



National Committee on Uniform Traffic Control Devices

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Attachment No. 1
Item No.: 17B-RW-01

NCUTCD Proposal for Changes to the Manual on Uniform Traffic Control Devices

TECHNICAL COMMITTEE: Regulatory and Warning Signs Committee
ITEM NUMBER: 17B-RW-01
TOPIC: Horizontal Alignment Signing
ORIGIN OF REQUEST: NCHRP 03-106, Traffic Control Device Guidelines for Curves.
Joint Task Force: Tom Heydel (chair), Bruce Ibarguen, Dan Waddle, Paul Carlson, Jim Pline, Bob Seyfried, Zoubir Ouadah (Markings Technical Committee), Dan Paddick.
AFFECTED SECTIONS OF MUTCD: 2C.06, 2C.07, 2C.09, 2C.10, 2C.11, 2C.12, 2C.13, 2C.14, 2C.15.

DEVELOPMENT HISTORY:

- Approved by RW Technical Committee: 06/29/2017
- Approved by Markings Technical Committee: 06/29/2017
- Approved by RW Technical Committee following sponsor comments: 01/03/2018
- Approved by Markings Technical Committee following sponsor comments: 01/03/2018
- Tabled by Council 1-5-2018 REVISEE RESUBMITTED TO SPONSORS
- Approved by RW Technical Committee following sponsor comments: 06/21/2018
- Approved by Markings Technical Committee following sponsor comments: 06/21/2018
- Approved by NCUTCD Council: 06/22/2018

This is a proposal for recommended changes to the MUTCD that has been approved by the NCUTCD Council. This proposal does not represent a revision of the MUTCD and does not constitute official MUTCD standards, guidance, or options. It will be submitted to FHWA for consideration for inclusion in a future MUTCD revision. The MUTCD can be revised only through the federal rulemaking process.

SUMMARY:

The final report for NCHRP 03-106, Traffic Control Device Guidelines for Curves was issued April 2015 by Texas A&M Transportation Institute, Texas A&M University and Vanasse Hangen Brustlin, Inc. That research included writing MUTCD text to revise Table 2C-5 along with sections of Part 2C and Part 3 that apply to TCD guidelines for curves. The objective of the research was to identify potential improvements to the MUTCD guidelines for the application of TCD's on curves.

33 In addition, a separate issue emerged that Sections 2C.14 and 2C.15 should be combined into one
34 section to address Exit and Ramp Speed signs and Combination Horizontal Alignment/Advisory
35 Exit and Ramp Speed Signs since we are impacting Section 2C.14 anyway. It made sense to
36 just incorporate that task forces work (item 17B-RW-02) into this proposal as directed by
37 RWSTC and make it into one ballot item 17B-RW-01.
38

39 **DISCUSSION:**

40 The research used unfamiliar driver behavior on actual test roadway segments and crash-based
41 safety studies to determine how drivers respond to various traffic control devices. Presently,
42 Table 2C-5 deals only with warning signs but does not factor other traffic control devices such as
43 pavement marking, raised pavement markers and delineators. As a result of the research the
44 MUTCD language was revised to reflect the driver behavior to the traffic control devices and
45 modify the language in the MUTCD to account for that behavior and safety analysis. Sections in
46 Part 2C and Part 3 were evaluated related to traffic control devices for curves and how it relates
47 to volumes and speed.
48

49 In addition, Sections 2C.14 and 2C.15 are combined into one section. This is not part of the
50 NCHRP 03-106 report, MUTCD language proposal. However, to avoid two separate ballot
51 items impacting the same section in the MUTCD, we included it into this proposal, since both
52 the NCHRP report and the other RWSTC task force for Section 2C.14 impact section 2C.14.
53

54 This item was tabled by Council on January 5, 2018 due to the high number of sponsor
55 comments (271). Sponsor vote as ballot item: 27 concur, 37 concur in part and 4 do not concur.
56 As a result it was tabled by Council and recommended that RWSTC send out again as a ballot
57 item for the June 2018 meeting. The proposal incorporates the sponsor comments and the
58 revised proposal is as follows below. **This proposal is being kept as item # 17B-RW-01 since
59 that was the item # when it originally went to sponsors. This will avoid confusion with
60 changing the number.**
61

62 **RECOMMENDED MUTCD CHANGES**

63
64 The following present the proposed changes to the current MUTCD within the context of the
65 current MUTCD language. Proposed additions to the MUTCD are shown in blue underline and
66 proposed deletions from the MUTCD are shown in ~~red strikethrough~~. Changes previously
67 approved by NCUTCD Council (but not yet adopted by FHWA) are shown in green double
68 underline for additions and ~~green double strikethrough~~ for deletions. In some cases, background
69 comments may be provided with the MUTCD text. These comments are indicated by
70 **[highlighted light blue in brackets]**.
71
72

PART 1. GENERAL
CHAPTER 1A. GENERAL

PART 2. SIGNS

Chapter 2C. WARNING SIGNS AND OBJECT MARKERS

Section 2C.06 Treatments for Changes in Horizontal Alignment ~~Horizontal Alignment Warning Signs~~

Support:

01 A variety of horizontal alignment warning signs (see Figure 2C-1), pavement markings (see Chapter 3B), and delineation (see Chapter 3F) can be used to advise motorists of a change in the roadway alignment. Uniform application of these traffic control devices with respect to the amount of change in the roadway alignment conveys a consistent message establishing driver expectancy and promoting effective roadway operations. ~~The design and application of horizontal alignment warning signs to meet those requirements the needs of motorists are addressed in Sections 2C.06 through 2C.15.~~

Figure 2C-1 Horizontal Alignment Signs and Plaques



~~Standard:~~ Option`

02 The following list identifies treatments (traffic control devices and non-traffic control devices) that may be used in advance of or within a change in horizontal alignment.

