Traceability: *Implementation and Application*
DENSO overview

DENSO in North America

<table>
<thead>
<tr>
<th></th>
<th>DENSO International America, Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>North America Regional Headquarters</strong></td>
<td><strong>Companies</strong></td>
</tr>
<tr>
<td>Companies</td>
<td>31 (13 States)</td>
</tr>
<tr>
<td>Employees</td>
<td>22,325 (15,700 U.S.)</td>
</tr>
<tr>
<td>Consolidated Revenue</td>
<td>US$10.9 billion (1,156.3 billion yen)</td>
</tr>
<tr>
<td>Operating Profit</td>
<td>US$400 million (42.5 billion yen)</td>
</tr>
</tbody>
</table>

* Figures are based on IFRS. Data is accurate as of March 31, 2018 unless otherwise stated.

* U.S. dollar amounts have been translated, for convenience only, at the rate of 110 yen = US$1, the approximate exchange rate prevailing on March 31, 2018. Billion is used in the American sense of one thousand million.
Main products: Automotive Fields

**Powertrain Systems**
Engine-related products, such as gasoline/diesel engine control systems and fuel pumps, variable valve timing-related products, and sensors, in addition to products for drive systems, such as oil pressure control valves.

**Electrification Systems**
Electrification systems and components for EV and Hybrid vehicles. Electric power supply and starting system components such as alternator and starter. Motors, such as wiper systems, power window, air conditioner.

**Mobility Systems**
AD & ADAS products such as millimeter-wave radars, image sensors, driver status monitors and airbag systems, and Connected & Cockpit products such as telematics control units and Vehicle to Vehicle / Vehicle to Infrastructure communication devices, head-up displays, meters, cockpit systems.

**Electronic Systems**
Microelectronic devices such as automotive ICs and semiconductor sensors, electronics products such as engine control computers and body control computers.

**Thermal Systems**
Air-conditioning systems for cars and buses, truck refrigeration units, related air-conditioning products, radiators, and cooling systems.
What is Traceability

... the ability to trace the history, application or location of an entity by means of recorded identifications.

ISO 8402 (Quality Management and Quality Assurance)
Traceability serves as a preventive measure by providing quick and accurate part genealogy data to **limit the scope of potential problems**.

- **Improve response time**
- **Limit the scope of containment**
- **Control costs**
- **Preserve reputations and corporate image**

Strong traceability can serve as insurance to protect against many negative effects of a quality spill.
### Expanded Risk Range

#### Tier 3

<table>
<thead>
<tr>
<th>Lot 1</th>
<th>Lot 2</th>
<th>Lot 3</th>
<th>Lot 4</th>
<th>Lot 5</th>
<th>Lot 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Suspect Lots</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lot 9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lot 10</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Lot 11</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lot 12</td>
</tr>
</tbody>
</table>

#### Tier 2

<table>
<thead>
<tr>
<th>Suspect</th>
<th>Sub ass'y</th>
<th>Sub ass'y</th>
<th>Sub ass'y</th>
<th>Sub ass'y</th>
</tr>
</thead>
</table>

#### Tier 1

<table>
<thead>
<tr>
<th>Suspect</th>
<th>Final ass'y</th>
<th>Final ass'y</th>
</tr>
</thead>
</table>

#### OEM

<table>
<thead>
<tr>
<th>Suspect</th>
</tr>
</thead>
</table>

**Unclear start and stop**

**Weak traceability can lead to significant increase in exposure.**
Minimized Risk Range

Strong traceability can significantly limit exposure.
Steps to DESIGNING an effective system

1. Determine Traceability needs.
2. Consider physical and logistical realities.
3. Select applicable technology.
4. Define details of inventory control.
5. Design system for effective data storage and retrieval.

Take time to PLAN and avoid rushing into IMPLEMENTATION.
Traceability Needs

Focus on CRITICAL Components and Processes

1. Customer specific requirements.
2. High SEVERITY FMEA items.
4. Safety and critical failure.
5. PPH (zero-mile and field).

Apply a structured approach to selection of key trace items.

CQI-28 AIAG Traceability Guideline 1st Edition
Physical and Logistical Considerations

- **Physical size**
- **Material type**
- **Identifier durability**
- **Transportation medium**

Understand physical and logistical constraints.
Technology Alternatives

1. Label
2. Ink Jet
3. Micro percussion (metals, plastics, ceramics)
4. Laser
5. RFID
6. Memory (electronics)

Many options ... choose wisely.
Inventory Control

1. FIFO

2. Prevention of mixed lots

3. Rejection and Rework control

4. Plan for Service production

A few items easy to overlook.

CQI-28 AIAG Traceability Guideline 1st Edition
Retention and Retrieval

1. Retention period: legal, regulatory, customer requirements, internal risk
2. Electronic storage
3. Network linked
4. Remote accessible
5. Searchable / useable
Two elements:

- **Trace Unit (lot size)**
- **Trace Time (time to assemble suspect information)**

Adopt a standard appropriate for your situation.
DMAT Overview

DENSO Manufacturing Athens Tennessee, Inc. (DMAT)
DENSO utilizes a 9-Gate Quality Management System. Early planning is necessary to avoid extra costs for proper traceability.
5 Main Components and Their Functions

1. **Plunger** - Driven by the Cam Shift, Downward motion drives suction force, upward motion Pressurizes Fuel and Drives Fuel Out the Delivery Valve.

2. **Solenoid Controlled Valve** - Controls Delivery Flow Rate and Volume by Timing. When a Signal is Applied the Rod, Armature Closes and Acts as the Barrier Between the High Pressure and Low Pressure Chambers Inside the Pump.

3. **Damper** - Pressure Pulsation is Decreased by Damper Deformation. Acts as a Low Pressure Chamber Inside the Pump

4. **Delivery Sub-Assembly** - Delivers Fuel to the Fuel Rail. Comprised of the Delivery Valve and the Relief Valve. The Relief Valve Opens to Reduce Rail Pressure when Exceedingly High Pressure Occurs in the Fuel Rail.

5. **O-Ring** - Acts as the Oil Seal between the Pump and the Engine Cylinder Head
## HPP Assembly Traceability Matrix

<table>
<thead>
<tr>
<th>Part Name (Assembly)</th>
<th>Critical Control</th>
<th>Required Rank</th>
<th>Actual Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>V</td>
<td>III</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IV</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Final and sub-assembly BOM items.**

Traceability planning matrix to ensure Sub-assy / ASSYs meet required rank based on Critical Control designation.
Assemblies and Sub-Assemblies utilizing required traceability
**HPP Component Traceability Matrix**

Same strategy utilized for Component Supply chain

<table>
<thead>
<tr>
<th>Part Name (Component)</th>
<th>Critical Control</th>
<th>Required Rank</th>
<th>Actual Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>V</td>
<td>IV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 piece</td>
<td>1 box</td>
</tr>
<tr>
<td>Lower level BOM items.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
HPP Traceability in Practice

**<Rank V>** Per Piece ID
- Delivery S/A
  - Flange S/A
  - Print 2D code (by laser marking)

**<Rank IV>** Per Magazine ID
- Kanban
- Transfer to magazine
- ID Info Read
- Machine
- Line controller
- Lot Control Server
- Up-Load
- Up-Load
- Dedicated equipment required (for each line)

**<Rank III>** Per Lot ID
- Up-Load
- Take out paper (large batch)
- Transfer to magazine
- Upload into server before washing
- Washing Assy
- Washing Assy
100% traceable to inventory and transportation locations.