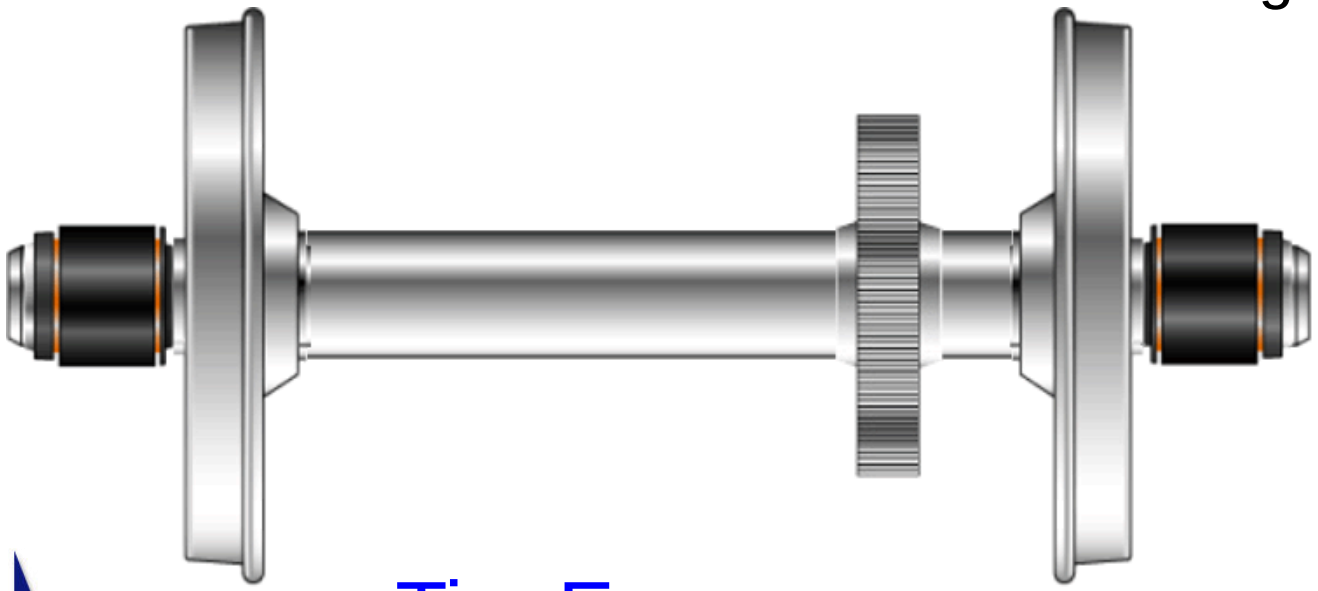
The Use and Standardization of Barcodes in Railroad Wheel and Wheelset Manufacturing



Tim Epperson

ARKANSAS INDUSTRIAL COMPUTING

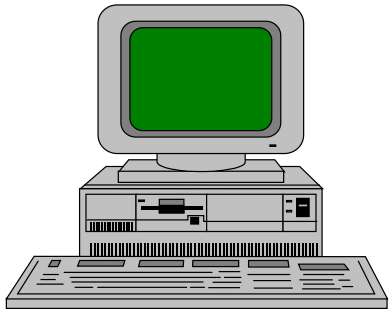
WheelShopAutomation.com

877-834-9540

Benefits of Barcoding

- ✓ Speed
  - Data entry with standard barcodes is 10 times faster than manual data entry
- ✓ Uniform Data Collection
  - Collect the required data every time
- ✓ Timely Feedback
  - Data entered can be immediately checked for accuracy
  - Inventories can be updated in real-time
- ✓ Improved Productivity and Profitability
  - Collect more information in less time—get to know your process
  - Fewer mistakes means more $$$

Barcodes are Accurate



- A typical key-entry operator experiences approximately one undetected error in every ***300*** characters entered

- A barcode introduces only one undetected error in every ***3,000,000*** characters scanned