~~In advance of horizontal curves on freeways, on expressways, and on roadways with more than 1,000 AADT that are functionally classified as arterials or collectors, horizontal alignment warning signs shall be used in accordance with Table 2C-5 based on the speed differential between the roadway's posted or statutory speed limit or 85th percentile speed, whichever is higher, or the prevailing speed on the approach to the curve, and the horizontal curve's advisory speed.~~ (green cross outs above approved by Council January 2011, RW # 7, Attachment # 8)

105

Table 2C-5. Horizontal Alignment Sign Selection

Type of Horizontal Alignment Sign	Difference Between Speed Limit and Advisory Speed			
	5 mph	10 mph	15 mph	20 mph or more
Turn (W1-1), Curve (W1-2), Reverse Turn (W1-3), Reverse Curve (W1-4), Winding Road (W1-5), and Combination Horizontal Alignment/Intersection (W10-1) (see Section 2C.07 to determine which sign to use)	Recommended Optional	Required Recommended	Required	Required
Advisory Speed Plaque (W13-1P)	Recommended Optional	Required Recommended	Required	Required
Chevrons (W1-8) and/or One Direction Large Arrow (W1-6)	Optional	Recommended Optional ¹	Required Recommended ²	Required
Exit Speed (W13-2) and Ramp Speed (W13-3) on exit ramp	Optional	Optional	Recommended	Required

106
107
108
109
110

Note: Required means that the sign and/or plaque shall be used, recommended means that the sign and/or plaque should be used, and optional means that the sign and/or plaque may be used.
See Section 2C.06 for roadways with less than 1,000 ADT.

111 (Table 2C-5 items shown above was approved by Council January 20, 2011, RW #8, Attachment
112 # 9)

113 **We are now deleting the above Table 2C-5 that was modified and approved by Council on**
114 **January 20, 2011 and providing a new Tables 2C-5a & 2C-5b**

115
116 ¹ ~~Optional when one or more of the treatments listed in Section 3A.07 are used. Remove this~~
117 ~~previously approved sentence~~

118 ² ~~Recommended when one or more of the treatments listed in Section 3A.07 are used. Remove~~
119 ~~this previously Council approved sentence~~

120

121 Support:

122 The curve safety countermeasures identified below have been shown to be beneficial when
123 applied in combination with horizontal alignment warning signs to enhance safety around curves:

- 124 1. ~~Wide Edge lines,~~
- 125 2. ~~Delineators,~~
- 126 3. ~~Raised Retroreflective Pavement Markers~~
- 127 4. ~~Longitudinal Rumble Strips or Stripes~~
- 128 5. ~~Profiled Pavement Markings and/or~~
- 129 6. ~~Other curve safety countermeasures with demonstrated safety benefits in reducing~~
130 ~~horizontal curve crashes. (Delete previously Council approved items from June 27,~~
131 ~~2013.~~

132

- 133 A. Horizontal alignment signs (Turn (W1-1, W1-1a), Curve (W1-2, W1-2a, W1-10 series,
134 W1-11, W1-13, W1-15), Reverse Turn (W1-3), Reverse Curve (W1-4), Winding Road
135 (W1-5), Exit Speed (W13-2), Ramp Speed (W13-3), Combination Horizontal Alignment
136 (Advisory Exit or Ramp Speed W13-6 and W13-7) signs.

- 137 B. Advisory Speed Plaque (W13-1P)
- 138 C. Chevrons (W1-8)
- 139 D. Delineators (Chapter 3F)
- 140 E. One Direction Large Arrow (W1-6) sign
- 141 F. Raised Retroreflective Pavement Markers (Section 3B.12 through 3B.13).
- 142 G. Increased sign or marking retroreflectivity.
- 143 H. Increased sign size
- 144 I. Wide Edge Lines.
- 145 J. Pavement Word, Symbol and Arrow markings (symbol or words) (Section 3B.20)
- 146 K. Rumble Strips
- 147 L. Driver Feedback Sign (Section 2C.08a)
- 148 M. Speed reduction markings (Section 3B.22)
- 149 N. Longitudinal markings.
- 150 O. Treatments that are not traffic control devices such as:
 - 151 a. Improved surface friction (high friction surface treatments)
 - 152 b. Safety edge SM(angled pavement edge treatment)
 - 153 c. Illumination (lighting improvements)
 - 154 d. Increased superelevation

156 ~~Examples of curve safety countermeasures with demonstrated safety benefits include~~
 157 ~~illumination, safety edge, and high friction surface treatments. (Approved by Council June 27~~
 158 ~~2013, Attachment # 3, RW # 2)~~

159 ~~Delete this sentence above that was approved by Council on June 27, 2013 and list them above~~
 160 ~~instead.~~

162 ~~Option:~~

163 ~~*03 Horizontal Alignment Warning signs may also be used on other roadways or on arterial and*~~
 164 ~~*collector roadways with less than 1,000 AADT based on engineering judgment.*~~

