Parts Marking for Traceability

SPEC2000 - An Industrial Standard for this Millennium

Jon Andresen
President, Technology Solutions, Oakland, CA
Technical Director, Center for AutoID – Ohio University
Who Am I?

Here to tell you: \textit{forget the darn bar code!}

(I’m really the Data Guy!)
What is SPEC2000?

- A specification to exchange information:
  - Purchasing transactions
  - Repair Order transactions
  - Aircraft and Engine warranty
  - Reliability Data Collection and Exchange
  - Bar Coding / Direct Part Marking

- System for buying and selling aircraft parts and repair services
  - Defines data for business transactions

- Established network of suppliers and airline operators

- Established and very well supported EDI format
  - used for 40+ years - started as ATA Spec200

In Summary: SPEC2000 is a data standard and an eBusiness standard.
**SPEC2000 Overview**

**Customer**
- EDI Standards
  - Purchasing / Invoicing
  - Repair Order Admin.
  - Warranty Claims

**File Transfers**
- Provisioning
- Delivery Configuration
- Lead Time Performance Data
- Inventory Consumption Data
- Reliability Data

**Electronic Data Interchange**

**Marketplace Databases**
- Manufacturer Prices / Lead Times
- Tools, Test, & Ground Equip.
- Repair Agency Capabilities / Prices
- Surplus Parts Availability
- Reliability Database

**Bar Codes**
- Bar Coded Shipping Labels
- Perm. Bar Code ID on Parts

**MFR / Supplier / Repair Agencies**

1000+ companies involved Worldwide!
Customer/Supplier Interchanges

- Requirements Specification for new part (documents, diagrams, etc.)
- Design Data (performance specs, visuals, CAD drawings, etc.)
- Commercial negotiations (discussion documents, contract drafts, etc.)
- Progress Monitoring/updates (letters, phone calls, documents, etc.)
- Initial/replenishment Purchasing Transactions (POs, expedites, etc.)
- Parts Shipments Involving New, Repair, Warranty, & Exchange Parts
- Parts Traceability: mfgr, install, remove, repair, store, ship, scrap, etc.
- Trading Transactions (quotes, warranties, invoices, etc.)
- Engineering & Maintenance Information (manuals, graphics, training, etc.)
- Customer Support & Service Bulletins (documents, photos, graphics, etc.)
Why SPEC2000?

Is this your business model?
...because of this!

It is too costly to do business 25 (or 2500) different ways!
SPEC2000

Business Architecture

Customers and Suppliers
Build A Piece as It’s Needed
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SPEC2000 Bar Code Taskforce

Functional and Data Architecture

The Foundation is laid!
(giving parts a Social Security Number)

Permanent Bar Code Identification of Parts

Legend:
- Existing Standards
- ‘In-Process’ Standards (June 2002)
- Future Standards

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Functional and Data Architecture

These business function have been in place for years!

Legend:

- Existing Standards
- ‘In-Process’ Standards (June 2002)
- Future Standards

Reliability Data

- Shop Tear Down Report
- Line Removal Data

Permanent Bar Code Identification of Parts

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The FAA wants this piece!

Traceability/Authentication of Parts

Permanent Bar Code Identification of Parts

Legend:
- Existing Standards
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Reliability Data
- Shop Tear Down Report
- Line Removal Data
- Flight Hrs & Landings

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Functional and Data Architecture

Permanent Bar Code Identification of Parts

Traceability/Authentication of Parts

Legend:

- Existing Standards
- ‘In-Process’ Standards (June 2002)
- Future Standards

These are being currently worked!

Reliability Data

- Shop Tear Down Report
- Line Removal Data
- Schedule Interruption Data
- Pilot, Cabin, Maint. Log
- Flight Hrs & Landings

Purchasing

Warranty

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Functional and Data Architecture

Traceability/Authentication of Parts

Permanent Bar Code Identification of Parts

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Functional and Data Architecture

Permanent Bar Code Identification of Parts

Traceability/Authentication of Parts

This is the hardest one! (which Serial # is actually in there?)

