

## **APPENDIX**

### **F. APPLICATION GUIDELINES FOR PIPE END TREATMENTS**

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**Table F-1: Application Guidelines for Pipe End Treatments - Part A**

(see page F-3 for notes)

Standard Plan Index	Description		Application			Inlet End		
	Type	Pipe Size	Cross Drain	Side Drain	Median	Application	Hydraulic Performance	$K_e$
430-010	U Type Concrete With Grate	Single 15" thru 30"	Limited	Limited	Yes	Yes	Fair	0.7
430-011	U Type Concrete	Single 15" thru 30"	Limited	No	Yes	Limited	Good	0.5 to 0.7
430-012	Concrete Energy Dissipater	Single 30" thru 72"	Limited	No	No	No	NA	NA
430-020	Flared End Section Concrete	Single 12" thru 72"	Yes	No	Yes	Yes	Good	0.5
430-021	Cross Drain Mitered End Section	Single & Multiple 15" thru 72"	Yes	No	Yes	Yes	Fair	0.7
430-022	Side Drain Mitered End Section	Single & Multiple 15" thru 60"	No	Yes	No	Yes	Fair	0.7 w/o, 1.0 w/ grate
430-030	Straight Concrete	Single & Multiple 15" thru 54"	(a) Yes	No	Limited	Yes	Excellent	0.2
430-031	Straight Concrete	Single & Double 60"	Yes	No	Limited	Yes	Excellent	0.2
430-032	Straight Concrete	Single & Double 66"	Yes	No	Limited	Yes	Excellent	0.2
430-033	Straight Concrete	Single & Double 72"	Yes	No	Limited	Yes	Excellent	0.2
430-034	Straight Concrete	Single 84"	Yes	No	Limited	Yes	Excellent	0.2
430-040	Winged Concrete	Single 12" thru 48"	Yes	No	Yes	Yes	Very Good	0.3

**Table F-2: Application Guidelines for Pipe End Treatments - Part B**

(see page F-3 for notes)

Standard Plans Index	Description		Outlet End		Safety		Economic Rating
	Type	Pipe Size	Applicable	Erosion Tolerance	Permitted Location	Traffic-Safe Grate Available	
430-010	U Type Concrete With Grate	Single 15" thru 30"	Yes	Very Good	Inside CZ	Required	Good
430-011	U Type Concrete	Single 15" thru 30"	Yes	Good	Grate Required Inside CZ	Yes	Fair
430-012	Concrete Energy Dissipater	Single 30" thru 72"	Yes	Excellent	Outside CZ	No	NA
430-020	Flared End Section Concrete	Single 12" thru 72"	Yes	(c) Very Good	(c) Outside CZ	No	Very Good
430-021	Cross Drain Mitered End Section	Single & Multiple 15" thru 72"	Yes	Good	(d) Outside CZ	No	Very Good
430-022	Side Drain Mitered End Section	Single & Multiple 15" thru 60"	Yes	Good	(e) Inside CZ	Yes	Good
430-030	Straight Concrete	Single & Multiple 15" thru 54"	Limited	Good	Outside CZ	No	Fair
430-031	Straight Concrete	Single & Double 60"	Limited	Good	Outside CZ	No	Fair
430-032	Straight Concrete	Single & Double 66"	Limited	Good	Outside CZ	No	Fair
430-033	Straight Concrete	Single & Double 72"	Limited	Good	Outside CZ	No	Fair
430-034	Straight Concrete	Single 84"	Limited	Good	Outside CZ	No	Fair
430-040	Winged Concrete	Single 12" thru 48"	Yes	Good	Outside CZ	No	Good

**LEGEND:**

- (a) For back of sidewalk location, see Standard Plans, Index 425-060.
- (b) For temporary construction or use on a minor facility.
- (c) Construction of optional toewall and concrete jacket may be necessary. Flared end section sizes 12 inch and 15 inch may be located as close as 8 feet beyond the outside edge of the shoulder.
- (d) Mitered end section sizes 15 inch, 18 inch, and 24 inch may be located as close as 8 feet beyond the outside edge of the shoulder.
- (e) Mitered end section size 30 inch and larger does not require a grate if pipe is located outside CZ and is offset from approach ditch alignment.

**NOTES:**

1. All end treatments must be selected to satisfy hydraulic suitability with proper consideration given to safety and economics.
2. CZ denotes clear zone; it was formerly CRA, denoting clear recovery area.
3. Grates should not be placed on outlet ends unless positive debris protection is provided at inlet end.
4. Additional notes concerning application restrictions may be shown on individual indexes.
5. Economic ratings are based on statewide average costs.
6. End treatments with a  $K_e$  of 0.5 or greater should be used only in areas of low design velocities and negligible debris.
7. Pipe sizes are circular, Class III B wall, concrete pipe. Elliptical pipe and corrugated pipe are to be checked for fit. Metal pipe sizes should be reviewed using 2  $\frac{2}{3}$ -inch x  $\frac{1}{2}$ -inch corrugation up to 30 inches and 3-inch x 1-inch corrugation for larger sizes.