165 Guidance:

166 *03 Except as provided in Section 2C.06a, the selection of traffic control devices used to warn*
 167 *road users of a change in horizontal alignment or to provide guidance in navigating the change*
 168 *in horizontal alignment should be based on engineering judgment considering one or more of the*
 169 *following factors:*

- 171 1. *The speed of traffic on the approach to the change in horizontal alignment.*
- 172 2. *The recommended advisory speed for the change in horizontal alignment*
- 173 3. *The difference between the speed limit and the advisory speed or the speed differential,*
 174 *for the change in horizontal alignment.*
- 175 4. *Daily traffic volumes on the roadway.*
- 176 5. *The typical mix of vehicle types on the roadway*
- 177 6. *Sight distance throughout the change in horizontal alignment.*
- 178 7. *Other types of traffic control devices that are used in advance of and within the change in*
 179 *horizontal alignment on the same roadway segment.*
- 180 8. *The crash history of the change in horizontal alignment.*
- 181 9. *Inclement road weather conditions*
- 182 10. *The presence of driveways or intersections within the curve radius*

184 **Section 2C.06a Device Selection for Changes in Horizontal Alignment**

185 **Support:** (Move this support statement to the end of the section 2C.06a after the option
186 **statements**)

187 01 For purposes of selecting traffic control devices for changes in horizontal alignment, an
188 arterial or collector is considered to have pavement markings when: 1) a centerline is present; or
189 2) edgelines are present or 3) both centerline and edgelines are present. See Sections 3B.01 and
190 3B.07 for centerline and edgeline provisions.

191 **Standard:**

192 02 **The devices indicated in Table 2C-5b as “Standard” represent the minimum traffic**
193 **control devices that shall be used based on the Table 2C-5a applications chart, except as**
194 **provided in paragraphs 04, 06, and 07 below.**

195 **Guidance:**

196 ~~04~~ 03 *The devices indicated in Table 2C-5b as “Guidance” represent the minimum traffic control*
197 *devices that should be used based on the Table 2C-5a applications chart, except as provided in*
198 *paragraphs 04, 06 and 07 below.*

199 **Support:**

200 Table 2C-5a represents existing AADT, type of roadway, and whether or not there are existing
201 markings.

202

203

204 **Table 2C-5a - Applications for Table 2C-5b**

<u>System</u>	<u>AADT</u>	<u>Are There Existing Pavement Markings?</u>	<u>Table 2C-5b Provisions</u>
Arterials & Collectors	> 4000	YES	Standard
Arterials & Collectors	3000 - 4000	YES	Guidance
Arterials & Collectors	> 3000	NO	Standard
Arterials & Collectors	1000 – 3000	NO	Guidance
Freeways and Expressways	NA	NA	Standard
Other Roadways including Arterials and collectors	< 1000	NA	Option

205

<u>Device</u>	<u>AADT</u>	<u>Speed Differential</u>	<u>Installation</u>
Advisory Speed Plaque (W13-1P)*	NA	15 mph	Standard
Advisory Speed Plaque (W13-1P)*	NA	10 mph	Guidance

206 *(See Section 2C.08)

207

208 Option:

209 07 04 A One Direction Large Arrow (W1-6) sign may be used in place of or to supplement
 210 delineators (see Section 3F.03) or Chevrons (W1-8) when geometric conditions limit the number
 211 of delineators or chevrons that are visible or when the number of delineators or chevrons that can
 212 be installed within the change in horizontal alignment is less than the spacing specified in
 213 Sections 2C.09 or 3F.04.

214 08 05 Additional or supplemental devices may be used for a change in horizontal alignment on the
 215 basis of engineering judgment.

216 09 06 Devices for changes in horizontal alignment may be omitted when the speed limit on the
 217 approach to an alignment change is 20 mph or less.

218 10 07 Devices for changes in horizontal alignment may be omitted on urban streets with an AADT
 219 of 1000 vehicles per day or less on the basis of engineering judgment.

220

221

222

Table 2C-5b. Selection of Devices for Changes in Horizontal Alignment

Speed Limit ^a (mph)	Devices for Curve Advisory Speed (mph) ^b										
	20	25	30	35	40	45	50	55	60	65	70
25	M/W	—	—	—	—	—	—	—	—	—	—
30	W	M/W	—	—	—	—	—	—	—	—	—
35	D	W	M/W	—	—	—	—	—	—	—	—
40	C	D	W	M/W	—	—	—	—	—	—	—
45	C	C	D	W	M/W	—	—	—	—	—	—
50	C	C	C	D	W	M/W	—	—	—	—	—
55	C	C	C	C	D	W	M/W	—	—	—	—
60	C	C	C	C	C	D	W	M/W	—	—	—
65	C	C	C	C	C	C	D	W	M/W	—	—
70	C	C	C	C	C	C	C	D	W	M/W	—
75 or higher	C	C	C	C	C	C	C	C	D	W	M/W

223

224

Notes:

225

^aThe 85th percentile speed may be used in place of the speed limit (Section 2C.06a).

227

^bDevice abbreviations:

229

- M/W – On paved roadways install pavement markings or advanced horizontal alignment warning sign. On unpaved roadways install advance horizontal alignment warning sign.
- W – advance horizontal alignment warning sign.
- D – delineators plus advance horizontal alignment warning sign.
- C – chevrons plus advance horizontal alignment warning sign. “Pavement markings may be excluded on unpaved roadways; otherwise the other provisions of the Table apply”.