Barcode Symbologies

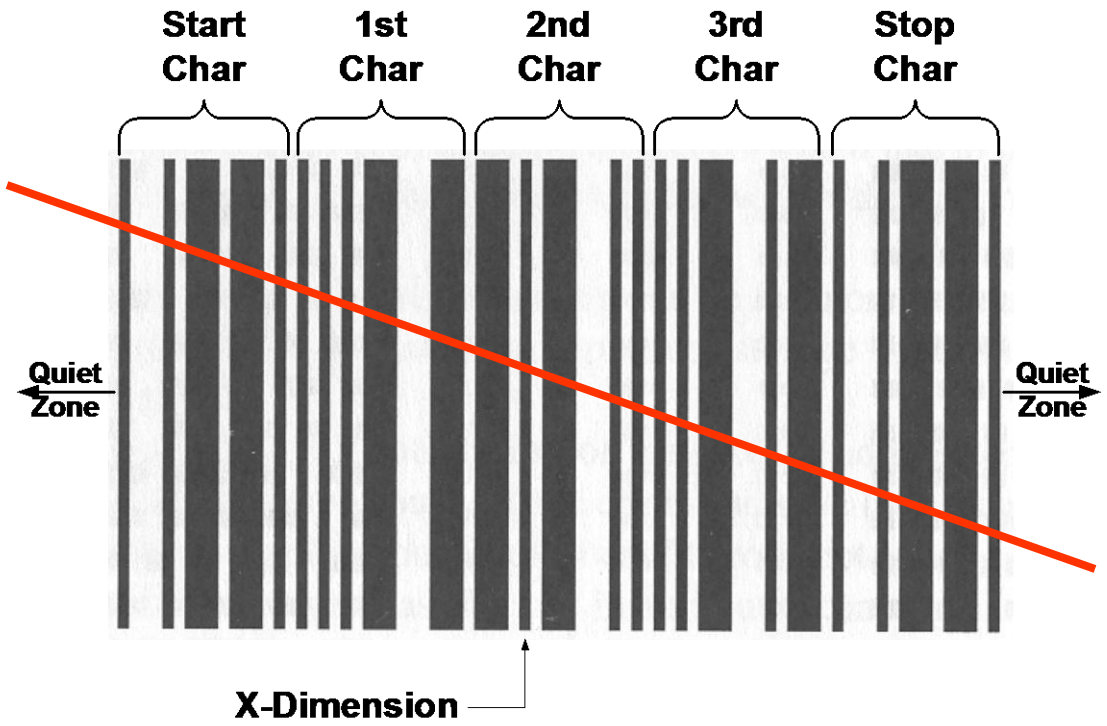
1234567890

1234567890

1234567890

- UPC
  - Numeric only (primarily retail)
- Code 39
  - Alphanumeric, space and +-$/%
  - General manufacturing - Wheels!
- Code 128
  - Full ASCII character set (128 characters)
  - High density
- Interleaved 2 of 5 (ITF-14)
  - Numeric only (shipping containers)

Code 39 Barcode Structure



- ✓ Alphanumeric
- ✓ Large, easy to read
- ✓ 9 elements per character
- ✓ Contains the data being collected

2-Dimensional Barcodes

All 2-D barcodes have bulit-in error detection and correction

- PDF417 – PDF stands for Portable Data File and is capable of storing over 1800 characters in a standard PDF417 code.

- MaxiCode was developed by UPS. It is designed specifically for sortation and tracking applications.

- Data Matrix was developed by International Data Matrix. Data Matrix is typically used for part marking applications. Data Matrix can be stamped into metal parts for permanent marking.

PDF417 Benefits

- ✓ Over 1,100 characters per square inch
- ✓ Error correcting code
- ✓ Physically smaller - labels are less expensive
- ✓ Allows more data to be collected
- ✓ Data is portable
- ✓ Can contain binary data

Barcode Scanner Types

- Hand-held Scanners
  - CCD
  - Laser
  - Area Imager
  - Wireless
- Fixed Laser Scanners
  - Raster
  - Omni-Directional
  - Holographic

CCD Scanners

Advantages

- Reads damaged and dirty labels well
- Inexpensive ($300)

Disadvantages

- Short range (3-8 in.)

Laser Scanners

Advantages

- Simple and proven
- Reads dirty labels
- Long range (over 6 feet)
- Inexpensive ($500)

Disadvantages

- Single scan line
- Affected by damaged labels

Area Imager Scanners

Advantages

- Reads damaged and dirty barcodes very well
- Reads 2-D barcodes

Disadvantages

- Short range (< 5 in.)
- Cost ($1,300)

