Bridge Load Rating Updates
Load Rating for Emergency Vehicles

Amjad Waheed, PE
Bridge Management & Rating Engineer
Office of Structural Engineering
Ohio Department of Transportation

Columbus, OH
December 5, 2016
Topics to be covered

1. Load Rating for Emergency Vehicles (EV)
   a) FHWA Requirements
   b) Emergency Vehicles Configurations

2. ODOT Plan for EV load rating
   a) EV load rating - New Bridges
   b) EV load rating - Existing Bridges
   c) Timeline for EV load rating
   d) Revised load rating spreadsheets
   e) Revised BR-100
3. **EV Rating Impact on SHV Rating**  
   **Contracts for Local Bridges**  
   a) Local bridges to be rated for EV  
   b) Change in Scope to include EV  
   c) Additional cost of rating for EV  
   d) ODOT Share & Availability of Funds
Topics to be covered

4. Old Legal Load Posting Sign
5. New Legal Load Posting Sign
6. EV Load Posting Sign (not final)
7. Saving Load Rating Factors for EV
8. Special Cases
Load Rating for EV – FHWA Requirements

Memorandum

Subject: ACTION: Load Rating for the FAST Act’s Emergency Vehicles

Date: November 3, 2016

From: Original signed by
Joseph L. Hartranft, Ph.D., P.E.
Director, Office of Bridges and Structures

To: Division Administrators
Federal Lands Highway Division Directors

On December 4, 2015, the President signed into law the Fixing America’s Surface Transportation Act (FAST Act) (Pub. L. 114-94). Section 1430 of the FAST Act amended 23 U.S.C. 127, “Vehicle weight limitations—Interstate System,” by revising the weight limits for certain vehicles on the Interstate System. The purpose of this memorandum is to provide guidance on maintaining compliance with the load rating and posting requirements of 23 CFR Part 650—specifically for the amended weight limits in 23 U.S.C. 127(b). Emergency Vehicles, i.e., bridges on the Interstate System and within reasonable access to the Interstate System, are defined in a September 30, 1992, Non-Regulatory Supplement to 23 CFR Part 658 as at least one road mile from access to and from the National Network of highways, which includes the Interstate System, or further if the limits of a State’s reasonable access policy for food, fuel, repairs, and rest extend to facilities beyond one road mile.

An emergency vehicle as defined in the FAST Act is designed to be used under emergency conditions to transport personnel and equipment to support the suppression of fires and mitigation of other hazardous situations (23 U.S.C. 127(b)(2)). The gross vehicle weight limit for emergency vehicles is 86,000 pounds under section 127(c). The statute imposes the following additional limits, depending upon vehicle configuration:

- 24,000 pounds on a single steering axle
- 33,500 pounds on a single drive axle
- 62,000 pounds on a tandem axle
- 52,000 pounds on a tandem rear drive steer axle

Emergency vehicles are typically operated by fire departments and are primarily equipped for firefighting, but are also used to respond to and mitigate other hazardous situations in an emergency. These vehicles may not meet Federal Bridge Formula B. They can create higher load effects compared to the AASHTO legal loads (i.e., Types 3, 3.52, 3-3, and 3.54 to 3.74) which are currently included in the AASHTO Manual for Bridge Evaluation (MBE). The Federal Highway Administration (FHWA) has determined that, for the purpose of load rating, two emergency vehicle configurations produce load effects in typical bridges that envelop the effects resulting from the family of typical emergency vehicles that is covered by the FAST Act:

1. Type EV2 - for single rear axle emergency vehicles
   - Front Single Axle: 24,000 pounds
   - Rear Single Axle: 33,500 pounds
   - Wheelbase: 15 ft.

2. Type EV3 - for tandem rear axle emergency vehicles
   - Front Single Axle: 24,000 pounds
   - Rear Tandem Axle: 62,000 pounds (two 31,000 pound axles spaced at 4 ft.)
   - Wheelbase: 17 ft. (distance from front axle to the centerpiece of rear tandem axle)

Load ratings (or rating factors) should be determined for these emergency vehicle configurations i.e., Types EV2 and EV3, at the operating or legal load rating level in accordance with the methods specified in the AASHTO MBE. First Edition with two exceptions:

1. Multiple presence: If necessary, when combined with other unrestricted legal loads for rating purposes, the emergency vehicle needs only to be considered in a single lane of one direction of a bridge.

2. Live load factor: A live load factor of 1.3 may be utilized in the Load and Resistance Factor Rating (LRF) or Load Factor Rating (LFR) method.

