# Memorandum

U.S. Department of Transportation

Federal Railroad Administration

MAY

Date:

6 1996

Reply to Attn of: T-96-01

subject: Improper Application of Uniform Section Rail Joint Bar Original Issue Number and Date: TB-82-**5**6, 9/3/82 Reissued: 1/1/83 and 7/1/85

From: Edward R. English Director, Office of Safety Assurance and Compliance

 To: All Regional Administrators, Deputy Regional Administrators, Supervisory Railroad Safety Specialists (Track), and Federal and State Track Inspectors

## **Technical Instructions:**

In 1996, the Track Technical Resolution Committee recommended that FRA, together with its industry partners, form a task force to review the interchangeability of joint bars. In the meantime, this bulletin is in effect.

The use of a uniform section joint bar of headfree design on a rail section other than for designed constitutes a deviation from Standard: Title 49 CFR 213.121(a); "Each rail joint, insulated joint, and compromise joint must be of the proper design and dimensions for the rail on which it is applied."

The use of a uniform section joint bar of head contact design on a rail section other than for designed may constitute a deviation from Standard. Specifically, the use of a 112-pound RE section head contact bar on 115 pound RE and 119-pound RE section rail is a deviation from Title 49 CFR 213.121(a).

## Definitions:

1) Head Contact Joint: The head contact bar supports the rail ends by a box-type construction, carrying the load between the underside of the head and the base of the rail, (see Figure 1).

2

2) Head Free Joint: The head free joint bar does not contact the underside of the rail head, but instead contacts the rail in the fillet area. The load distribution is referred to as a triangular load distribution (see Figure 2).

The differences between the head contact joint bar and the head free joint bar are significant.

It is evident the joint bar and the rail do not bend or flex exactly with each other along their length. Tests and measurements show that for Positive Bending (Figure 3), there exists a downward

Bex · Ty • S Head Contact Joint Figure 1 TrianGula Lead Distribution Head Free Joint Figure 2

bearing pressure of the under side of the head of the rail on the top surface of the joint bars for some distance along the bar away from the rail end, (approximately 2 inches), and also an upward bearing pressure of the upper surface of the base of the rail at parts of the length of the bar further away from the rail end, (bearing distance approximately 3 inches). The converse is true for Negative Bending, (Figure 3).

### Consequences:

The headfree joint bar accepts bearing and shear forces from vertical loads in the rail's upper fillet. A head contact bar is not designed to fit into the filet.

The head contact joint bar accepts bearing from vertical loads on the flat underside of the rail's head: generally on a 1 to 4 slope. It is not designed to seat into the rail's upper filet.



Although the vertical fishing dimension for the 112 and 115 RE rail sections is identical (3 3/16 inches), the head filet radius is different:

For the 115-pound section, radius equals 3/4 inch For the 112-pound section, radius equals 3/8 inch

As shown in Figures 4 and 5 the 112 headfree bar fits the 115 rail filet practically at a point, most probably inducing joint bar

stresses in excess of design. The 115 headfree bar does not fit into the 112 fillet but bears in a very small area beneath the head of the rail, most probably inducing joint bar stresses in excess of design and exerting a wedge action between the rail head and rail web, promoting head-web defects.

In addition, the joint bar may experience a twist, or torsional force from the tightening of the track bolts. The torsional stress from twist will be the greatest at the head and toe of the bar at the rail ends.

Figure 6 depicts an exception to the non-use of a uniform section joint bar of head contact design on a rail section other than for designed. A 131-pound or 132-pound head contact joint bar may be used in lieu of a 131/132 or 131/136 compromise joint bar if rail drilling and joint bar punching are similar. The width of the rail head is sufficient to allow full contact in the upper fishing wear surface.

#### Summary

3

1) 112-pound RE joint bars should not be used as compromise joint bars between 112 RE and 115 RE rail.





- 2) 115 pound RE joint bars should not be used as compromise joint bars between 112 RE and 115 RE rail.
- 3) 131 RE head contact bars or 132 RE head contact bars may be used as compromise joint bars between 131 RE and 132
   RE rail or 136 RE rail where rail drilling and joint bar punching are similar. (Note: FRA Standards do not prohibit the track owner from field drilling bolt holes to fit).



Refer to the following Table for variances in rail sections, giving particular attention to dimension H, height of rail, and dimension F, vertical fishing dimension. The table does not contain the rail section filet radius. Refer to the track owner's standard plan for filet dimension. The attached drawings provide examples of head free and head contact bar designs.

### Epilog

4

While this bulletin directly discusses compromise joint bars, it is stressed that 112 RE bars are not to be used on 115 RE and 119 RE rail and vice versa. 131 RE headfree and 132 RE headfree joint bars, or 131 RE headfree and 136 RE headree joint bars are not interchangeable and are not to be intermixed.