Legend:

- Existing Standards
- ‘In-Process’ Standards (June 2002)
- Future Standards

Reliability Data

- Shop Tear
- Down Report
- Line Removal
- Data
- Schedule
- Interruption Data
- Pilot, Cabin, Maint. Log
- Flight Hrs & Landings

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Functional and Data Architecture

Permanent Bar Code Identification of Parts

Legend:

Existing Standards

‘In-Process’ Standards (June 2002)

Future Standards

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These will happen in the future!
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### SPEC2000 Bar Code Taskforce

### Functional and Data Architecture

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**Legend:**
- **Existing Standards**
- **‘In-Process’ Standards** (June 2002)
- **Future Standards**

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Historically, real parts traceability is done poorly and is very expensive.

- Most parts tracked by Serial # within Part # it hasn’t worked!
- Three logic flaws
  - Airlines/operators invent their own numbering systems for parts
  - When form / fit / function changes - new Part # required
    - this effectively loses the ability to track it
  - No control between companies of Part Numbers assigned, no legal ‘teeth’ regarding bogus parts

The business problem we’re trying to solve is one of Part identification and traceability.
How much does it cost you to make an error?
Benefits of Bar Code Technology

1) Touch typists average 1 error every 30 characters
2) Bar code errors occurs once every 3 million characters!

How many touch typists in your production areas?
What’s this?

263265930

Part Number?

Serial Number?

Location?

Order Number?

Employee Number?

SSN without the dashes?

Who knows ???

This is a NAKED number with no intelligence whatsoever!
Example of an Intelligent Number

Serial Number showing the Text Element Identifier (TEI)

Simple, plain text, WYSIWYG, easy for people - easy for computers
Tracking Parts - the Solution
SPEC2000 Permanent Bar Code ID

What is it?
- A universal ‘Social Security Number’ for serialized parts
- Only 2 rules:
  1) unique Serial # within CAGE Code
  2) label or mark lasts the life of the part

Easy to understand,
Easy to communicate

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Benefits of SPEC2000 Implementation

- **Every piece of data is intelligent**
  - the electronic data (quotes, orders, adv. shipping notice, etc.) and the bar coded data (shipping labels, perm. bar code ID) both use the same data identifier

- **Bar coded data and HRI allows for business transitions**
  - Human readable data allows for existing business systems to continue, and allows for more advanced companies to benefit from Auto ID savings.

- **Bar coded data and HRI allows for manual fail-over**
  - Human readable data is included with all bar codes to allow manual processes to continue when technology fails
What is SPEC2000 Perm. Bar Code ID?

- It is an ISO TS21849 specification
- It is used by 1000+ international companies
- It is adopted by the Aerospace Industries Association (AIA)
- It is adopted by the railroad industry
- It is used in some automotive companies
- It is used in several military programs
  - C17, CH47 Helicopter, torpedo marking
So why do we want to mark parts?

1. We have too much money and we need to spend it.
2. We want to look busy for the rest of our careers.
3. We are mentally unstable.

Marking parts is a cost - not a benefit!

The common identification and tracking of the part has ALL the benefits!
SPEC2000 Part Marking Data

How much? What kind of data?

- For new parts, 3 pieces of data required:
  » **MFR** Code – manufacturer’s CAGE Code
  » **SER** # - unique Serial # within the CAGE Code
  » **PNR** # - manufacturer’s Part #

- How does SPEC2000 Data Dictionary define these?
  » **MFR** = 5 characters, A/N, assigned by the DoD once
  » **SER** = 1→ 15 characters, A/N, dash (-) is only special char.
  » **PNR** = 1→ 15 characters, A/N, dash (-) is only special char.
### SPEC2000 - An Industrial Standard for this Millennium

**For New Parts:**

<table>
<thead>
<tr>
<th>Data Elements</th>
<th>1-D Linear Barcode (Preferred on Data Plates)</th>
<th>2-D Data Matrix (Preferred on Direct Part Marking)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MFR / SER</strong></td>
<td><img src="image1" alt="MFR 12345" /> <img src="image2" alt="SER ABC123" /></td>
<td><img src="image3" alt="MFR 12345" /> <img src="image4" alt="SER ABC123" /> (see Note)</td>
</tr>
<tr>
<td><strong>or</strong></td>
<td><img src="image5" alt="USN 12345ABC123" /></td>
<td><img src="image6" alt="USN 12345ABC123" /></td>
</tr>
<tr>
<td><strong>USN (= MFR+SER)</strong></td>
<td><img src="image7" alt="PNR F100F200" /></td>
<td><img src="image8" alt="PNR F100F200" /> (Conditional on DPM Applications)</td>
</tr>
<tr>
<td><strong>PNR</strong></td>
<td><img src="image9" alt="DMF 082000" /></td>
<td><img src="image10" alt="DMF 082000" /></td>
</tr>
<tr>
<td><strong>DMF</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
Human Readable Interpretation does NOT include embedded slash “/” but the data does include it. A Carriage Return is not embedded in the 2D Data Matrix.
Example of SPEC2000-Formatted PERMANENT ID DATAPLATE

Permanent Identifier

“Current” Part #
For very small parts, **2D Data Matrix bar code symbology** was approved in June 1998.