Raster Scanners

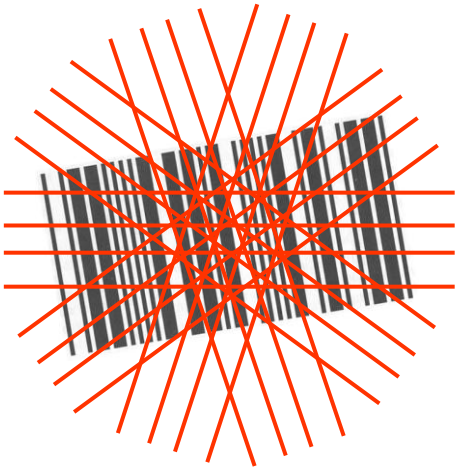
Advantages

- Simple, proven operation
- Several thousand scans per second

Disadvantages

- One line or beam
- Small scanning area
- Depends on good label positioning

Omni-Directional Scanners



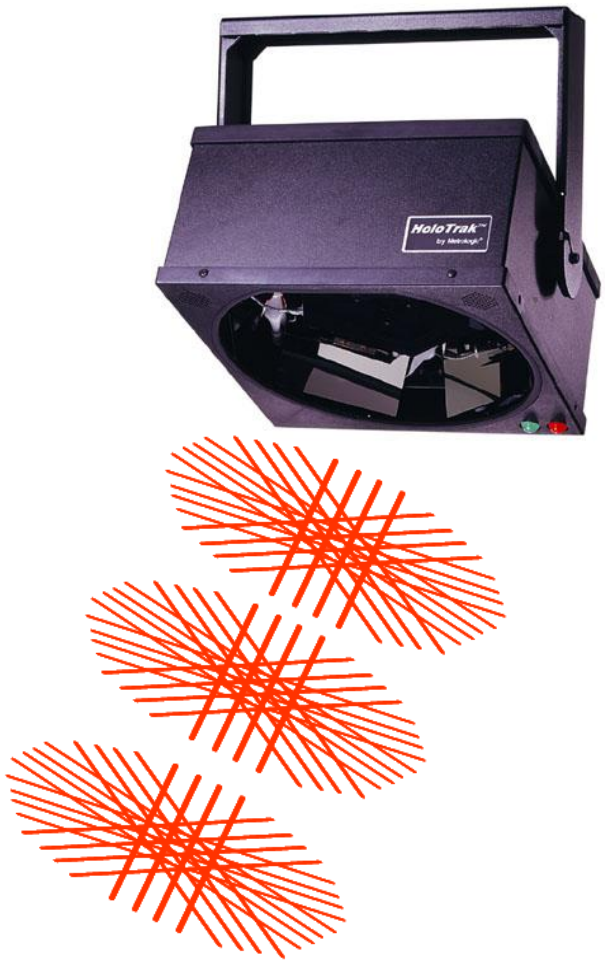
Advantages

- up to 80 scan lines
- Several thousand scans per second
- Up to 20 inches wide
- Independent of label rotation

Disadvantages

- Dependent on object height
- Cost ($2,500-$8,000)

Holographic Scanners



Advantages

- Multiple scan lines
- Multiple scan heights
- Independent of label position and height
- High speed
- Reads 2-D barcodes
- Up to 26 inches wide

Disadvantages

- Cost ($10,000-$25,000)

Label Construction

- Paper
  - Inexpensive
  - Easily damaged
  - Deteriorates in heat, cold, rain and ice
- Film based polyvinyl or polyester
  - Resists tearing
  - Resists heat, cold, rain and ice
  - More difficult to print on

Label Printing

- Direct Thermal Printing
  - Inexpensive
  - Requires specially coated paper
  - Print fades with time and can easily scratch
- Thermal Transfer
  - Produces high resolution barcodes
  - Images won’t fade or smudge
  - Prints on a variety of label stock
  - Requires one-time use ribbon