#

Attachment

cc. D. Hollingsworth, Louisville S. Fender, Denver 

$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Ту	ж ул Ул	VgL er   I Ini	Heikht.	Hase	liead	Web	Depth of Head	Fishing	Depth of Base	Head Angle	Jiase Angle	Slope of Head	Hottem of Kail to C. L. Web Rail,	C.S. Steel Corp. and T.C.I.	Hethie- hem Steel Co.	Culo- railu F. & 1. Cu.	Jan Jan Suc
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{c} A \in L \land & X_{1} = \frac{1}{2}, \frac{1}$				11	Б	RD		<u>п</u>		E		~		1.	1244.			
<ul> <li>Y A. K. P. A. 4</li> <li>100 7 7/16</li> <li>100 7 7/16</li></ul>		AFEA	*	34!	75/16		25,6	1/16	1.516	+416	1416	104	1-++	1 ++		ļ			_
<ul> <li>103 7 1/16 0 + 4 1</li> <li>113 1 1/16 1 1/16 1 1/16 1 1/16 1 1/16 1 1/16 1</li> <li>110 6 1 1/1 1/15 1 1/5 1</li> <li>110 6 1 1/1 1/15 1 1/15 1 1/15 1</li> <li>110 6 1 1/1 1/15 1 1/15 1 1/15 1</li> <li>110 6 1 1/1 1/15 1 1/15 1 1/15 1</li> <li>110 6 1 1/1 1/15 1 1/15 1 1/15 1</li> <li>110 6 1 1/1 1/15 1 1/15 1 1/15 1 1/15 1</li> <li>110 6</li></ul>	<ul> <li>133 27/16 6/46 [J] 17/16 137/26</li></ul>	~~.Υ Λ. Κ. Έ. Α	L 1 (1	₩ 17	5/10	6	3.	3.4	2 1/16	4 1/16	1 3/16	1 10 3	14*	4*	4	1140.31	140-RE		
- 113 - 1 / 7 / 8 / 8 / 1 / 1 / 1 / 1 / 1 / 1 / 1 / 1	<ul> <li>130 0 37 8 0 12 37 2 37 8 37 8 37 8 37 8 37 8 37 8 37</li></ul>		x 1	33 7	1/16	6 746	μ 11	11/16	1 15/16	3 15/10	1 3/16	1.04	1 1 1 1	110.40	3 3/4 1.7/5	113331	133-RE	1330	1333
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	<ul> <li>Iso 6, 3/4</li> <li>Iso 1/4</li> <li>Is</li></ul>			31 77	1/8	6	3	21/32	1 3/4	4 3/16	1 3/16				4 1/4	13128	IJI-KE	11311	1312
<ul> <li>* 115 lo 3/7 is 1-2 iz 3.42 is % 111/16 i 11/36 i 1/76 i 1/776 i 1/776 i 0/76 i 1/77 i 1/76 i 1/776 i 0/76 i 1/77 i 1/76 i</li></ul>	<ul> <li>** 115 16 3/7 (5 1-1 2 J.J.2 5/8 ) 117/21 117/21 127/21 127</li> <li>** 10 6 1/7 3 5/2 3 25/21 19/21 127/21 127</li> <li>** 10 6 1/7 3 5/2 3 25/21 19/21 127/21 127</li> <li>** 10 6 1/7 3 5/2 3 25/21 19/21 127/21 127</li> <li>** 10 5 5/7 3 5/7 12 25/21 19/21 12/21 127</li> <li>** 10 5 5/7 3 5/7 12 25/21 19/21 12/21 127</li> <li>** 10 5 5/7 3 5/7 12 25/21 19/21 12/21 127</li> <li>** 10 5 5/7 3 5/7 12 25/21 19/21 12/21 127</li> <li>** 10 5 5/7 3 5/7 12 25/21 25/21 12/21 127</li> <li>** 10 5 5/7 3 5/7 12 25/21 25/21 12/21 127</li> <li>** 10 5 5/7 3 5/7 12 25/21 25/21 12/21 127</li> <li>** 10 5 5/7 3 5/7 12 25/21 25/21 12/21 127</li> <li>** 10 5 5/7 3 5/7 12 25/21 25/21 25/21 25/21 127</li> <li>** 10 5 5/7 3 5/7 12 25/21 25/21 25/21 25/21 25/21 127</li> <li>** 10 5 5/7 5 5/7 12 25/21 25/21 25/21 25/21 25/21 25/21 127</li> <li>** 10 5 5/7 5 5/7 12 25/21 25/21 25/21 25/21 25/21 25/21 25/21 127</li> <li>** 10 5 5/7 5 5/7 12 25/21 25/21 25/21 25/21 25/21 25/21 25/21 127</li> <li>** 10 5 5/7 5 5/7 5 5/7 12 25/21 25/21 25/21 25/21 25/21 25/21 127</li> <li>** 10 5 5/7</li></ul>	•	1.	30 16	3/4	6	2 13/16	21, 32	1 27/32	3 11/16	1 7/32	4	"	1 10 16	3 3/8	11.4025*	130-KE	1300*	1302
$ \begin{array}{c} 110 \ 6 \ 7/6 \ 1 \ 7/2 \ 1 \ 2 \ 3/2 \ 1 \ 7/2 \ 1 \ 1/2 $	A. K. AA.     Too 19, 37, 45, 57, 52, 52, 44, 57, 46, 11, 74	-	*:1	15 10	5/8	5 1/2	2 23. 32	5-8	1 11/16	3 13/16	1 1/8	•		1 to 40	3 1/4	1115.25	115-KE	1150	1152