Under 23 CFR 650.313(c), all highway bridges must be load rated and, if necessary, posted in accordance with the MBE. Recognizing that States and Federal agencies cannot immediately load rate every Interstate System bridge and bridges within reasonable access to the Interstate, FHWA recommends utilizing the following approach to prioritize load rating and posting for emergency vehicles:

Group 1: Bridges that meet any one of the following criteria do not need to be immediately load rated for emergency vehicles.

- An operating or legal load rating factor for the AASHTO Type 3 vehicle of at least 1.85;
- An inventory rating factor for the H5 20 design load of at least 1.0 using the LFR method, or
Load Rating for EV – FHWA Requirements

Load Rating Updates

http://www.fhwa.dot.gov/bridge/loadrating/161103.cfm
On December 4, 2015, the President signed into law the *Fixing America’s Surface Transportation Act* (FAST Act) (Pub. L. 114-94). Section 1410 of the FAST Act amended 23 U.S.C. 127, *Vehicle weight limitations—Interstate System*, by revising the weight limits for certain vehicles on the Interstate System. The purpose of this memorandum is to provide guidance on maintaining compliance with the load rating and posting requirements of 23 CFR Part 650—specifically for the amended weight limits in 23 U.S.C. 127(r), *Emergency Vehicles*, for bridges on the Interstate System and within reasonable access to the Interstate System. Reasonable access is defined in a September 30, 1992 Non-Regulatory Supplement to 23 CFR Part 658 as at least one-road-mile from access to and from the National Network of highways, which includes the Interstate System, or further if the limits of a State’s reasonable access policy for food, fuel, repairs, and rest extend to facilities beyond one-road-mile.
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Group 1: Bridges that meet any one of the following criteria do not need to be immediately load rated for emergency vehicles.

a. An operating or legal load rating factor for the AASHTO Type 3 vehicle of at least 1.85;

b. an inventory rating factor for the HS 20 design load of at least 1.0 using the LFR method, or

c. an inventory rating factor for the HL-93 design load of at least 0.9 using the LRFR method.

However, the bridges in this group shall be rated for the emergency vehicles when a normal re-rating is warranted, including changes in structural condition and other loadings.
Load Rating for EV – FHWA Requirements

Group 2: Bridges not in Group 1 should be rated for the emergency vehicles following their next inspection to incorporate the latest condition of the bridge, but no later than December 31, 2019. Emergency vehicles should be included in any new load ratings for these bridges when the load ratings occur before December 31, 2019.

When a load rating results in an operating rating factor less than 1.0 for the emergency vehicles, the bridge shall be appropriately posted for both the governing single axle weight limit and tandem axle weight limit derived from the above emergency vehicle configurations, i.e., Types EV2 and EV3 (23 CFR 650.313(c)). When posting is necessary, the following sign format, using the appropriate weight limits, should be considered:

```
EMERGENCY VEHICLE
AXLE WEIGHT LIMIT

SINGLE 13 T
TANDEM 17 T
```
ODOT Plan for Load Rating

Task 1:
Emergency Vehicle Configurations (EV2 & EV3)

Task 2:
Modify ODOT load rating spreadsheets and Rating Summary form BR-100
ODOT Plan for Load Rating

Task 3:
Complete the initial identification of routes & existing bridges which will require load rating for EV2 & EV3
   a. Bridges carrying Interstate mainline traffic including ramp traffic on all Interstate Interchanges
   b. Bridges on the Interstate System & within one road mile from the exterior ramp gore point

Task 4:
Finalize the set of load rating vehicles for all new EV-qualified bridges to be rated at the time of design
ODOT Plan for Load Rating

Task 5:
Finalize the spreadsheet to track EV bridges & rating values

Task 6:
   a) Identify bridges in EV-Group 1 (Inventory Rating Factor for HS20 ≥ 1.000 or for HL93 ≥ 0.900
   b) Identify bridges in EV-Group 2 (not in Group 1)

Task 7:
Finalize the Posting Sign for EVs
ODOT Plan for Load Rating

Task 8:
Propose an EV Plan of Action (EV-POA) to complete load rating of existing bridges in EV-Group 2

