A Review of the Automotive Industry’s Material Content Reporting Requirements

Texas Instruments Incorporated
Sensors & Controls

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Member Technical Staff
Introduction – Texas Instruments

Directive 2000/53/EC on End of Life Vehicles (ELV)

Material Content Reporting Options

International Material Data System (IMDS)

Review of IMDS
  - System Description
  - Format of Submissions
  - Other IMDS Tasks

Conclusions
Texas Instruments Incorporated

Striving to be the World’s Premier Electronics Company

R E A L  W O R L D  S I G N A L  P R O C E S S I N G ™

2002

TI Revenues ($Million)

<table>
<thead>
<tr>
<th>Category</th>
<th>Revenue ($Million)</th>
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<tbody>
<tr>
<td>Semiconductor</td>
<td>6,944</td>
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<tr>
<td>Sensors &amp; Controls</td>
<td>958</td>
</tr>
<tr>
<td>Educational &amp; Productivity Solutions</td>
<td>494</td>
</tr>
</tbody>
</table>

Innovate. Create. Make the Difference™
Introduction: Sensors & Controls

- S&C Comprised of three major business units:
  - Sensors
  - Controls
  - Radio Frequency Identification

- More than 6,000 employees around the globe

- Technology Development and Manufacturing in nine locations in the Americas, Asia and Europe
Introduction: Sensors & Controls
S&C manufactures sensors that are used in various automotive systems.

Supply to all the major automakers directly as a tier one supplier or through others as a sub-tier supplier.

IMDS Entry Requirements:
- existing product lines
- new product lines (PPAP)
- 50% - 70% complete
EC Directives (WEEE; ROHS & ELV)

- Directive on Waste Electrical and Electronic Equipment (WEEE)
- Directive on Restriction of Use of Certain Hazardous Substances (RoHS)
- Directive on End-of-Life Vehicles (ELV)

Objective is the prevention of waste from vehicles and also the reuse, recycle, & recovery of end-of-life vehicles and components, thus improving environmental performance for all economic operators involved.

Automobile producers to provide appropriate information to treatment facilities, concerning dismantling, and re-use.
Requirements of the End-of-Life Vehicle Directive:

Ban on the use of hazardous substances (lead, mercury, cadmium, hexavalent chromium) with exemptions.

Total limit @ 2.0 grams/vehicle of Cr+6 for corrosion protection purpose only; 0.0 gram for any other application in June 2003

Requirements for the re-use and recovery at vehicle end-of-life.

Achieve re-use and recyclability of at least 85% average vehicle weight by 2005 with greater percentages for 2015

Improve recycled content.

End-of-Life disposition information
End of Life Vehicles Directive

End-of-Life Vehicles Treatment: Targets to be achieved

- 85% re-use / recovery
- 80% re-use / recycling
- 95% re-use / recovery
- 85% re-use / recycling

New Vehicles

- Type Approval: 95% re-useable / recoverable
- 85% re-useable / recyclable
- free from lead, mercury, cadmium and chromium VI (exemptions listed in Annex II)
- provision of dismantling information
- delivery to treatment facility with no cost for last holder and/or owner

Vehicle Population

- delivery to treatment facility with no cost for last holder and/or owner

In 2000, the automotive manufacturers were faced with the challenge of how to meet the requirements of the End-of-Life Vehicle directive.

- Certify that their products do not contain prohibited hazardous substances.
- Demonstrate the percent of recycled content built into their products.
- Demonstrate the percent of their products that can be re-used or recycled at end-of-life.
- Provide appropriate information to treatment facilities concerning the dismantling, re-use and recycling of their products.
Development of the Automotive Manufacturer strategy:

- Starting in 1996, the Association of Automotive Manufacturers established a procedure for the collection of material content data (Material Data Sheets).