x         x	<ul> <li><i>x</i></li> <li><i>x</i></li></ul>	-	1	12 10	0.5/8   	5 1/2	12 23,32; 1 36.12	19/32	1 11/10	3 13/16	3 1/8	2		1.0.16	3 3/4	111228	112-RE	1121	1122
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	A. K. AA.       100       [b]       [b]       2       2.15       [b]       100-2A       100-2	-	<b>x</b> 1	00 16		5 3/8	2 11/10	9/16	1 21/32	3 9/32	1 1/16	*	-		2 31/32	11023	100-RE	10025	1002
<ul> <li>** 90 15 5/6 31 /8 12 9/16 9/16 11 /2 23 3/2 11 11 /2 21 21 /2 21</li></ul>	<ul> <li># 90 IS 5/K IS //S IS //</li></ul>	A. K. A	. 10	<b>UO</b> (6		5 1/2	2 3/4	9/16	1 9/16	3 3/8	1 1/16 !	1 to 4	1 to 4	1 -	2 15/10	10020	100-RA	1003	1002
$ \begin{array}{c} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 $	1         1	•	¥ •	90 15	5/8	5 1/8	2 9/16	9/16	1 15/32	3 5/32	1	5	4		2 29/32	9020	90-KA -	902	907
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	A. R. A. 3.       100       1074       1174       1174       1174       117       17       7       1274       100       100       100       100       1074       100       1074		1 4	80 15	1.8	4 5/8	2 1/2	33/64	1 7/16	2 23/32	31/32	-			2 9/16	8020	80-RA	801*	·
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	A. R. A. B. 100 5 41/641 3/64 12 11/21 9/16 13/641 2/64 11/21 13" 13" 12" 2 62/123 000 00.88 0002 100200 100.88 0002 100200 100.88 0002 100200 10020 1		·   2	40 Ha 60 La	1/2	4 1/4	2 3/8	15/32	1 11/32	2 3/2	29/32		e	-	2 13/32	4020*	• • • • • • • • • •	••••	• • • •
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	* 00  s 17/61 / 40/61 2 9/16   3/6/61 / 12/21 2 1/32   1/21 * 1 2 1 2 1/21 9/00 90.88* 905* * 01 4 33/64 / 3/64 2 1/8 33/64   3/64 / 13/64   3/64   3/64   1/22   13* 1 2 / 12/21 4000* 6 00 4 3/16   31/76 / 2 / 13 / 3/64   13/64   3/64   3/22   13* 1 2* 2 / 2 / 2 / 2 / 2 / 2 / 2 / 2 / 2 /	A. R. AB	. 11	00 15	41/64	5 9/64	2 21/32	9/16	1 45/64	2 55/64	1 5/64	13*	13ª	3°	2 65/128	10030	100-RB	1002	1003
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	<ul> <li>A 0 4 13/16 17/16 17/16 13/26</li></ul>		ç	90 5	17/64	1 49/64	2 9/16	9/16	1 39/64	2 5/8	1 1/32	4		-	2 11/32	90.10	90-R.B*	905*	
$ \begin{array}{c} 10 \ i \ 37.64 \ i \ 3$	<ul> <li>10 14 33/44 2/46 2/4 3/4 3/46 1/4 2/48 3/46 1/74 = '' 2/128 7000 *</li></ul>		1	80 4	15/10	4 7/16	2 7/16	35/64	1 15/32	2 15/32	1	•	•		2 15/64	\$030*	80-RB*	- 802*	
A. S. C. E. 100 is $31/4$ is $31/4$ is $31/4$ if $1/2$ is $31/4$ is $1/2$ is $1/4$	A. S. C. E. 100 (5 3)/16 3)/16 1/2 3)/21 1/2 3)/26 3)/26 3)/26 (102.5)			70 4	35/64:	4 3/64	2 3/8	33/64	1 23/64	2 17/64	59/64				2 7/128	7030	<b>*</b> • • • • • • • • •	••••	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	1       1	A SC F	i i i	nn is	3/10	5 11/10,	7 1/4	31/04	1 45/64	2 2/64	1/4	170	170	Ser	1 29/32	10010	100 15	••••	•••
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	<ul> <li>St B 3/16 5 3/16 2 0/16 1/2 23/8 1/2 5/16 1/2 23/8 1/2 5/16 1/2 23/8 1/2 5/16 1/2 23/8 1/2 5/16 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2</li></ul>	4. U. C. L.		90 5	3/8	5 3/8	2 5'8	9/16	1 19/32	2 55/64	59/64	1.1			2 45/128	9040	90-45		ans