Task 9:
Approval of the EV-POA; identification of resources for EV-POC

Task 10:
Implementation of the EV-POA
## Tentative Timeline for EV Load Rating

<table>
<thead>
<tr>
<th>Tasks</th>
<th>ODOT Plan for EV-Rating</th>
<th>Tentative_dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>EV2 &amp; EV3 Configurations</td>
<td>12/15/2016</td>
</tr>
<tr>
<td>Task 2</td>
<td>Modified ODOT rating spreadsheets and BR-100</td>
<td>2/15/2017</td>
</tr>
<tr>
<td>Task 3</td>
<td>Identification of routes &amp; bridges</td>
<td>4/15/2017</td>
</tr>
<tr>
<td>Task 4</td>
<td>New load ratings start using EV</td>
<td>5/1/2017</td>
</tr>
<tr>
<td>Task 5</td>
<td>Spreadsheet to track EV ratings</td>
<td>4/30/2017</td>
</tr>
<tr>
<td>Task 6</td>
<td>Identification of bridges in Groups 1 &amp; 2</td>
<td>5/15/2017</td>
</tr>
<tr>
<td>Task 7</td>
<td>EV Posting sign</td>
<td>4/30/2017</td>
</tr>
<tr>
<td>Task 8</td>
<td>EV-POA completion</td>
<td>5/30/2017</td>
</tr>
<tr>
<td>Task 9</td>
<td>EV-POA approval</td>
<td>6/30/2017</td>
</tr>
<tr>
<td>Task 10</td>
<td>EV-POA implementation completion</td>
<td>10/15/2019</td>
</tr>
</tbody>
</table>
Emergency Vehicles

EMERGENCY VEHICLES
ALL AXLE LOADINGS

Rear Axle
33.5 k

Front Axle
24 k

Conversion
1 kip = 1,000 lbs.
1 T = 2,000 lbs.
1 kip = 4.448 kN
1 m = 3.2808 ft.

EV2
28.75T; 15 ft.

EV3
43T; 19 ft.

Rear Tandem
62 k

Front Axle
24 k

4 ft.
15 ft.

Load Rating Updates
Revised Rating Spreadsheets

LFR and LRFR Load Rating Spreadsheets will be modified to include EV loading of bridges:

1. Steel beams with non-composite concrete deck simple
2. Steel beams with composite concrete deck simple
3. RC slab simple
4. Pre-stressed precast box-beams simple
5. Composite pre-stressed box-beams simple
6. RC precast box-beams simple
7. RC T-beam simple
8. CMP Modified minimum cover
And more

Tentative Completion Date: February 15, 2017
Revised BR-100

Load Rating Summary Form (BR-100) will be modified to include EV loading

Tentative Completion Date: February 15, 2017
EV Rating Impact on SHV Rating Contracts for Local Bridges

Verify if the bridge under contract is qualified for EV rating

If a bridge is NOT qualified for EV load rating (Groups 1 & 2) proceed with the current scope & contract
EV Rating Impact on SHV Rating Contracts for Local Bridges

If a bridge is qualified for EV load rating (Groups 1 & 2) then:

a) Change in Scope to include EV2 & EV3 with SHV & Old Ohio Legal Loads
b) Re-write the contract, if needed
c) Additional cost will be shared by ODOT
d) Additional funds are available from ODOT
All new EV-qualified bridges shall be analyzed and rated for EV2 and EV3 vehicles; also
All new EV-qualified bridges shall be designed to have a rating factor of at least 1.000 for both EV2 and EV3 vehicles
EV Load Rating – New Bridges

Load Rating Requirements for New EV-qualified Bridges

Rating Loads:

1) HS20 or HL93
2) Current Ohio Legal Loads
   a. Old Ohio Legal Loads (2F1, 3F1, 4F1 & 5C1)
   b. AASHTO SHVs (SU4, SU5, SU6 & SU7)
3) Emergency Vehicles (EV2 & EV3)
Old Ohio Legal Loads

**OLD OHIO LEGAL LOAD**

**ALL AXLE LOADINGS**

- **2F1**
  - 15.0T; 10 ft.

- **3F1**
  - 23T; 14 ft.

- **4F1**
  - 27T; 18 ft.

- **5F1**
  - 40T; 51 ft.

**Conversion**

- 1 kip = 1,000 lbs.
- 1 T = 2,000 lbs.
- 1 kip = 4.448 kN
- 1 m = 3.2808 ft.
AASHTO SHV Configurations

SPECIAL HAULING VEHICLES (SUV)

ALL AXLE LOADINGS

 Conversion
1 kip = 1,000 lbs.
1 ft = 2,000 lbs.
1 kip = 4,448 kN
1 m = 3.2808 ft.

SU4
27T; 18 ft.

SU5
31T; 22 ft.

SU6
34.75T; 26 ft.