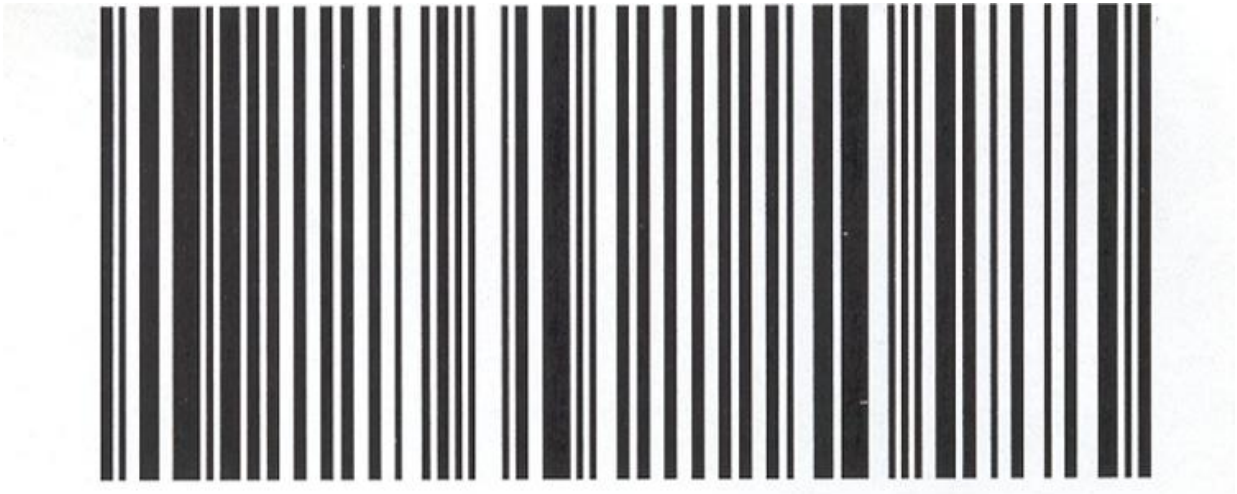
Label Placement

- Wheel Tread
  - Useful to wheel manufacturers, bad for wheelset manufacturers
  - Ideal for scanning large quantities of wheels quickly
  - Unreadable after two revolutions on a track
- Wheel Plate
  - Useful to wheelset manufacturers, bad for wheel manufacturers
  - Easily scanned by fixed scanners
  - Protected throughout the assembly process
  - Accessible even at the car assembly stage

Keeping the Label on the Wheel

- Place labels on the plate of the wheel
- Wheels make good bowls
  - Store wheels on their edge or plate down to protect from water and ice damage
- Use acrylic based adhesives
  - Wide temperature range
  - Work with your label vendor

Barcode Verification



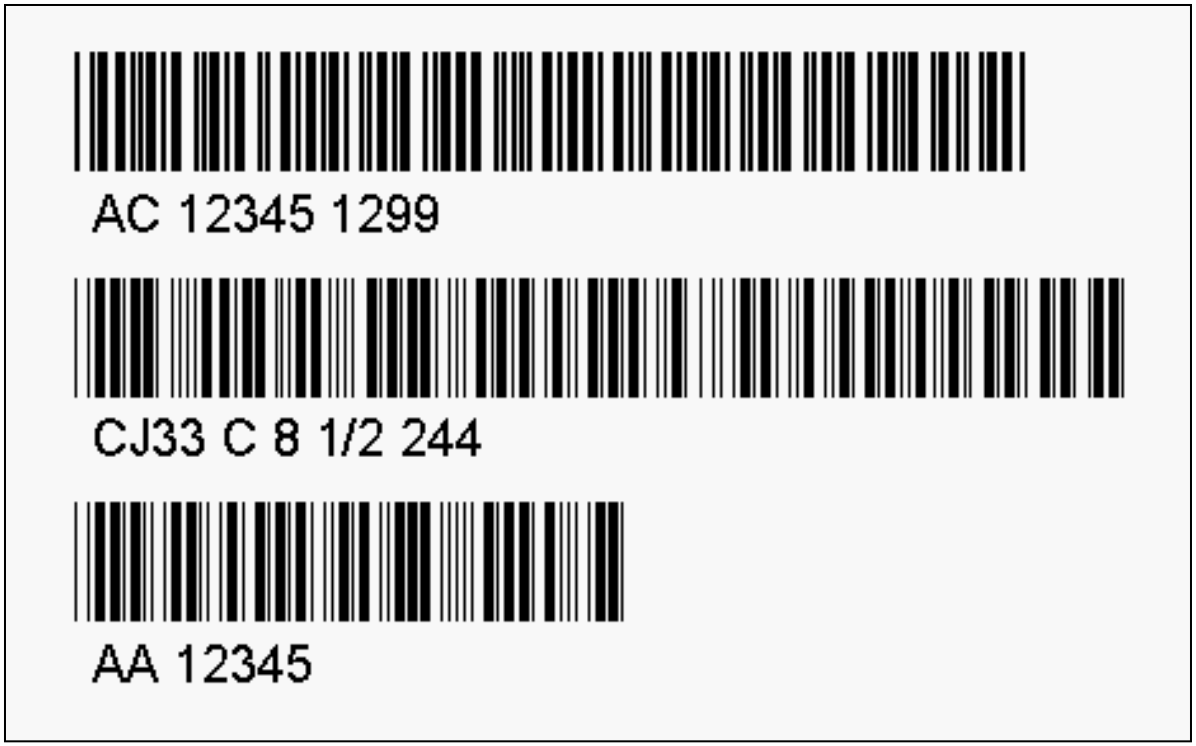
Scan your own labels!