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	<ul> <li>Be B: is 1 2 1/2 35/64 11/2 2/5 2/6 1//6</li> <li>To 4 5/6 13/16 (21/52) 1/2 1/2 12/64 2/52 1/2 1/2 12/64 2/52 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/</li></ul>	ĸ	8	65  S	3/16	5 3/16	2 0/16	9/16	1 35/64	2 3/4	57/64	4	•	-	2 17/64	8540	85-A5	851*	85
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	<ul> <li>73 (4 12/164 13/1612 13/32 17/32 11 27/32)</li> <li>73 (4 12/164 13/161 11/32)</li> <li>74 (5 14 7/16 12/162 13/32)</li> <li>75 (7 12)</li> <li>75 (7 12)&lt;</li></ul>	-	8	89.  S	·	s	2 1/2	35/61	1 1/2	2 5/8	7/8				2 3/16	8040	80-AS	\$00*	80
$ \begin{array}{c} 6 + 3 / 6 + 3 / 8 + 2 / 16 + 3 / 8 + 1 / 12 / 12 + 13 / 22 + 13 / 23 + 3 / 32 + 13 / 32 + 3 / 32 + 13 / 32 + 3 / 32 + 13 / 32 + 3 $	$ \begin{array}{c} 10^{\circ} 4 \ 3/6 \ 4 \ 7/6 \ 7$	4	1	73 4	13/16	4 13/16	2 15/32	17/32	1 27/64	2 35/64	27/32		<b>.</b>		2 15/128	7540	75-AS	755*	• • • •
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	B         B	-		70-14. 61: 14	3/8 5	4 3/8	2 7/10	33/64	1 11/32	2 15/34	13/10			-	2 3/64	7040	70-AS	301-	•••
A. T. & S. Fe.       99       5 $3/4$ 5 $3/16$ 2 $1/16$ 9/16       1 $15/321$ 3 $3/521$ 1 $10.4$ 1 $to.4$ 1 $to.64$ 1 $to.616$ 2 $29/32$ 90.27       90.27 <th< td=""><td>A. T. &amp; S. Fe. 90 is 3/a is 3/16 is 9/16 is 1/32 is 3/22 if 1/2 if 1/32 is 3/22 if 1/2 is 1/32 is 3/22 if 1/32 is 3/22 is 1/32 is 3/25 is 1/36 is 1/36 is 1/32 is 3/26 is 3/26</td><td>-</td><td></td><td>50 i4</td><td>1/4</td><td>4 1/4</td><td>2 3/8</td><td>31/64</td><td>1 7/32</td><td>2 17/64</td><td>49/64</td><td><b>.</b></td><td></td><td></td><td>1 115/128</td><td>6040</td><td>60-A5</td><td>601</td><td>••••</td></th<>	A. T. & S. Fe. 90 is 3/a is 3/16 is 9/16 is 1/32 is 3/22 if 1/2 if 1/32 is 3/22 if 1/2 is 1/32 is 3/22 if 1/32 is 3/22 is 1/32 is 3/25 is 1/36 is 1/36 is 1/32 is 3/26	-		50 i4	1/4	4 1/4	2 3/8	31/64	1 7/32	2 17/64	49/64	<b>.</b>			1 115/128	6040	60-A5	601	••••
Car. Pret. 85 is 1/8 is 1/8 is 1/2 is 1/2 is 1/16 in 7/16 is 11/66 ii 1/64 is 1/64 is 1/6 is 1/2 is	C. 2 Prov. 18 15 1/7 15 2 1/2 9/16 h 7/16 12 11/161 4 1 16 1 16 32 [2 11/22] 4524* 4 3.5 CP	A. T. & S.	Fe. 9	90 5	5/8	5 3/16	2 9/16	9/16	1 15/32	3 5/32	1	1 to 4	1 to 4	1 to 16	2 29/32	9021*	90-82**	993*	90
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	C & N. W.       100 .5 45/041 g 0/44 12 9/16       139/641 g 0/46 11 39/641 g 0/46 11 39/641 g 0/46 11 37       15"       2"       12 19/12 1.033" 100.031       100.0	Can. Pas.	1 8	BS  5	1/8	5.	2 1/2	9/16	1 7/16	2 11/16	1		"	1 to 32	2 11/32	8524*	AS-CP		-45
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	C. B. & Q. S. 5 3746 3746 2172 174 1742 3766 376 3766 376 3766 376 3766 376 376	CAN.W	. 10	00 15	45/64!	5 9/64 1	2 9/16	9/16	1 39/64	2 61/64	1 9/64	13°	13*	3.	2 79/128	10032	100-071		108
C. F. & L 14 RE M. 136 17, 57, 16 is 2, 157, 16 11/16 1 35/16 37/16 1 37/16 1 10/16 1	C. F. & L vitt NY, 15: 57: 57: 6 2 15/14 11/16 11/16 13/16 11/16	0480		90 <u>15</u> EC.E	3/16	5 3/32 i z 1/14 i	2 1/2	1/2	1 17/32	2 31/32	1 1/32			3/64:3/4 e <sup>a</sup>	2 33/64	95324	20-021 <sup>2</sup>		••••