- Concurrently, investigation began on automated systems for providing/obtaining material content data:
  - Individual queries of each and every supplier regarding the material content of their products
  - Product Material Content Web (or equivalent) to be queried, as necessary
  - Product Material Content Web provided by the customer with data inputs required of the supplier

- In 1998, the Automotive Manufacturers developed an electronic system, the International Material Data System (IMDS at http://www.mdsystem.com).
End of Life Vehicles Directive

- Individual Material Content Declarations

Each supplier certifies that the materials of concern are **not** contained in their product.
■ Individual Material Content Declarations

Ticona

Via FAX: 508-236-2077

November 10, 2003
GSK/402/03

Mr. Russ Brodeur
Texas Instruments, Inc.

Dear Mr. Brodeur:

As per your request, I have reviewed the formula of Ticona’s Fortron® 1140L and it does not use cadmium, lead, mercury, hexavalent chromium, PBB or PBDE in its formula nor its process.

Sincerely,

G. S. Kirshenbaum
Manager, Product Safety

GSK/rr

cc: F. Lach

Dear Sirs,

Un-using of regulation substances

Our company guarantees that the specified substances are not contained about the beryllium copper alloy sold over to your company.

Object material: Beryllium copper alloy

Respectfully yours,

NGK INSULATORS, LTD.
New Metals Division
Environmental Control

Yasuhiro Miyamoto
Each supplier maintains a website providing information on the content of their products.
Material Content Web Sites
-- by specific product
-- by product family

(June 3, 2002)

CERAMIC R.F. TRANSISTOR PACKAGES WITH STUD

<table>
<thead>
<tr>
<th>Name of the part</th>
<th>Material weight (mg)</th>
<th>Material name</th>
<th>Material analysis (element)</th>
<th>Material analysis (weight%)</th>
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<tbody>
<tr>
<td>Stud</td>
<td>1367</td>
<td>Cu-Alloy</td>
<td>Cu</td>
<td>99.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Fe</td>
<td>0.1</td>
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<tr>
<td>Heatspreader</td>
<td>120</td>
<td>Ceramic Gold plated</td>
<td>BeO</td>
<td>99.7</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Au</td>
<td>0.3</td>
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<td>Lid</td>
<td>139</td>
<td>Ceramic</td>
<td>Al₂O₃</td>
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<tr>
<td>Leads</td>
<td>265</td>
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<td>Fe</td>
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<td>Wires</td>
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<td>Gold</td>
<td>Au</td>
<td>99.99</td>
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</table>

Table of main material declaration - Family representative: M122

<table>
<thead>
<tr>
<th>Pin Count</th>
<th>Package Body Size (L x W x H)mm</th>
<th>Package Total Mass (gms)</th>
<th>Constituent</th>
<th>Substance</th>
<th>Amount of Substance (mg)</th>
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<tr>
<td>44</td>
<td>14 x 14 x 14</td>
<td>0.68</td>
<td>Epoxy</td>
<td>Polyester</td>
<td>4.1</td>
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<td>52</td>
<td>14 x 14 x 14</td>
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<td>64</td>
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<td>Epoxy</td>
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<td>80</td>
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<td>100</td>
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<td>Polyester</td>
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<td>120</td>
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<td>Epoxy</td>
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<td>128</td>
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<td>Epoxy</td>
<td>Polyester</td>
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<td>160</td>
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<td>0.85</td>
<td>Epoxy</td>
<td>Polyester</td>
<td>4.1</td>
</tr>
</tbody>
</table>

1. Pin count 44 made with lead frame alloy 42 option contains 766 mg Ni and 189 mg Fe.
End of Life Vehicles Directive

- Material Content Data submitted to a 3rd Party

Each supplier submits detailed product content data to a 3rd party.
End of Life Vehicles Directive

- Bitte beachten Sie die Einträge unter Aktuell und FAQs auf den öffentlichen Seiten.
- Please be aware of News and FAQ entries on the public pages.
IMDS provides a common method for identifying materials, substances and attributes. Suppliers proactively send material composition information.

IMDS manages aggregated data sent forward through the supply chain.
End of Life Vehicles Directive

Why IMDS?

- Several automakers have attributed the IMDS format on the ELV requirements for the automakers to supply information on recycled content, end-of-life recyclability, and specific chemical-specific (Cr+6 weight) data.