230

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235

Table 2C-5b is based on the difference between the speed limit and the curve advisory speed.

236

237

238

239

240 **Section 2C.07 Horizontal Alignment Signs (W1-1 through W1-5, W1-11, W1-15)**

241 **Standard:**

242 ~~01 If Table 2C-5 indicates that a horizontal alignment sign (see Figure 2C-1) is required,~~
243 ~~recommended, or allowed, the sign installed in advance of the curve shall be a Curve (W1-~~
244 ~~2) sign unless a different sign is recommended or allowed by the provisions of this Section.~~

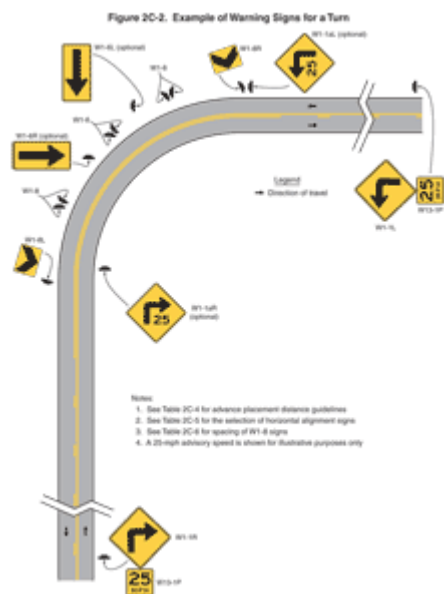
245
246 ~~02 A Turn (W1-1) sign shall be used instead of a Curve sign in advance of curves that have~~
247 ~~advisory speeds of 30 mph or less (see Figure 2C-2).~~

248 Guidance:

249 02.01 A turn sign (W1-1) should be used instead of a Curve sign in advance of curves when the
250 advisory speed is 1/2 or less of the posted speed or a speed differential of 25 MPH or more exists.
251 (approved by Council January 20, 2011, RW # 8, attachment #9)

252
253

Figure 2C-2 Example of Warning Signs for a Turn



254
255 **Guidance:**

256 03 02 Where there are two changes in roadway alignment in opposite directions that are
257 separated by a tangent distance of less than 600 feet, the Reverse Turn (W1-3) sign should be
258 used instead of multiple Turn (W1-1) signs ~~and~~ or the Reverse Curve (W1-4) sign should be used
259 instead of multiple Curve (W1-2) signs.

260 **Support:**

261 02a Figure 2C-2 provides an example of warning signs used for a turn.

262 **Option:**

263 04 03 A Winding Road (W1-5) sign may be used instead of multiple Turn (W1-1) or Curve (W1-
264 2) signs where there are three or more changes in roadway alignment each separated by a tangent
265 distance of less than 600 feet.

266 05 04 A NEXT XX MILES (W7-3aP) supplemental distance plaque (see Section 2C.55) may be
267 installed below the Winding Road sign where continuous roadway curves exist for a specific
268 distance.

269 06 05 If the curve has a change in horizontal alignment of 135 degrees or more, the Hairpin Curve
270 (W1-11) sign may be used instead of a Curve or Turn sign.

271 07 06 If the curve has a change of direction of approximately 270 degrees, such as on a cloverleaf
272 interchange ramp, the 270-degree Loop (W1-15) sign may be used instead of a Curve or Turn
273 sign.

274 *Guidance:*

275 08 07 *When the Hairpin Curve sign or the 270-degree Loop sign is installed, either a One-*
276 *Direction Large Arrow (W1-6) sign or Chevron Alignment (W1-8) signs should be installed on*
277 *the outside of the turn or curve.*

278

279 **Section 2C.08 Advisory Speed Plaque (W13-1P)**

280 Option:

281 01 The Advisory Speed (W13-1P) plaque (see Figure 2C-1) may be used to supplement any
282 warning sign to indicate the advisory speed for a condition.

283 **Standard:**

284 02 **The use of the Advisory Speed plaque for horizontal curves shall be in accordance with**
285 **Section 2C.06a ~~the information shown in Table 2C-5.~~ The Advisory Speed plaque shall also**
286 **be used where an engineering study indicates a need to advise road users of the advisory**
287 **speed for other roadway conditions.**

288 03 **~~If used,~~ The Advisory Speed plaque shall carry the message XX MPH. The speed**
289 **displayed shall be a multiple of 5 mph.**

290 04 **Except in emergencies or when the condition is temporary, an Advisory Speed plaque**
291 **shall not be installed until the advisory speed has been determined by an engineering study.**

292 05 **The Advisory Speed plaque shall only be used to supplement a warning sign and shall**
293 **not be installed as a separate sign installation.**

294 06 **The advisory speed shall be determined by an engineering study that follows**
295 **established engineering practices.**

296 Support

297 See Section 1A.04, Traffic Control Devices Handbook for established engineering practices

298 NOTE: Edit committee changed Section 1A.11 to be 1A.04 for publications.

299 Support:

300 ~~07—Among the established engineering practices that are appropriate for the determination of~~
301 ~~the recommended advisory speed for a change in horizontal alignment horizontal curve are the~~
302 ~~following:~~

303 ~~—A. An accelerometer that provides a direct determination of side friction factors~~