SU7
38.75T; 30 ft.
ODOT Share and Availability of Funds

- Funds are available from ODOT to cover the additional cost of including load rating for EV in the current SHV rating contracts
- ODOT will share 50% of the cost of SHV & EV load rating contracts
Saving Results of Load Rating for EV

- Current SMS cannot store the Rating Factors (RF) of EV2 & EV3
- Save the final load rating summary form (BR-100) in your bridge files; &
- Also, store the RFs in a spreadsheet
Old Legal Load Posting Sign
New Legal Load Posting Sign

WEIGHT LIMIT

AXLES
2  10T
3  14T
4  18T
5  22T
6+ 24T

NEW BRIDGE LOAD POSTING SIGN
(Size: 35 inches by 60 inches)
EV Posting Sign (Not final)

EMERGENCY VEHICLE AXLE WEIGHT LIMIT SINGLE 13T TANDEM 17T
EV Posting Sign (Not final)

Load Rating Updates
Special Cases

- **Trusses**
  - Treat them like other bridge types
- **Gusset Plate Analysis**
  - If gusset plate analysis controls the bridge rating, re-analyze for EVs
- **Special Bridge Postings**
  - No change in policy
- **Bridges Exempt from Load Rating**
  - No change in policy
- **Non-Highway Bridges**
  - No change in policy
Questions?

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Bridge Management and Load Rating Engineer
Ohio Department of Transportation

Amjad.Waheed@dot.ohio.gov
(614) 752-9972
Interchanges on the Interstate
Interchanges on the Interstate
Interchanges on the Interstate

Load Rating Updates
Examples of Load Rating from Inventory Coding Guide

Appendix L of the Inventory Coding Guide
Example of Load Rating Summary Form BR-100

<table>
<thead>
<tr>
<th>SFN</th>
<th>BRIDGE NUMBER</th>
<th>DISTRICT</th>
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<tbody>
<tr>
<td>2901110</td>
<td>GRC-00-004</td>
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<table>
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<tr>
<th>ORIGINAL CONSTRUCTION YEAR</th>
<th>REHABILITATION YEAR</th>
<th>OVERALL STRUCTURE LENGTH</th>
<th>FEATURE INTERSECTION</th>
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<tbody>
<tr>
<td>1990</td>
<td>2016</td>
<td>106 ft</td>
<td>Fairless Creek</td>
</tr>
</tbody>
</table>

**SPECIAL ASSUMPTIONS & COMMENTS:**
Three span (32'-40' - 32' w/ bearings) continuous PC slab superstructure reconstructed on existing foundations. The deck is 30' deep and 61' 10" width and face-sole of TST rail. Tangent alignment, 10 degree RF slope.

**LOAD RATING PURPOSE:** 8 - Update Analysis Model and Software
**LOAD RATING SOFTWARE:** 3 - AASHTO Eq. (VINTS)
**RATING SOURCE:** 1 - Plan information available for load rating analysis (Default)
**RATING METHOD:** 0 - Load & Resistance Factor Rating (LRFR) reported by rating factor (RF)

**ORIGINAL DESIGN LOADING:** A - ML93

**STRUCTURE RATING SUMMARY**

<table>
<thead>
<tr>
<th>Loading Type</th>
<th>GVW (Tons)</th>
<th>Rating Factor - RF</th>
<th>Legal Weight (Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML93 Loading</td>
<td>1,037</td>
<td>1.062</td>
<td></td>
</tr>
<tr>
<td>Ohio - 271</td>
<td>15</td>
<td>1.765</td>
<td>15.00</td>
</tr>
<tr>
<td>Ohio - 371</td>
<td>39</td>
<td>2.093</td>
<td>23.00</td>
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<tr>
<td>Ohio - 571</td>
<td>77</td>
<td>2.166</td>
<td>37.00</td>
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<tr>
<td>Ohio - 571</td>
<td>40</td>
<td>3.010</td>
<td>40.00</td>
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<table>
<thead>
<tr>
<th>Loading Type</th>
<th>GVW (Tons)</th>
<th>Rating Factor - RF</th>
<th>Legal Weight (Tons)</th>
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<tbody>
<tr>
<td>SU4</td>
<td>27</td>
<td>2.507</td>
<td>77.00</td>
</tr>
<tr>
<td>SU5</td>
<td>31</td>
<td>2.175</td>
<td>31.00</td>
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<tr>
<td>SU6</td>
<td>34.75</td>
<td>2.113</td>
<td>34.75</td>
</tr>
<tr>
<td>SU7</td>
<td>38.73</td>
<td>2.062</td>
<td>38.73</td>
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**Overall Posting Rating:**
100%