From DaimlerChrysler Corp. Characteristics Standard, CS-9003

| TABLE 2: STRATEGIC RECYCLABILITY OF VEHICLE INTRODUCED IN THE FOLLOWING MODEL YEAR (1) |
|-----------------------------------|---|---|---|---|---|---|
| New Models                        | 80%  | 82%  | 82%  | 85%  | 95%  | 95%  |
| Carryover Models                  | 75%  | 80%  | 82%  | 85%  | 85%  | 95%  |

(1) All values are by weight and include 5% for energy recovery. Values after 2002 for new models have a 10% energy recovery value included. For both new and carryover models after 2010 a 10% energy value applies.
IMDS: One Certification Procedure for the Industry

End of Life Vehicles Directive
Supplier Responsibilities in IMDS.

- It is the position of the automotive manufacturers that suppliers are responsible for both entering their data into IMDS and rolling data entry requirements to their suppliers.

- Tier One suppliers to cascade information to their suppliers.
  - Suppliers Register into IMDS.
  - Report the material content of their products directly into IMDS
  - Tier One suppliers retrieve the information from IMDS and report to the Automotive Manufacturers.

- Penalties for Suppliers who fail to input data.

- Preference for Suppliers with products without restricted materials.
SUPPLIER COMPLIANCE

– Accountability
  • PPAP
  • Scorecard – Deduct 5 Points from Supplier Delivery Rating
  • Terms and Conditions
• From 1996 to 2000, Automobile Manufacturers required submission of material content data via hardcopy Material Data Sheets.
• In September 2000, automakers who developed IMDS issue statement to CEOs of Tier One suppliers of impending requirements.
  • Suppliers input data on four materials of concern (Cr\textsuperscript{6+}, Hg, Pb, Cd). European platforms first, then other geographies.
  • Suppliers input data on 100% of material content, certify labeling of polymeric parts, and % of recycled content.
  • Most companies (Ford, GM, Visteon, etc.) have made demonstration of IMDS entry a requirement to any PPAP document approval.
### Vehicle Manufacturers' IMDS Deadlines

<table>
<thead>
<tr>
<th>OEM</th>
<th>Location</th>
<th>Requirements</th>
<th>Due Date</th>
<th>Issues/Notes</th>
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<tbody>
<tr>
<td>BMW</td>
<td>Worldwide</td>
<td>Full IMDS declaration, all models</td>
<td>31 Aug 01</td>
<td></td>
</tr>
<tr>
<td>Daimler Chrysler</td>
<td>Europe</td>
<td>Full IMDS declaration, all models</td>
<td>15 Jun 01</td>
<td></td>
</tr>
</tbody>
</table>
| Ford (except Jaguar, Land Rover, Volvo) | Vehicles sold in all other markets (CY2002 Req) | IMDS declaration¹, production and service parts:  
- RSMS/RSL listed substances at a minimum  
- For all RSMS listed substances: Certify polymeric parts are market; % recycled content  
Full 100% substance reporting (Full IMDS declaration) | 31 Dec 02 | Under consideration |
| GM-Fiat (except GM de Brazil and Holden) | GME, Inc. Opel, Vauxhall, Saab, Fiat  
GM North American Vehicles Operations or Powertrain | Full IMDS declaration, all other components to Opel, Vauxhall, SAAB, Fiat, GME/Fiat Powertrain  
Full IMDS declaration, all other models | 30 Sep 02  
31 Dec 03 |             |
| Jaguar, Land Rover | Europe | Same as Ford Europe |  |             |
| Porsche | Europe | Full IMDS declaration, all models | 31 May 01 | Original request  
Latest request; Minimum of ELV metals |
| Volkswagen | Europe | Full IMDS declaration, all models  
Full IMDS declaration, all models | 01 Mar 01  
31 Aug 01 |             |
| Volvo | Europe | Full IMDS declaration, all parts in production from 01W35 | 30 Jun 02 | Volvo Car’s “Black & Grey” list has been merged with Ford’s RSMS. |

### System Description

- Each Automaker has established their own schedule for entering material content information into IMDS.
- Each Automaker has defined the criteria of an acceptable IMDS entry.
Example of “Ford-specific” IMDS Requirements