304 ~~—B. A design speed equation~~

305 ~~—C. A traditional ball bank indicator or other equivalent device using the following criteria:~~

306 ~~—— 1. 16 degrees of ball bank for speeds of 20 mph or less~~

307 ~~—— 2. 14 degrees of ball bank for speeds of 25 to 30 mph~~

308 ~~—— 3. 12 degrees of ball bank for speeds of 35 mph and higher~~

309 ~~08—The 16, 14, and 12 degrees of ball bank criteria are comparable to the current AASHTO~~
310 ~~horizontal curve design guidance. Research has shown that drivers often exceed existing posted~~
311 ~~advisory curve speeds by 7 to 10 mph.~~

312 *Guidance:*

313 09 The advisory speed should be determined based on free-flowing traffic conditions.
314 10 Because changes in conditions, such as roadway geometrics, surface characteristics, or sight
315 distance, might affect the advisory speed, each location should be evaluated periodically or
316 when conditions change.

317

318 **Section 2C.08a Driver Feedback Signs (WX-XX):**

319 **Option:**

320 01 A supplemental driver feedback LED sign indicating YOUR SPEED XX MPH (WX-XX)
321 sign may be used near the point of curvature of a horizontal curve to supplement the standard
322 horizontal alignment warning sign; which includes an advisory speed plaque, or used
323 downstream of a posted speed limit sign. The vehicle speed display may be static or flash at
324 acceptable rates (See Section 2A.07)

325 **Standard:**

326 02 The legend, YOUR SPEED, on a YOUR SPEED XX MPH (WX-XX) sign shall be a
327 black legend with a font size in conformance with the appropriate facility type on a yellow
328 retroreflective background. The LED legend displaying the speed value shall be a yellow
329 illuminated legend with not less than 20 mm pitch LEDs covering the stroke width of a 10
330 inch series numeral on an opaque black background.

331 **Option:**

332 03 ~~A driver feedback LED sign that displays the legend "SLOW TO XX MPH" may be used to~~
333 ~~activate the sign speed legend when the approaching vehicle speed exceeds the posted speed.~~
334 ~~(approved by Council June 28, 2014, Attachment # 1, RW # 3)~~

335

336 Delete paragraph 3 from the previously approved Council item from June 28, 2014 and replace it
337 with:

338 03 When an approaching vehicle activates the sign speed legend, a driver feedback LED sign
339 that displays the legend "SLOW TO XX MPH" may be used. The driver feedback sign may be
340 installed to supplement the speed limit sign or advisory speed sign

341

342 **Section 2C.09 Chevron Alignment Sign (W1-8)**

343 **Standard:**

344 01 The use of the Chevron Alignment (W1-8) sign (see Figures 2C-1 and 2C-2) to provide
345 additional emphasis and guidance for a change in horizontal alignment shall be in
346 accordance with the information shown in Table 2C-5.

347 **Option:**

348 02 ~~When used~~, Chevron Alignment signs may be used instead of or in addition to standard
349 delineators. (approved by Council January 19, 2012, attachment # 8, RW #8)

350 **Standard:**

351 03 The Chevron Alignment sign shall be a vertical rectangle. No border shall be used on
352 the Chevron Alignment sign.

353 04 ~~If used~~, ~~The~~ Chevron Alignment signs shall be installed on the outside of a turn or
354 curve, in line with and at approximately a right angle to approaching traffic. Chevron
355 Alignment signs shall be installed at a minimum height of 4 feet, measured vertically from
356 the bottom of the sign to the elevation of the near edge of the traveled way.

357 **Option:**

358 04a LEDs may be used to enhance chevron signs and, if vehicle activated the LEDs may be
359 flashed concurrently but not sequentially within the sign panel.

360 **Standard:**
361 04b The LEDs used in the chevron alignment sign shall consist of yellow LEDs outlining
362 the chevron symbol. (approved by Council June 28, 2014, RW # 3, Attachment # 1)

363 *Guidance:*

364 *05 The approximate spacing of Chevron Alignment signs on the turn or curve measured from*
365 *the point of curvature (PC) should be as shown in Table 2C-6.*
366

Table 2C-6. Typical Spacing of Chevron Alignment Signs on Horizontal Curves

Advisory Speed	Curve Radius	Sign Spacing
15 mph or less	Less than 200 feet	40 feet
20 to 30 mph	200 to 400 feet	80 feet
35 to 45 mph	401 to 700 feet	120 feet
50 to 60 mph	701 to 1,250 feet	160 feet
More than 60 mph	More than 1,250 feet	200 feet

Note: The relationship between the curve radius and the advisory speed shown in this table should not be used to determine the advisory speed.