$ \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \end{array}{} \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \begin{array}{c} \end{array} \\ \begin{array}{c} \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \begin{array}{c} \end{array} \\ \begin{array}{c} \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \end{array} \\ \begin{array}{c} \end{array} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \begin{array} \\ \end{array} \end{array} \\ \end{array} \\$	* 2.1       19* 6       31/16       51/2       21/23       5/8       12/6       131/16       1/6       1       100       1100	C. F. & L.	ARE ST 13	36 17	5/16	6	2 15/16	11/16	1 15/16	4 3/16	1 3/16	I to 4	1 10 4	1 10 40	3 7/8	13637	83-C.B.	1360	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	**       106       63/16       51/2       2       2/32       13/4       13/8       13/4       13/2       13/4       10/3       13/4	•	11 '×	19 6	13/16	5 1/2 .	2 21/32	5/8	1 7/8	3 13/16	1 1/8	•	*		3 1/4			1190	119
D. L. & W. 118   6 1/2 : 5 3/8   2 7/8 5/8   1 29/32:3 1/2   1 3/32   13"   13"   3 1/4"   3 13/32   118 DL-XI 105 16 : 5 3/8   2 3/4   5/8   1 23/32: 2 11/36   1/32   4"   4"   4"   4"   2 3/8   100-DL   115   6 3/8   5 1/2   2 73/32   3/4   1 11/16:3 13/16'   1/8   4"   4"   2 3/8   100-DL   118 DL-XI 110 16 1/2 1/2 1/3/12 1/3/2 1/3/2 1/3/2 1/3/2 1/3/2 1/3/2 1/3/2 1/3	D. L. & W.       116 [0 1/2 is 3/8 [2 7/8] 5/8 [1 29/32] 31/2 [13/2		* 10	06 16	3/16	5 1/2	2 21/32	19/32	1 3/4	3 3/8	1 1/16				2 15/16		••••••	1060	• • • •
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	103       10       13       10       12 <t< td=""><td>D. I. &amp; W</td><td>. 11</td><td>18  6</td><td>1/2</td><td>53/8</td><td>2 7/8</td><td>5/8</td><td>1 29/32;</td><td>3 1/2</td><td>1 3/3Z</td><td>13-</td><td>13-</td><td>3 1/4</td><td>3 13/32</td><td></td><td>118 DL-M</td><td>•••••</td><td>• • • •</td></t<>	D. I. & W	. 11	18  6	1/2	53/8	2 7/8	5/8	1 29/32;	3 1/2	1 3/3Z	13-	13-	3 1/4	3 13/32		118 DL-M	•••••	• • • •
D. R. G. W. 115 is 5/4 is 1/2 iz $^{3}/312$ if 1/1/16/3 i3/16 if 1/8 if if i/8 if i/6 is 5/8 is 1/2 is 1/8 is 1/2 is 1/3 is 1/3/2 is 1/3	D. R. G. W. 115 16 X/3 15 1/2 12 73/32 3/4 1 11/1613 13/16 <sup>1</sup> 1/8 4 3 14 <sup>4</sup> 14 <sup>4</sup> 4 <sup>4</sup> 2 5/8	4	: 10	01 .5	7/16	5 3/2	2 3/4   2 3/4	5/8	1 23/32	7 11/16	1 1/32	E	<b>.</b>		7 3/2	1003.3	105-DL	••••	• • • •
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	D. & R. G.       90 IS 1/2       I /2       I /2       9/16       1 /4       I /4       14*       14*       4*       2 5/8	D. R. G. V	к. <sub>1</sub> 11	15 6	3/8	5 1/2	2 73/32	3/4	1 11/16:	3 13/16	1 1/8	•	æ		3 1/32			1155*	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	85 5 $1/4$ 51/4       2 $1/2$ 9/16       1 $3/4$ 2 $5/6$ 7/5       13°       13°       13°       5Tr.       430°         Grt. Nor.       110 i6 $1/2$ 2 $3/4$ 9/16 i $3/6$ 13/6       100 is $3/4$ 57.       13/16       100 degree         90 is $3/8$ 5       2 $5/8$ 9/16       1 $1/3$ 13/36       100 degree       100 degree       2 $3/4$ 9/16       1 $1/3$ 13/16       100 degree       2 $3/6$ 9/16       1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 1 $1/3$ 2 $1/32$ 1 $1/32$ 1 $1/32$ 1 $1/32$ 1 $1/32$ 1 $1/32$ <td>D. &amp; R. G</td> <td> 9</td> <td>90 15</td> <td>1/2</td> <td>5 1/8</td> <td>: 9/16</td> <td>9/16</td> <td>1 5/8</td> <td>2 7/8</td> <td>1  </td> <td>14*</td> <td>14"</td> <td><b>4</b>*</td> <td>2 5/8</td> <td></td> <td>• • • • • • • • • • •</td> <td>906*</td> <td></td>	D. & R. G	9	90 15	1/2	5 1/8	: 9/16	9/16	1 5/8	2 7/8	1	14*	14"	<b>4</b> *	2 5/8		• • • • • • • • • • •	906*	
