET.

AMP = SHEAR LOOP AMPLITUDE MEASURED FROM FACE OF ELEMENT WIRE TO TIP OF LOOP WIRE.

A_r = MINIMUM RADIAL REINFORCEMENT REQUIRED IN SQUARE INCHES PER SQUARE FOOT OF PIPE MEASURED AT THE INNER CAGE OVER MINIMUM ARC LENGTHS X AND Z AT THE TOP AND BOTTOM OF THE PIPE, RESPECTIVELY.

X & Z = MINIMUM LENGTH OF STIRRUPS MEASURED AT INNER CAGE.

S = MAXIMUM SPACING OF ROWS OR RADIAL REINFORCEMENT AT INNER CAGE.

S IS BASED ON SECTION 12.10.4.2.6 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 8TH EDITION, WHERE S SHALL NOT EXCEED 0.75*d*∅, WHERE ∅ IS 0.9 PER AASHTO SECTION 12.5.5. THE MAXIMUM SPACING HAS BEEN ROUNDED UP FROM THE CALCULATED VALUE TO THE NEAREST ½".

PIN ALL SHEAR REINFORCEMENT. PROVIDE ELEMENT BAR WITH A MINIMUM DIAMETER OF 0.19" AND A LOCK ROD OF THE SAME DIAMETER

SECURE LOCK RODS PLACED ON THE INSIDE OF THE OUTER CAGE NO MORE THAN 6" FROM THE END OF EACH LOCK ROD, AT 12" MAXIMUM SPACING.

SET INSIDE CIRCUMFERENTIAL REINFORCEMENT COVER BY USING A 1" CHAIR FOR THE CIRCUMFERENTIAL REINFORCEMENT.

① EQUIVALENT DIAMETER EQUALS DIAMETER OF CIRCULAR PIPE WITH APPROXIMATELY EQUIVALENT CROSS-SECTION AREA.

② NOT AVAILABLE IN THIS SIZE/CLASS COMBINATION.

③ SEE STANDARD PLATE 3007 FOR SHEAR REINFORCEMENT OPTIONS AND ADDITIONAL DETAILS AND INFORMATION.

④ WHEN SHEAR LOCK MAT ALTERNATE IS USED, LOCATE THE LONGITUDINALS ON THE INNER CAGE AS SHOWN.

APPROVED MARCH 5, 2020

Rom Sln
STATE DESIGN ENGINEER

STATE OF MINNESOTA
DEPARTMENT OF TRANSPORTATION

REINFORCED CONCRETE PIPE ARCH
SPECIAL DESIGN - SHEAR REINFORCEMENT
INSTALLED FROM INSIDE

SPECIFICATION
REFERENCE

2501
2503

STANDARD
PLATE
NO.

3014K

3 OF 3

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