**BRIDGE POSTING REQUIRED BY RATING:**
No load posting is recommended

**Sign Posting Recommendation:**

<table>
<thead>
<tr>
<th>AGENCY/FRM</th>
<th>ODOT - Office of Structural Engineering</th>
<th>REPORT DATE: 11/13/2016</th>
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<tbody>
<tr>
<td>RATED BY</td>
<td>PE #</td>
<td>PHONE NUMBER</td>
</tr>
<tr>
<td>Andrea Portis</td>
<td>54004</td>
<td>614-752-6032</td>
</tr>
<tr>
<td>REVIEWED BY</td>
<td>PE #</td>
<td>PHONE NUMBER</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EMAIL</td>
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</table>
### SMS Load Rating Screen

**LOAD RATING**

<table>
<thead>
<tr>
<th>(31) Design Load:</th>
<th>A - HL93</th>
</tr>
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<tbody>
<tr>
<td>(63) Operating Rating Method:</td>
<td>8 - Load &amp; Resistance Fac</td>
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<tr>
<td>(64) Operating Rating Factor:</td>
<td>1.862</td>
</tr>
<tr>
<td>(700) Operating Rating Load:</td>
<td>3 - HL93 Loading</td>
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<tr>
<td>(701) Operating Rating Load GVW:</td>
<td>36 tons</td>
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<tr>
<td>(65) Inventory Rating Method:</td>
<td>8 - Load &amp; Resistance Fac</td>
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<tr>
<td>(66) Inventory Rating Factor:</td>
<td>1.437</td>
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<tr>
<td>(702) Inventory Rating Load:</td>
<td>3 - HL93 Loading</td>
</tr>
<tr>
<td>(41) Open Posted or Closed:</td>
<td>A - OPEN, NO RESTRICTI</td>
</tr>
</tbody>
</table>

| (703) Inventory Rating Load GVW: | 36 tons |
| (704) Load Rating Date: | 11/18/2016 |
| (705) Load Rater First Name: | Andrea |
| (706) Load Rater Last Name: | Parks |
| (707) Load Rater Ohio PE Number: | 54304 |
| (708) Load Rating Software: | 3 - AASHTO BrR (VIRTIS) |
| (709) Rating Source: | 1 - Plan information avail |
| (711) Live Load Response: | S - Satisfactory |

### OHIO LEGAL LOADS

<table>
<thead>
<tr>
<th>(715) Ohio Legal Load 1:</th>
<th>2F1</th>
</tr>
</thead>
<tbody>
<tr>
<td>(716) Ohio Legal Load 1 GVW:</td>
<td>15,000 tons</td>
</tr>
<tr>
<td>(717) Ohio Legal Load 1, Rating Factor:</td>
<td>3.705</td>
</tr>
<tr>
<td>(718) Ohio Legal Load 2:</td>
<td>3F1</td>
</tr>
<tr>
<td>(719) Ohio Legal Load 2 GVW:</td>
<td>23,000 tons</td>
</tr>
<tr>
<td>(720) Ohio Legal Load 2, Rating Factor:</td>
<td>2.668</td>
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<tr>
<td>(721) Ohio Legal Load 3:</td>
<td>SU4</td>
</tr>
<tr>
<td>(722) Ohio Legal Load 3, GVW:</td>
<td>27,000 tons</td>
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<tr>
<td>(723) Ohio Legal Load 3, Rating Factor:</td>
<td>2.407</td>
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<tr>
<td>(70) Bridge Posting:</td>
<td>5 - Equal to or above legal</td>
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<tr>
<td>(724) Ohio Legal Load 4:</td>
<td>SU6</td>
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<tr>
<td>(725) Ohio Legal Load 4 GVW:</td>
<td>31 tons</td>
</tr>
<tr>
<td>(726) Ohio Legal Load 4, Rating Factor:</td>
<td>2.275</td>
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<tr>
<td>(727) Ohio Legal Load 5:</td>
<td>SU6</td>
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<tr>
<td>(728) Ohio Legal Load 5 GVW:</td>
<td>34.75 tons</td>
</tr>
<tr>
<td>(729) Ohio Legal Load 5, Rating Factor:</td>
<td>2.113</td>
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<tr>
<td>(730) Ohio Legal Load 6:</td>
<td>SU7</td>
</tr>
<tr>
<td>(731) Ohio Legal Load 6, GVW:</td>
<td>38.75 tons</td>
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<tr>
<td>(732) Ohio Legal Load 6 Rating Factor:</td>
<td>2.002</td>
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<tr>
<td>(733) Posting Required by Rating:</td>
<td>N - No</td>
</tr>
<tr>
<td>(734) Ohio Percent Legal:</td>
<td>150 %</td>
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</table>
Afterthoughts

EV Posting Sign