Grt. Nor.       10       6 1/2       15       1/2       12       12       14       19/32       1/8       1/8       1/6       1/2       1/7	Grt. Nor. 110 (6 1/2 15 1/2 2 3/4 19/32 11 3/8 3 3/4 11 1/8 11 0.6 1 10.			NS 5	1/4	3 1/4	2 1/2	9/16	1 3/4	2 5/8	7/5	13°	1 <b>3°</b>		Str.		•••••	8500	•••
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	100       13       14 <t< td=""><td>Grt. Nor.</td><td>11</td><td>10 ið</td><td>1/2</td><td>5 1/2</td><td>2 3/4</td><td>19/32</td><td>1 5/8</td><td>3 3/4</td><td>1 1/8</td><td>1 to 4</td><td>1 to 4</td><td>1 to 16</td><td>3 1/4</td><td>11036</td><td>110-GN</td><td>·····</td><td>140.</td></t<>	Grt. Nor.	11	10 ið	1/2	5 1/2	2 3/4	19/32	1 5/8	3 3/4	1 1/8	1 to 4	1 to 4	1 to 16	3 1/4	11036	110-GN	·····	140.
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	90       5       3/8       15       2       5/8       5/8       1       1/2       2       7/8       1       1/2       2       7/8       90.4*       90.CN*       90.4*       100.4       1       10.4       10.7       10.7       10.7       10.7       10.7       10.7       10.7       10.7       10.7       10.7       10.7       10.7       10		· · · · ·	00 13	3/1		2 5/8	9/16	1 15/37	3   77/8	1 1/32	13*	13*	-	2 53/64	9074*	100-G.N.	0.04*	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	#       45       5       5       2 21/32       21/32       1 19/32       2 1/2       29/32       14*       14*       #       2 5/32       853*       854*         Headfree       132       (7.5/16)       16       131/32       21/32       1 15/16/4       3/16       1 10 4       1 to 40       4 1/4       13227       132RE-T*       1	· •	. 9	0 15	3/8	5	2 5/8	5/8	1 1/2	2 7/8	i	4		50	2 5/8	9034*	90-G.N*	904*	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Headfree       132 (7.5/16 16       '2 31/32 (21/32)       1 15/16/4 3/16 (1 3/16)       1 to 4       1 to 40       4 1/4       13227       132RE-T*       1320          A. R. E. A.       131       (5 1/16)       (2 7/32)       (21/32)       (2 1/32)	4		IS įS	<u> </u>	s !	2 21/32	21/32	1 19/32	2 1/2	29/32	14*	14*	-	2 5/32	8553*	854*		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	A. R. E. A. 131 [7 1/4 16 [2 27/32 21/32 2 1/32 1 31/16] 7/32 130 6 15/165 /2 2 1/3 [1 7/6 ]3 11/16] 7/32 131 6 15/165 1/2 2 17/16 [1 9/32 1 7/7 [3 13/16] 1/6 112 16 3/4 [5 1/2 2 11/16] 19/32 1 13/16] 13/16[1 1/8 110 16 7/16 [5 1/2 2 11/16] 19/32 1 13/16] 13/16[1 1/8 110 16 7/16 [5 1/2 2 11/16] 19/32 1 29/32] 3 13/21 1 /3 A. R. AA. 100 6 5/32 5 1/2 2 11/16 9/16 1 23/32[3 3/8 < 1 1/16 4 2 31/32 1 100RA-T <sup>*</sup> 4 100 16 1/16 [5 3/4 2 37/64 9/16 1 23/32] 3 3/8 < 1 1/16 4 2 31/32 1 100RA-T <sup>*</sup> 4 100 16 3/4 [5 3/4 2 37/8 9/16] 1 23/32[3 3/8 < 1 1/16 4 2 31/32 1 100RA-T <sup>*</sup> 4 100 16 3/4 [5 3/4 2 37/8 9/16] 1 23/32[3 7/8 1 1 5 100 RA-T <sup>*</sup> 5 100 RA-T <sup>*</sup> 5 2 7/8 