- Must use IMDS as method of making material content declarations.
- All substances listed in the Restricted Substance Management Standard (WS-M99P9999-A1) must be reported.
- Ford does NOT require 100% basic substance disclosure – materials not covered by the standard can be reported as “miscellaneous.”
- A “Flat Bill of Materials” is acceptable for electronic components - materials still need to be disclosed, but transistors, resistors, etc. can be grouped together.
Example of “GM-specific” IMDS Requirements

- Must use IMDS as method of making material content declarations.
- All substances listed in the Restricted Substance Standard (GMW3059) must be reported.
- GM requires the following statement in the “Remarks” if any “joker” is used:

“The material doesn’t have any restricted or reportable substances according to GMW3059 and VDA 232-101 guidelines.”
GETTING STARTED ON IMDS

- Initial registration and obtaining an Account.
  - Texas Instruments NA (Attleboro, MA) 2883
  - Texas Instruments Europe (Almelo) 4394
  - Texas Instruments Germany (Freising) 2169
  - Texas Instruments Asia (Japan) 14299

- System originally limited access by region. Upgrades allow one account for each company (simplify data sharing)

- Establish Account Manager
  - Logon and Passwords
  - System Permissions
  - Data Sheet Management
  - Organizational Unit Assignment and Management
Managing material data sheets for the automotive industry

The International Material Data System (IMDS) enables you to create material data sheets on your computer in a secure and comfortable manner. The system offers a broad range of innovative capacities being updated continuously.

Working with the IMDS implies being up-to-date and using the extensive and fascinating services of the Internet. Material data sheet creation in a new dimension - worldwide.

For further information please contact the IMDS Service Center, available from Monday to Friday via phone +49 (0)421 5258-686 or by E-mail.

Important user information

Log on and select preferred language.
Automakers have established very specific rules regarding the format of IMDS entries.

IMDS Entry Structure:
- Component (red square)
- Sub-component (yellow circle)
- Material (green double circles)
- Element/Substance (blue triangle)

Not following the acceptable IMDS Entry Structure will result in “Rejection.”

Each company has slight variations to what they allow.
Making IMDS Entries

- Step 1: Collect Material Content Data
- Step 2: Decide on Entry Format (Normal, FBOM)
- Step 3: Enter required materials
- Step 4: Assemble Part in IMDS
- Step 5: Validate
- Step 6: Recycling Information
- Step 7: Supplier Information
- Step 8: Customer Information
- Step 9: Customer Specific Requirements
- Step 10: Send
- Step 11: Follow-up
Collect Material Account Data

- Material Content Data Input Format
  - IMDS Format:
    - TI part number
    - Supplier Number provided by Customer
    - Customer part number
  - Material Account Information
    - Total part weight
    - Detailed Material Account
    - Recyclability Characteristics
  - Supplier Information
  - Additional Information required of Customer
    - Use of the Material in the Part (Ford)
  - Customer IMDS number/identifier
93PSL2-1 / 93PSL2-3

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
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<tbody>
<tr>
<td>76118-2</td>
<td>base cap</td>
</tr>
<tr>
<td>76199-1</td>
<td>cap seal</td>
</tr>
<tr>
<td>28924-1</td>
<td>disc seat</td>
</tr>
<tr>
<td>28780-1</td>
<td>converter</td>
</tr>
<tr>
<td>28714-2</td>
<td>washer</td>
</tr>
<tr>
<td>37660-1</td>
<td>formed disc</td>
</tr>
<tr>
<td>28817-2</td>
<td>Hexport</td>
</tr>
<tr>
<td>28814-1</td>
<td>diaphragm</td>
</tr>
<tr>
<td>46705-3</td>
<td>USCAR Base</td>
</tr>
<tr>
<td>76144-1</td>
<td>o-ring</td>
</tr>
<tr>
<td>28931-1</td>
<td>gasket</td>
</tr>
<tr>
<td>76096-1</td>
<td>silicone seal</td>
</tr>
</tbody>
</table>