MFR 12345
SER ABC123
PNR 100200300400A
Direct Part Mark (DPM) Technologies

- Dot Peen
- Laser Etch
- Laser Bonding
- Chemical Etch
- Micro Milling
- Inkjet
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Telesis Marker

Dot Peen

2D Part Marking Equipment

Dapra Marker

Laser

RVSI Fixed Station Reader

Mx1000 w/ 2 Camera Boxes

Modified Blade Box

RVSI Hand-Held Reader
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Examples of

Square and Rectangular Data Matrix

Dot Peen Technology
Examples of Laser Etching
high quality, very small bar codes on a pin head
# For In-Service Parts:

<table>
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<tr>
<td>SPL / UCN</td>
<td>SPL 54321</td>
<td>SPL 54321/UCN 123ABC</td>
</tr>
<tr>
<td></td>
<td>UCN 123ABC</td>
<td><strong>Note:</strong> Human Readable Interpretation does NOT include embedded slash &quot;/&quot; but the data does include it. A Carriage Return is not embedded in the 2D Data Matrix</td>
</tr>
</tbody>
</table>

or

| UST (= SPL+UCN) | UST 54321123ABC | UST 54321123ABC |

Other Data Elements

Other data elements shown above may also be included.
Confused about what makes up a SSN?

**New SSN:**
- MFR xxxxxx
- SER yyyyyy...

**In-Service SSN:**
- SPL xxxxxx
- UCN yyyyy...

PNR is the current, manufacturer’s Part #
DMF is conditional on New Parts, doesn’t apply for In-Service Parts
SPEC2000 Part Marking Data

**Is there another way to mark parts?**

- Yes, the same **DATA** can be concatenated into one # called a **Universal Serial Number**
  
  » **USN** = the **CAGE Code** + **Unique Serial #**

  - **Example:** MFR 2D67A ➔ USN
    
    SER 1234567
    
    2D67A1234567

**How can you tell what data is where?**

- CAGE Code is always first 5 characters
- Whatever remains is the unique Serial #

**Pros and cons?**

- Good for very small parts; not good for long numbers
- Harder for people if typing; slightly harder for systems
Questions about Unique Serial #s

- See addendum in printed document
- Questions:
  - How complicated is this?
  - Won’t the data rules restrict the Serial Numbers?
  - Won’t we run out of numbers?
  - Won’t we need a centralized system to control all the numbers?
  - Sequential Serial #s are important to use for our warranty?
  - We have always serialized within the Part #. How can we move forward without discarding everything?
  - Our Serial #s are randomly assigned and out of my control. How do I handle that?
  - What about company mergers? Won’t that cause duplicate Serial #s?
So how **should** I mark my parts?

- **Forget the bar code!**
  - create a unique Serial Number system first

- **The preference** for Serialized Part Marking
  - **Labels**: Data Plates or Polyester Labels, if appropriate
    » Data: CAGE Code, unique Serial #, Part # on 2nd label
    » Bar code: on existing data plate using Code 128 symbology
  - **Direct Part Marking**
    » Data: CAGE Code, unique Serial #, Part # in 2nd bar code
    » Bar code: 2D Data Matrix symbology using laser etch/dot peen

We’re aiming at lowest cost, most ubiquitous use of the **data**!
Permanent Bar Code ID on Parts – Benefits - WIIFM

- parts can be tracked from cradle-to-grave
- easy, error-free data entry to improve tracking
- social security number for every company to use: OEM, airframer, airline, repair shop, distributor
- no clearinghouse to allocate serial numbers
- works for In-Service parts as well as new parts
- meets FAA/JAA regulations and Best Commercial Practice
- works in today’s “open systems” world
- allows industry to share data: e.g., traceability, reliability, composition, supply chain collaboration
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## SPEC2000 Bar Code Taskforce

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### Traceability/Authentication of Parts