11/16 [1 45/64] 3 5/64 31/32 13 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 4 1 to 16 2 23/32 8521 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 16 2 23/32 8521 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 16 2 23/32 8521 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 16 2 23/32 8521 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 16 2 23/32 8521 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 16 2 23/32 8521 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 16 2 23/32 8521 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 16 2 23/32 8521 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 16 2 23/32 8521 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 16 2 23/32 8521 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 16 2 23/32 8521 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 4 1 to 16 2 23/32 8521 <sup>*</sup> 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64] 1 to 4 1 to 16 1 1 to 4 1 to 16 1 1 to 16	Headfree	1 13	32 17	· 5/16 h	6 !	2 31/32	21/32	1 15/16	4 3/16	1 3/16	1 to 4	1 to 4	1 to 40	4 1/4	13227	132RE-T*	1320	• • • •
13       16       15/16       12       17/32       17/32       17/32       11/36       13/32       100       100       R	<ul> <li>130 % 15/165 1/2 21/32 21/32 11/36 11/8</li> <li>131 % 15/165 1/2 21/36 19/32 1 13/16 11/8</li> <li>112 % 3/4 5 1/2 211/16 19/32 1 13/16 13/16 11/8</li> <li>110 % 1/16 5 1/2 211/16 19/32 1 29/32 13/321 1/8</li> <li>110 % 1/16 5 3/2 1 29/32 13/321 1/8</li> <li>100 % 1/16 5 3/2 1 29/32 13/321 1/8</li> <li>100 % 1/16 5 3/2 1 23/32 3/8 4 1/16</li> <li>A. R. AA. 100 % 5/32 5 1/2 211/16 9/16 1 23/32 3/8 4 1/16</li> <li>A. R. AA. 100 % 5/32 5 1/2 211/16 9/16 1 23/32 3/8 4 1/16</li> <li>A. R. AA. 100 % 5/32 5 1/2 211/16 9/16 1 13/8 13/321 1</li> <li>112 % 3/6 9/16 1 23/32 13/32 11</li> <li>130 % 2 55/32 5 1/6 2 33/64 9/16 1 5/8 13/32 11</li> <li>130 % 2 55/32 5 1/6 2 33/64 9/16 1 5/8 13/32 13</li> <li>130 % 2 55/32 5 1/6 2 33/64 9/16 1 5/8 13/32 13</li> <li>130 % 2 55/32 5 1/6 2 33/64 9/16 1 5/8 13/32 13</li> <li>130 % 2 55/32 5 1/6 2 33/64 9/16 1 5/8 13/32 13</li> <li>130 % 2 55/32 5 1/6 2 33/64 9/16 1 5/8 13/32 13</li> <li>130 % 2 55/32 5 1/6 2 33/64 9/16 1 45/64 31/32 13</li> <li>130 % 2 55/32 5 1/00 RTT</li> <li>100 RTT</li> <li>100 RTT</li> <li>100 RTT</li> <li>100 RTT</li> <li>100 RTT</li> <li>110 16 2 23/32 8521</li> <li>11/16 1 25/32 2 11/32 12</li> <li>12 1/16 90 S0 % 2 17/32 17/32 1 29/64 2 15/16 63/64 1 10 4 1 10 16 2 23/32 8521</li> <li>Not rolled now Rolls destroyed.</li> </ul>	" A. R.	E. A.   13	31 7	1/4	6 I	7 31/32	21/32	1 7/8	4 3/16 1	1 3/16		-		4 1/4			• • • • •	•••
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	112 ic 3/4       5 1/2       12 1/16       19/32       1       13/16       100       100       100       100       100       100       100       100       100       100       100       100 <td< td=""><td>-</td><td>-   JJ</td><td>30 HG 11 LL</td><td>13/16</td><td>D   5 1/7  </td><td>2 27/32</td><td>21/32</td><td>2 1/32 1</td><td>3 11/10, 3 13/36</td><td>1 1/32</td><td></td><td></td><td>1 10 10</td><td>3 3/8 1 1/4</td><td>13027-</td><td>JJORE-T</td><td></td><td>130</td></td<>	-	-   JJ	30 HG 11 LL	13/16	D   5 1/7	2 27/32	21/32	2 1/32 1	3 11/10, 3 13/36	1 1/32			1 10 10	3 3/8 1 1/4	13027-	JJORE-T		130