367
368 *06 If used, Chevron Alignment signs should be visible for a sufficient distance to provide the*
369 *road user with adequate time to react to the change in alignment.*

370 **Standard:**

371 **07 Chevron Alignment signs shall not be placed on the far side of a T-intersection facing**
372 **traffic on the stem approach to warn drivers that a through movement is not physically**
373 **possible, as this is the function of a Two-Direction (or One-Direction) Large Arrow sign.**
374 **08 Chevron Alignment signs shall not be used to mark obstructions within or adjacent to**
375 **the roadway, including the beginning of guardrails or barriers, as this is the function of an**
376 **object marker (see Section 2C.63).**
377

378 **Section 2C.10 ~~Supplemental~~ Horizontal Alignment/Advisory Speed Signs**
379 **(W1-1a, W1-2a)**

380 *Option:*

381 *01 The Turn (W1-1) sign or the Curve (W1-2) sign may be combined with the Advisory Speed*
382 *(W13-1P) plaque (see Section 2C.08) to create a combination ~~supplemental~~ Turn/Advisory*
383 *Speed (W1-1a) sign or ~~supplemental~~ combination Curve/Advisory Speed (W1-2a) sign (see*
384 *Figure 2C-1).*

385 *02 The ~~supplemental~~ combination Horizontal Alignment/Advisory Speed sign may be used to*
386 *supplement the advance ~~supplemental~~ Horizontal Alignment warning sign and Advisory Speed*
387 *plaque ~~based upon an engineering study.~~ (approved by Council June 26, 2014, RW # 4, Retain*
388 *2009 MUTCD language using the term Horizontal not supplemental and not change it to*
389 *FHWA's edits)*

390 **Standard:**

391 **03 If used, the combination Horizontal Alignment/Advisory Speed sign shall not be used**
392 **alone and shall not be used as a substitute for a Horizontal Alignment warning sign and**
393 **Advisory Speed plaque at the advance warning location. The combination Horizontal**
394 **Alignment/Advisory Speed sign shall only be used as a supplement to the advance**
395 **Horizontal Alignment warning sign. If used, the combination Horizontal**
396 **Alignment/Advisory Speed sign shall be installed at the beginning of the turn or curve.**

397 *Guidance:*
398 04 *The advisory speed displayed on the combination ~~supplemental~~ Horizontal*
399 *Alignment/Advisory Speed sign should be based on the advisory speed for the horizontal curve*
400 *using recommended engineering practices (see Section 2C.08).*

401
402 **Section 2C.11 Combination Horizontal Alignment/Intersection Signs (W1-10 Series)**

403 *Option:*
404 01 *The Turn (W1-1) sign or the Curve (W1-2) sign may be combined with the Cross Road*
405 *(W2-1) sign or the Side Road (W2-2 or W2-3) sign to create a combination Horizontal*
406 *Alignment/Intersection (W1-10 series) sign (see Figure 2C-1) that depicts the condition where an*
407 *intersection occurs within or immediately adjacent to a turn or curve.*

408 *Guidance:*
409 02 *Elements of the combination Horizontal Alignment/Intersection sign related to horizontal*
410 *alignment should comply with the provisions of Section 2C.07, and elements related to*
411 *intersection configuration should comply with the provisions of Section 2C.46. The symbol*
412 *design should approximate the configuration of the intersecting roadway(s). No more than one*
413 *Cross Road or two Side Road symbols should be displayed on any one combination Horizontal*
414 *Alignment/Intersection sign.*

415 **Standard:**
416 03 **The use of the combination Horizontal Alignment/Intersection sign shall be in**
417 **accordance with the appropriate Turn or Curve sign information shown in ~~Table 2C-5~~**
418 **Section 2C.07**

419
420 **Section 2C.12 One-Direction Large Arrow Sign (W1-6)**

421 *Option:*
422 01 *A One-Direction Large Arrow (W1-6) sign (see Figure 2C-1) may be used either as a*
423 *supplement or alternative to Chevron Alignment signs or delineators in order to delineate a*
424 *change in horizontal alignment (see Figure 2C-2).*
425 02 *A One-Direction Large Arrow (W1-6) sign may be used to supplement a Turn or Reverse*
426 *Turn sign (see Figure 2C-2) to emphasize the abrupt curvature.*

427 **Standard:**
428 03 **The One-Direction Large Arrow sign shall be a horizontal rectangle with an arrow**
429 **pointing to the left or right.**
430 ~~04 The use of the One-Direction Large Arrow sign shall be in accordance with the~~
431 ~~information shown in Table 2C-5.~~
432 05 04 **If used, the One-Direction Large Arrow sign shall be installed on the outside of a turn**
433 **or curve in line with and at approximately a right angle to approaching traffic.**
434 06 05 **The One-Direction Large Arrow sign shall not be used where there is no alignment**
435 **change in the direction of travel, such as at the beginnings and ends of medians or at center**
436 **piers.**
437 07 06 **The One-Direction Large Arrow sign directing traffic to the right shall not be used in**
438 **the central island of a roundabout.**

439 *Guidance:*
440 08 07 ~~If used,~~ *the One-Direction Large Arrow sign should be visible for a sufficient distance to*
441 *provide the road user with adequate time to react to the change in alignment.*

442
443

444 **Section 2C.13 Truck Rollover ~~Warning~~ Sign (W1-13)**

445 Option:

446 01 A Truck Rollover ~~Warning~~ (W1-13) sign (see Figure 2C-1) may be used to warn drivers of
447 vehicles with a high center of gravity, such as trucks, tankers, and recreational vehicles, of a
448 curve or turn where geometric conditions might contribute to a loss of control and a rollover as
449 determined by ~~an~~ engineering study judgment.