Collect Material Account Data

TI Product

Product Material Breakdown

Query Suppliers
# Collect Material Account Data

## Current Semiconductor Material Content Data (ECOS) acceptable for IMDS.

<table>
<thead>
<tr>
<th>Pin/Package</th>
<th>16 D</th>
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<tbody>
<tr>
<td>Package Body Size (W x L x H) mm</td>
<td>3.91x9.9x1.58</td>
</tr>
<tr>
<td>Package Total Mass (g)</td>
<td>0.1436</td>
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<tr>
<td>Comments</td>
<td>TI LF-115</td>
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</table>

<table>
<thead>
<tr>
<th>Component</th>
<th>Substance</th>
<th>CAS Number</th>
<th>Amount of Substance (mg)</th>
<th>Percentage %</th>
<th>ppm</th>
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<tbody>
<tr>
<td><strong>Bond Wire</strong></td>
<td></td>
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<td></td>
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<tr>
<td>Metallurgy</td>
<td>Gold</td>
<td>7440-57-5</td>
<td>0.19998</td>
<td>0.1393</td>
<td>1393</td>
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<tr>
<td>Trace Metal</td>
<td>Beryllium</td>
<td>7440-41-7</td>
<td>0.000002</td>
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<td>0</td>
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<td>Trace Metal</td>
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<td>Trace Metal</td>
<td>Indium</td>
<td>7440-74-6</td>
<td>0.000006</td>
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<td>Reactive Diluent</td>
<td>Proprietary Material</td>
<td></td>
<td>0.023</td>
<td>0.016</td>
<td>160</td>
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</table>
Collect Material Account Data

- One entry into IMDS that satisfies multiple TI and customer part numbers.

Material Content Data For Family Of Parts

Customer Part Numbers
Flat Bill of Materials (Rules from EDS)

- All substances have to be attached to a material. If a data creator has made a chemical analysis of a part they will still have to be able to associate the substances to specific materials.

- Material names have to be specific and generic names are not allowed (i.e. plastic portion, metal portion etc.). An end-user has to be able to make a material analysis of the part from the material data sheet.

- Restricted substances and their application have to be declared in a way that this information is available (e.g. Lead in solder) so that compliance to legal requirements can be proven.
Making IMDS Entries

Normal MDS

- Circuit board
  - Printed circuit board
    - Glass fibre
    - Glass fibre
    - Epoxy
    - Epoxy resin
  - Resistor
  - Capacitor
  - IC
  - Connector
  - Lead solder
    - Lead solder
      - Lead
      - Tin

FBOM

- Circuit board
  - Glass fibre
    - Glass fibre
  - Epoxy
    - Epoxy resin
    - 
    - 
  - Lead solder
    - Lead
    - Tin
If no restricted basic substances in the material, you declare the material is in compliance by writing the following sentence in the remark of the material-level:

“The material doesn’t have any restricted or reportable substances according to GMW3059 and VDA 232-101 guidelines.”
Entry of Material Data is currently the most common reason for Rejection.

- **Sources of Material Data**
  - Published Database
  - Acquire from Material Supplier
  - Enter yourself

- **Minimum Requirements:**
  - classification of the material (e.g. ”unalloyed steel” or ”elastomers”).

- **Basic Substance Breakout**

- **For Metals:**
  - Material Name (e.g. steel, brass)
  - Material No. (e.g. steel, iron according to EN 10027)
  - Norms/Standards (e.g. EN10027, SAE J405).
The Automotive Manufacturers response to the End-of-Life Vehicle directive provides one model for responding to the WEEE and RoHS directives.

Other industry sectors are investigating models for obtaining data similar product content data (electronics, white goods, aerospace).

Impacted industries are likely to extend the requirements of the EC directives to all of their products.

Regardless of the ultimate response model, the collection and management of Material Content Data within every company is a key task.
Final Words

- Collecting Material Content Data is a cross-functional task and takes time for a company to learn:
  - Even if your company isn’t yet impacted by material content reporting requirements, it is worthwhile to begin collecting content data about your products (starting with Cr⁶⁺, Hg, Pb, Cd).
  - Level of effort necessary to collect data can be significant.
  - Be in front of the curve when material content reporting requirements for your industry arrive.

- Changing product material content takes time/effort. Begin looking for technology platforms that avoid use of materials prohibited by the directives.