Then

• 1911
  – 640,000 registered vehicles in the US
  – 200,000 miles of paved roads
  – 2,000 fatalities
First Pavement Markings

• 1911
  – Wayne County, Michigan
  – White center line along horizontal curves

• 1917
  – Oregon
  – Yellow center line along horizontal curves

• Circa 1917
  – Black center lines on concrete
Road Markings

- 1917
  - 5,000,000 registered vehicles in the US
  - 370,000 miles of paved roads
  - 9,500 fatalities
Before MUTCDs

• 1927 – AASHO Standard Road Marker & Signs
  – Markings not addressed, only signs
• 1930 – Manual on Street Traffic Signs, Signals, and Markings
  – Center lines
    • On curves, wide streets, and signalized intersections
  – White or yellow on bituminous pavements
  – Black or white on concrete pavements
1935 MUTCD

• 1935 First Edition
  – Center lines color was not specified
  – Edge lines not considered
  – “paint or lacquer of contrasting color”
  – Minimum width = 4 inch
  – Maximum width = 8 inch
Retroreflectivity

- 1937 – Initial testing of light retro-directing glass spheres in pavement markings
1941 - US40 in West Virginia
• White and yellow markings were favored due to war blackout conditions
• Chromium pigment was reserved to support war but yellow markings were continued with “earth pigments”
1948 MUTCD

- No black markings
- White was preferred for all markings except double centerlines (yellow) and no-passing zones, but white was still permitted for these markings
- Recommended against edge lines
Major Non-Uniformity in 1949
Texas Markings in 1949

- Austin, Congress St.

- Dallas, Central Expressway
1948 MUTCD

- Retroreflectivity
  - “better for night visibility but neither practicable nor necessary”
  - “doubtful value on lit city streets”
  - Should be used:
    - Center lines
    - No passing lines
    - On vertical surfaces of objects in or near the roadway
1954 Revision of the 1948 MUTCD

- Famous for what?
1954 Revision of the 1948 MUTCD

- All rural pavement markings required to be retroreflective
- Generally desirable for other markings that must be visible at night
1961 MUTCD

- Yellow mandated for center lines on multilane roadways and no-passing markings
- Center line width: 4-6 inch
- Edge line width: 2-4 inch
Retro Research Circa 1969

Reflective Edge Lines
Reflective Center Line
Non-Reflective Center Line
1971 MUTCD

- First FHWA Manual
- Yellow chosen as color to separate opposing traffic when used as a center line
-Introduced red markings as "shall not be entered"
-Width: 4-6 inch for all markings
1978 MUTCD

- Yellow specified as used today: center line on two-way roadways and left edge line on divided roadways
- Lane line: 10-30 ft ratio
1988 MUTCD (Rev 7 – 2000)

- Warrants for center lines and edge lines based on:
  - Functional class
  - Traffic volumes
  - Travelway width
• Secretary of Transportation shall revise the MUTCD to include:
  – Standard minimum level of retroreflectivity for pavement markings and signs, and (partially completed)
  – Standard to define roads that must have a center line and or edge lines. (completed in 2000)
• FHWA publishes Notice of Proposed Amendment to add minimum pavement marking retroreflectivity to MUTCD
### FHWA 2010 NPA Minimums

<table>
<thead>
<tr>
<th>Posted Speed (mph)</th>
<th>≤30</th>
<th>35–50</th>
<th>≥55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-lane roads with center line markings only</td>
<td>n/a</td>
<td>100</td>
<td>250</td>
</tr>
<tr>
<td>All other roads</td>
<td>n/a</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

**Exceptions:**

1. When RRPMs supplement or substitute for a longitudinal line (see Section 3B.13 and 3B.14), minimum pavement marking retroreflectivity levels are not applicable as long as the RRPMs are maintained so that at least 3 are visible from any position along that line during nighttime conditions.

2. When continuous roadway lighting assures that the markings are visible, minimum pavement marking retroreflectivity levels are not applicable.
Current Status

- FHWA plans a Supplemental NPA
- Currently at OMB for review
The “Now” Topics

• Contrast markings
• Audible markings
• Marking performance on seal coat
• Wet-retroreflective markings
• ASTM Test Methods
  – E1710 – Dry Retro
  – E2177 – Wet Recovery Retro
  – E2832 – Continuous Wet Retro
Now – Near Future

Orange WZ Markings
Now – Near Future

Lane Departure Warning
Lane Keeping Assistance
Near Future
Far Future
Far Future
Thanks!

Paul Carlson,  P-Carlson@tti.tamu.edu

TTI Open House @ RELLIS, Wed NOON – 3:00
The Future