450 **Support:**

451 ~~02— Among the established engineering practices that are appropriate for the determination of~~
452 ~~the truck rollover potential of a horizontal curve are the following:~~

453 ~~— A. An accelerometer that provides a direct determination of side friction factors~~

454 ~~— B. A design speed equation~~

455 ~~— C. A traditional ball bank indicator using 10 degrees of ball bank~~

456 **Standard:**

457 03 **If a Truck Rollover ~~Warning~~ (W1-13) sign is used, it shall be accompanied by an**
458 **Advisory Speed (W13-1P) plaque indicating the recommended speed for vehicles with a**
459 **higher center of gravity**

460 **Support:**

461 **See Section 1A.04, Traffic Control Devices Handbook for use of Truck Rollover sign.**

462 **NOTE: Edit committee changed Section 1A.11 to be 1A.04 for publications.**

463 Option:

464 04 The Truck Rollover ~~Warning~~ sign may be displayed as a static sign, as a static sign
465 supplemented by a ~~flashing~~ warning beacon, or as a driver feedback changeable message LED
466 sign activated by the detection of an approaching vehicle with a high center of gravity that is
467 traveling in excess of the recommended speed for the condition. The driver feedback LED sign
468 may be yellow LEDs in the warning sign border or a flashing advisory speed legend in the
469 advisory speed plaque.

470 **Guidance:**

471 04a The driver feedback LED sign should be a yellow LED legend on a black opaque
472 background displaying the vehicle speed approaching the change in horizontal alignment. The
473 detected speed should have a steady or flashing message displaying the vehicle speed
474 approaching the change in horizontal alignment. (approved by Council June 28, 2014, RW # 3,

475 Attachment # 1)

476 **Option**

477 04b An additional Truck Rollover sign may be placed in advance of the initial Truck Rollover
478 sign.

479 **Guidance:**

480 04c The location of the additional Truck Rollover sign should be determined by engineering
481 judgment.

482 **Standard**

483 04d If an additional Truck Rollover sign is used, it shall be accompanied by an advisory
484 speed plaque and either by a distance plaque or a RAMP plaque.

485 **Support:**

486 05 The curved arrow on the Truck Rollover ~~Warning~~ sign shows the direction of roadway
487 curvature. The truck tips in the opposite direction.

488

489 **Figure 2C-12**

490

491 Add:



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493

494 (Paragraphs 04b, 04c, 04d and ramp plaque in Section 2C.13 items above were approved by

495 Council 6-30-17, RW #4 17A.RW.04)

496

497 **Section 2C.14 Advisory Exit and Ramp Speed Signs (W13-2 and W13-3), and Combination**

498 **Horizontal Alignment/Advisory Exit and Ramp Speed Signs (W13-6 and W13-7)**

499 **Standard:**

500 ~~01—Advisory Exit Speed (W13-2) and Advisory Ramp Speed (W13-3) signs (see Figure 2C-~~

501 ~~1) shall be vertical rectangles.~~ The use of Advisory Exit Speed (W13-2), ~~and~~ Advisory

502 Ramp Speed (W13-3), Combination Horizontal Alignment/Advisory Exit Speed (W13-6)

503 and Combination Horizontal Alignment/Advisory Ramp Speed (W13-7) signs on freeway

504 ~~and expressway~~ turning roadways, exits and ramps shall be in accordance with the

505 information shown in Table 2C-5.

506 01a Advisory Exit Speed, Advisory Ramp Speed, Combination Horizontal

507 Alignment/Advisory Exit and Combination Horizontal Alignment/Advisory Ramp Speed

508 signs (See Figure 2C-1) shall be vertical rectangles.

509 01b The Advisory Exit Speed and Advisory Ramp Speed signs on turning roadway exits and

510 ramps shall be used when the difference between the speed limit and the advisory speed is

511 20 mph or greater.

512 Guidance:

513 01c The Advisory Exit Speed and Advisory Ramp Speed signs on turning roadway ramps should

514 be used when the difference between the speed limit and the advisory speed is 15 mph or greater.

515 Option:

516 01d The Advisory Exit Speed and Advisory Ramp Speed signs on turning roadway ramps may

517 be used on any ramp on the basis of engineering judgment or engineering study.

518 Guidance:

519 02 If used, the Advisory Exit Speed sign and the Combination Horizontal Alignment/Advisory

520 Exit Speed sign should be installed along the deceleration lane. ~~and the See Section 2C.08 for~~

521 the determination of the displayed advisory speed. ~~displayed should be based on an engineering~~

522 study. When a Truck Rollover (W1-13) sign (see Section 2C.13) is also installed for the ramp, the

523 advisory exit speed should be based on the truck advisory speed for the horizontal alignment

524 using recommended engineering practices.

525 03 ~~If used,~~ The Advisory Exit Speed and the Combination Horizontal Alignment/Advisory Exit

526 signs should be visible in time for the road user to decelerate and make an exiting maneuver.

527 Support:

528 04 Table 2C-4 lists recommended advance sign placement distances for deceleration to various

529 advisory speeds.

530 Option:

531 04a The Advisory Ramp Speed sign or a Combination Horizontal Alignment/Advisory Ramp

532 Speed sign may be installed along the ramp to confirm the ramp advisory speed beyond the exit

533 gore.

534 04b Where there is a need to remind road users of the recommended advisory speed, a horizontal

535 alignment warning sign with an advisory speed plaque or a Combination Horizontal

536 Alignment/Ramp Advisory Speed sign may be installed beyond the exit gore or on the outside of
537 the curve, provided that it is apparent that the sign applies only to exiting traffic. These signs
538 may also be used at intermediate points along the ramp, especially if the ramp curvature changes
539 and the subsequent curves on the ramp have a different advisory speed than the initial ramp
540 curve.