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	************************************	-	• 111	12 16	3/4	5 1/2	2 11/16	19/32	1 13/16	3 11/16	1 1/8		4		3 3/4	11227-	LIJKE-1	1130	1122
#       100 16 1/16       5 3/8       2 35/641       9/16       1 23/32       9/32       1 1/16       #       2 31/32        100 RE-T          #       A. R. AA.       100 16       5/32       5 1/2       2 11/16       9/16       1 23/32       3/6 × 1L       1/16       #       #       2 31/32        100 RE-T        100 RE-T        100 RE-T        100 RE-T	4       100 16 1/16 5 3/8       2 30/64 9/16       1 23/32 3 9/32       1 1/16       12 31/32       100 RE-T	×	* II	10 16	7/16	5 1/2	2 11/16	19/32	1 29/32	3 13/32	1 1/3	#	-	1 10 16	3 1/8	11027*	INNE-T"		110
A. R. AA. Inn 6532 5 1/2 2 11/16 9/16 1 23/3213 78 4 1 1/16 " 215/16 100RA-T"	A. R. AA. 100 6 5/32 5 1/2 2 11/16 9/16 1 23/3213 3/8 -1 1/16 90 5 25/32 5 1/8 2 31/64 9/16 1 5/8 12.57 <sup>3</sup> 1 Interbigh 100 15 3/4 5 3/4 2 7/8 9/16 1 45/643 3/64 31/32 13° 3° 8° 2 25/128.10055 90 5 5 2 7/8 11/16 1 25/32 2 11/32 7/8 E. Cy. Son. 85 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64 1 to 4 1 to 16 2 23/32 8521° 85-NR° 85 Not relied now Rolls destroyed.		* 18	6 00	1/16	5 3/8	2 30/64	9/16	1 23/32	3 9/32	1 1/16		•		2 31/32		100RE-T		•
Interb'gh 100 5 3/4 5 3/4 2 7/8 9/16 1 3/8 4 3/64 3 1/32 13° 13° 13° 1 2 7/32 9023 100-RT <sup>-</sup>	Interbigh ID IS 3/4 IS	A. R.	AA.   10	20 16	5/32	5 1/2	2 11/16	9/16	1 23/32	3 3/8	L 1/16	•			2 15/16		100RÅ-T*		• • • •
#         90         5         5         2         7/8         11/16         1         25/32/2         11/32         7/8         #         #         2         1/16         90.50°         90-RT           K. Cy. Son.         83         5         3/8         4         7/8         1         10         4         1         10         16         2         2/3/2         85/31°         85-NK°          85	90 15 5 2 7/8 11/16 1 25/32/2 11/22 7/8 X. Cy. Son. 83 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64 1 to 4 1 to 4 1 to 16 2 23/32 8521* 85-NK* 85 *Not rolled now Rolls destroyed.	Interhish	- 9	20 5	3/4	5 3/6	2 31/04	•/16	1 3/8	3 3/64	. 11/32	13*	13*	<b>2</b> °	2 65/128	10005*	100.RT <sup>e</sup> ·	909*	••••
K. Cy. Son. 85 5 3/8 6 7/8 2 17/32 17/32 1 29/66 2 15/16 63/64 1 to 4 1 to 16 2 23/32 8521* 85-NR* 85	K. Cy. Son. 85 5 3/8 4 7/8 2 17/32 17/32 1 29/64 2 15/16 63/64 1 to 4 1 to 16 2 23/32 8521* 85-NR* 85 *Not relied now-Rolls destroyed.	6	9	20 5		s	2 7/8	11/16	1 25/32	2 11/32	7/8	1	E		2 1/16	9050*	90-RT		••••
	*Not relicd new Rolls McStroyred.	K, Cy. Son	. 8	5 25	3/8	4 7/8	2 17/32	17/32	1 29/64	2 15/16	63/64	1 10 4	1 to 4	1 to 16	2 23/32	8521*	85-NK*		852
		"Not rolled	i newRoll	_ [ 16. 10 1	stroyed											1	: 4		•
"Not rolled now-Rolls Mcstroyed.			ļ				1										· · · ·	<u>}</u>	-
"Not rolled now-Rolls victoroyed.			ļ		1	1					l							H	
"Not rolled now-Rolls victoroyed.			i	1	1	1	' I			1	1	1	1	[ ] ]	ļ		Callin	RAISIN	5













Typical 132 LB Head Free Design