Barcode Verification (cont'd)

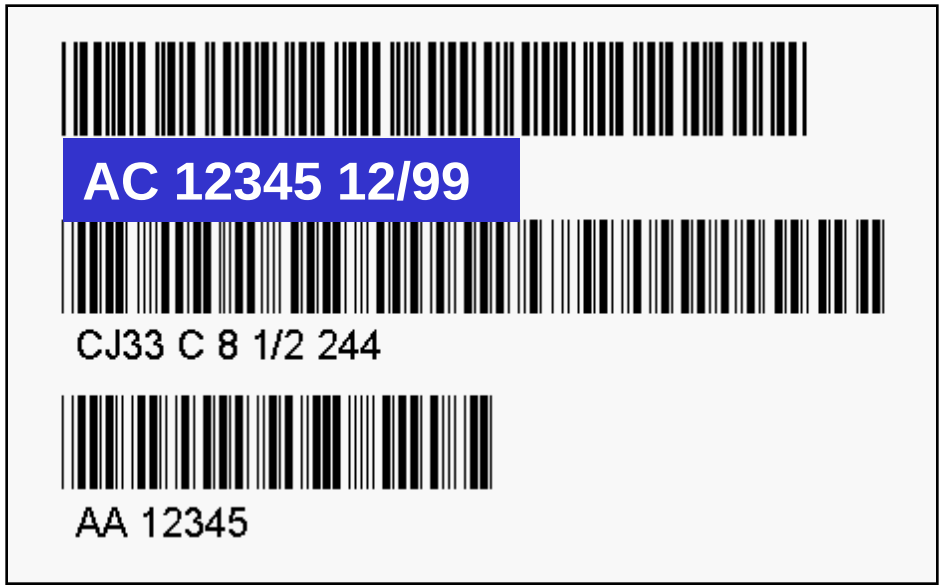
Incorrect

Correct

Wheel Barcodes



Current Wheel Barcode – 1st Line



Manufacturer

Serial Number

Date of Manufacture

Current Wheel Barcode – 2nd Line

- Wheel design
- Wheel Class
- Bore Size
- Tape Size

Current Wheel Barcode – 3rd Line

Heat Number

Data Format Standardization

- Use spaces between fields in the barcode
- Be consistent in field order
  - Manufacturer code should be the first two characters of the barcode
  - Date of manufacture should always be the last four digits of the barcode
- Be consistent in field formats
  - Tape size should always have three digits
  - Always include the fractions even when it is “0/0”
- Establish format for Heat Numbers

Data Format Standardization (cont'd)

- SIZE DOES MATTER…in the X-Dimension
  - Bigger barcodes are easier to scan and more difficult to damage
- Eliminate extra characters in barcodes
  - Computers don't understand inches
  - Computers don't care about extra spaces

Information Identification

- One finished freight car wheelset can have 12 different barcodes
  - Wheels (6), axle (2), bearings (4)
- Use of AAR manufacturing codes can help
- Use self identifying data

Extensible Markup Language (XML)

- XML is a method for putting structured data in a text file
- XML is a way for different systems to easily share data
- XML can be queried like a database
- XML provides self-describing transactions

XML is a Standard

- XML has been a World Wide Web Consortium (W3C) standard since February 1998
- Operating System independent
  - Works with Linux, Windows, HP 9000, AS400, etc.
- Used and supported by Microsoft, Sun Microsystems, Oracle, IBM, Dell, etc.
- XML is quickly becoming the new EDI standard
- XML is an integral part of Windows XP