- Permanent Bar Code Identification of Parts

### Legend:

- **Existing Standards**
- ‘In-Process’ Standards (June 2002)
- Future Standards

---

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## TRACEABILITY Database Example

**Min. Traceability Standard**

<table>
<thead>
<tr>
<th>CAGE Code</th>
<th>Serial Number</th>
<th>Current Part #</th>
<th>Action</th>
<th>Action Date</th>
<th>Action company</th>
<th>OEM</th>
<th>Original Serial #</th>
<th>Aircraft Number</th>
<th>Condition Code</th>
<th>Internal Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>61G49</td>
<td>1234567</td>
<td>F7DTR36</td>
<td>RMV</td>
<td>23/11/99</td>
<td>83PH4</td>
<td>Collins</td>
<td>T52D6110</td>
<td>UA3482</td>
<td>UNS</td>
<td>Shop 141</td>
</tr>
<tr>
<td>91673</td>
<td>83H6290</td>
<td>889073L8</td>
<td>INS</td>
<td>23/11/99</td>
<td>83PH4</td>
<td>Collins</td>
<td>83H6290</td>
<td>UA3482</td>
<td>SRY</td>
<td>UA3482</td>
</tr>
<tr>
<td>91673</td>
<td>SS12932</td>
<td>919846</td>
<td>SCP</td>
<td>24/11/99</td>
<td>83PH4</td>
<td>Honeywell</td>
<td>H12933</td>
<td></td>
<td>UNS</td>
<td></td>
</tr>
<tr>
<td>1283S</td>
<td>836</td>
<td>LPY67EF</td>
<td>INS</td>
<td>23/11/99</td>
<td>83PH4</td>
<td>Lucas</td>
<td>UA5224</td>
<td>SRY</td>
<td>UA3482</td>
<td></td>
</tr>
<tr>
<td>91673</td>
<td>9943</td>
<td>28374-22</td>
<td>OVH</td>
<td>30/11/99</td>
<td>83PH4</td>
<td>Boeing</td>
<td></td>
<td>SRY</td>
<td>Shop 180</td>
<td></td>
</tr>
<tr>
<td>83845</td>
<td>489GD5</td>
<td>938475-1</td>
<td>BLD</td>
<td>04/12/99</td>
<td>83PH4</td>
<td>GEW</td>
<td>489GD5</td>
<td>SRY</td>
<td>Delta</td>
<td></td>
</tr>
<tr>
<td>83845</td>
<td>MR32121 - 143</td>
<td>P9475-503</td>
<td>OVH</td>
<td>30/00</td>
<td>83PH4</td>
<td>Lucas</td>
<td>75463</td>
<td>SRY</td>
<td>Shop 180</td>
<td></td>
</tr>
<tr>
<td>81979</td>
<td>TS1-5221</td>
<td>7109783H</td>
<td>MRK</td>
<td>62/000</td>
<td>81979</td>
<td>EIA</td>
<td>991783</td>
<td>UA1731</td>
<td>UNS</td>
<td>Shop 142</td>
</tr>
</tbody>
</table>

**Action Codes:**
- MFG - manufactured
- MRK - marked (initialized) unit
- SHP - shipped
- INS - installed
- RMV - removed
- RPR - repaired
- OVH - overhauled
- EXC - exchanged
- SLD - sold
- SCP - scrapped
- WHR - warehoused

**Condition Codes:**
- SRY - Serviceable
- UNS - Unserviceable

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The Near Term Future

Customer A
Reliability Database
Internet
Customer B
Supplier 1
Customer C
Supplier 2
Traceability Database
Supplier 3
SPEC2000 Approach to Maintenance

Suppliers

Technical Information

Information

Database(s)
Key: common data like SSN

Warehouse

Materials Management

Maintenance Operations

Parts

SPEC 2100 Manuals

SPEC2000

Parts

Data

Data

Data

SPEC2000 - An Industrial Standard for this Millennium
Why SPEC2000?

- Only system with a SSN concept for parts
- Simple – unique Serial # within CAGE Code
- WYSIWYG – good for computer and people
- Common data definitions for eBusiness
- XML-compatible
- Established: 20 years, 1000+ companies
- It works!
The MRO Issue is Complex in our business…
but it all revolves around Quality Data

SPEC2000 insures quality data and well-defined processes for your people.
Thank You
for your attention!

For more information on Permanent Bar Code ID:

www.spec2000.com, click on Bar Coding tab
Questions?

wwwSPEC2000.com