541 *Guidance:*

542 *05—If used, the Advisory Ramp Speed sign should be installed on the ramp to confirm the ramp*
543 *advisory speed.*

544 *05 The horizontal alignment symbol displayed on the Combination Horizontal*
545 *Alignment/Advisory Exit and Ramp signs should be consistent with the ramp curve.*

546 *06—If used, Chevron Alignment (W1-8) signs and/or One-Direction Large Arrow (W1-6) signs*
547 *should be installed on the outside of the exit curve as described in Sections 2C.09 and 2C.12.*

548 *Option:*

549 *07—Where there is a need to remind road users of the recommended advisory speed, a horizontal*
550 *alignment warning sign with an advisory speed plaque may be installed at or beyond the*
551 *beginning of the exit curve or on the outside of the curve, provided that it is apparent that the*
552 *sign applies only to exiting traffic. These signs may also be used at intermediate points along the*
553 *ramp, especially if the ramp curvature changes and the subsequent curves on the ramp have a*
554 *different advisory speed than the initial ramp curve.*

555 *Support:*

556 *08 06* Figure 2C-3 shows an example of advisory speed signing for an exit ramp. **NOTE:**
557 **This figure was revised and approved by Council on 6-30-17 (16B.RW.04)**

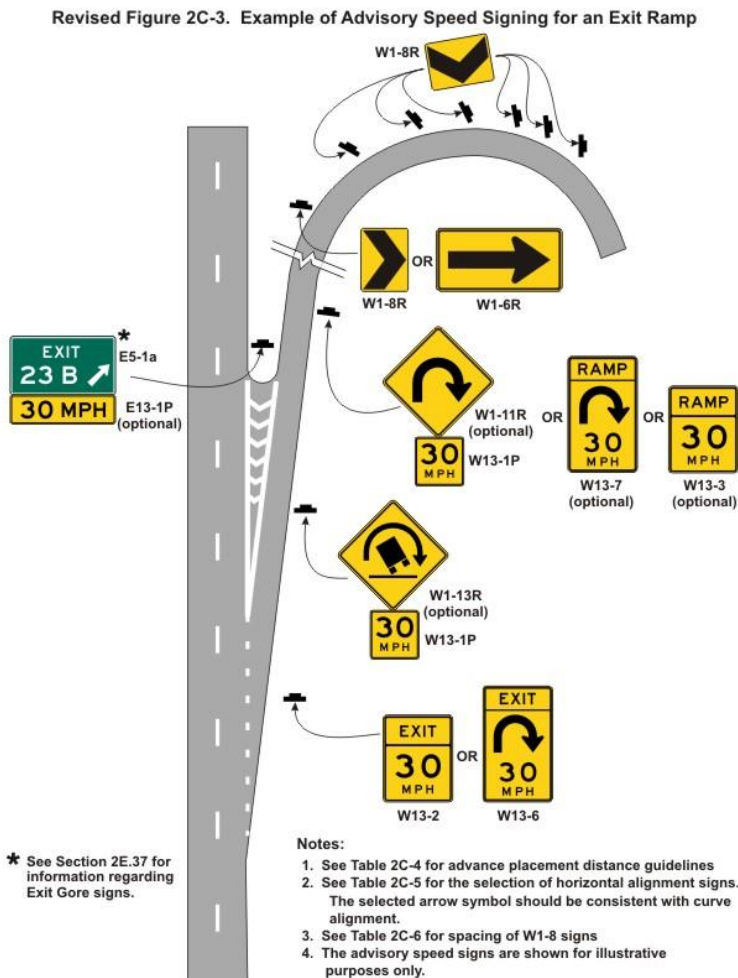
Figure 2C-3 Example of Advisory Speed Signing for an Exit Ramp (deleted)



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Figure 2C-3 is revised as shown below: 16B.RW.04 Previously Approved by Council 6-30-17



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Section 2C.15 Combination Horizontal Alignment/Advisory Exit and Ramp Speed Signs (W13-6 and W13-7)

Option:

~~01—A horizontal alignment sign (see Section 2C.07) may be combined with an Advisory Exit Speed or Advisory Ramp Speed sign to create a combination Horizontal Alignment/Advisory Exit Speed (W13-6) sign or a combination Horizontal Alignment/Advisory Ramp Speed (W13-7) sign (see Figure 2C-1). These combination signs may be used where the severity of the exit ramp curvature might not be apparent to road users in the deceleration lane or where the curvature needs to be specifically identified as being on the exit ramp rather than on the mainline.~~

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PART 3 – MARKINGS

CHAPTER 3A. GENERAL

Section 3A.XX after Section 3A.07 as follows:
New Section following existing Section 3A.07

Section 3A.07 Application of Markings, Delineation, and Rumble Strips in Combination with Horizontal Alignment Warning Signs

Option:

01 The following curve safety countermeasures may be used to supplement selected curve signing requirements as indicated in Table 2C-5.

1. Wide Edge lines
2. Delineators
3. Raised Retroreflective Pavement Markers
4. Longitudinal Rumble Strips or Stripes
5. Profiled Pavement Markings, and/or
6. Other treatments with demonstrated safety benefits in reducing horizontal curve crashes

Support:

02 Examples of curve safety countermeasures with demonstrated safety benefits include illumination, safety edge, and high friction surface treatments. (Previously APPROVED by COUNCIL, June 27, 2013)