XML in Wheel Manufacturing

The XML structure identifies the data independent of the order it is presented

<Mfg>**AC**</Mfg>

<SerialNo>**55102**</SerialNo>

<HeatNo>**123456**</HeatNo>

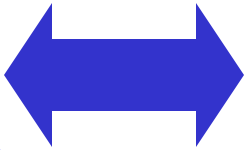
<TapeSize>**244**</TapeSize>

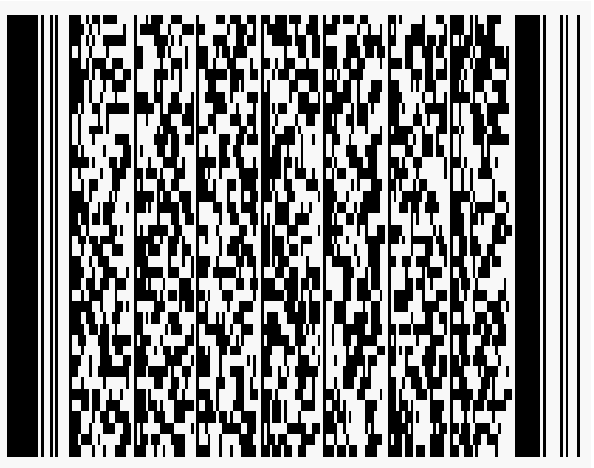
Using XML for Wheel Data

```
<Wheel>
   <Mfg>AC</Mfg>
   <SerialNo>55102</SerialNo>
   <MfgDate>01/01</MfgDate>
   <Size>H36</Size>
   <Class>C</Class>
   <BoreWhole>10</ BoreWhole>
   <BoreFract>15/16</ BoreFract>
   <TapeSize>244</TapeSize>
   <HeatNo>123456</HeatNo>
   <CertNo>5551212</CertNo>
</Wheel>
```

Using XML with 2-D Barcodes

```
<Wheel>
   <Mfg>AC</Mfg>
   <SerialNo>55102</SerialNo>
   <MfgDate>01/01</MfgDate>
   <Size>H36</Size>
   <Class>C</Class>
   <BoreWhole>10</ BoreWhole>
   <BoreFract>15/16</ BoreFract>
   <TapeSize>244</TapeSize>
   <HeatNo>123456</HeatNo>
   <CertNo>5551212</CertNo>
</Wheel>
```





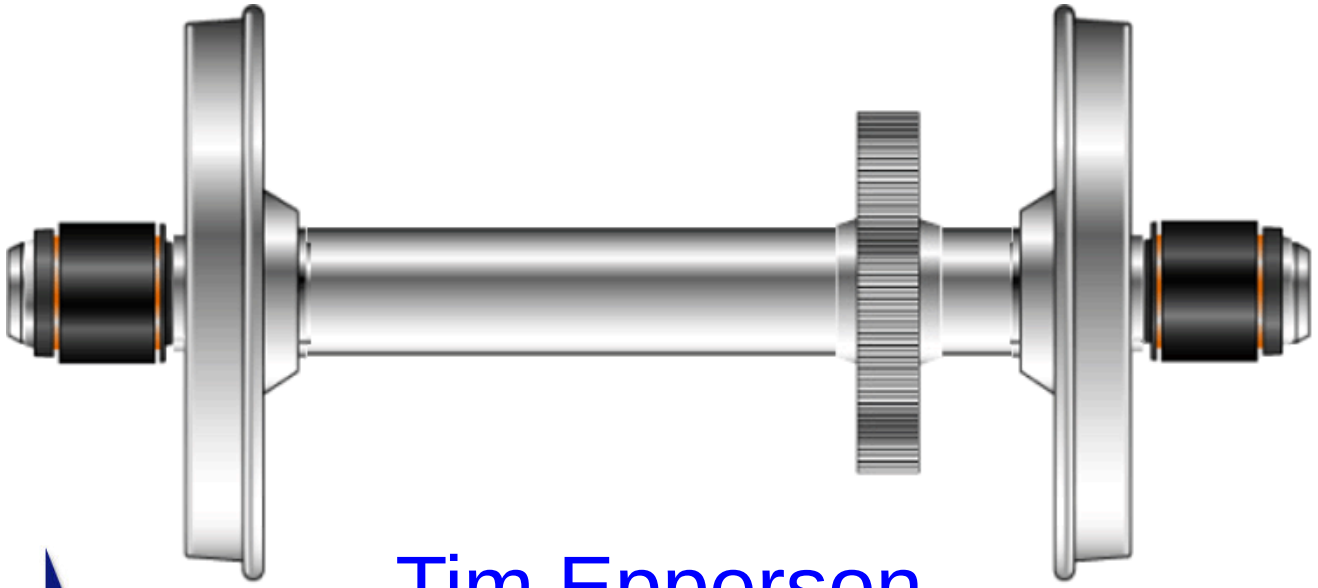
238 Characters

2-D XML Wheel Label

Establishing Standards

- Do it now before it is too late
  - Other wheel manufacturers are adding barcodes
  - Other component manufacturers are adding barcodes
- Be consistent with the data format
- Require data identification
  - Use AAR company codes
  - Self identifying data (XML?)
- Make the standard flexible and easy to build upon
- Allow for new technologies

Questions and Comments



Tim Epperson

ARKANSAS INDUSTRIAL COMPUTING

WheelShopAutomation.com

877-834-9540