ISO TC 184/SC 4 - Industrial data

Stand der Normung und Tätigkeit der Arbeitsgruppe zu

STEP

(Standard for the exchange of product model data)

nach Quelle:
Howard Mason, BAE SYSTEMS (BOS/N27)
Product Data Exchange/Sharing

- Industry requires complete, accurate and timely data exchange and use
  - Between all the participants in a value chain
  - Throughout the entire life cycle
  - Across all business functions
- Consistent models
- Common vocabulary
- Consistent reference data
- Information quality
ISO TC184/SC4 Organization

TC 184
Technical Committee 184 for Industrial Automation Systems and Integration

Secretariat
SC4 - Subcommittee 4 for Industrial Data

WG2
Parts Library

WG3
Product Modeling

WG8
Mfg. Mgmt Data

JWG9
Electrical/Electronic Applications

WG11
EXPRESS Language, Implementation, and Conformance Methods

WG12
SC4 Common Resources

PPC

SC1 - Subcommittee 1 for Physical Device Control

SC2 - Subcommittee 2 for Robots for Manufacturing Environments

SC5 - Subcommittee 5 for Architecture, Communications & Integration Framework

Secretariat

ISO
Participation

- 20 P-members
- 13 O-members
- 42 A-liaisons

- Approximately 200-250 experts, attending three working meetings a year with average attendance of 120
- Increasing profile in large industry
  - Commitment by US DoD, UK MoD
  - Industrial seminars
  - Links to major initiatives, such as DoD UID
## ISO TC184/SC4 Standards

<table>
<thead>
<tr>
<th>Standard</th>
<th>ISO Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEP</td>
<td>ISO 10303</td>
<td>Product data representation and exchange Standard for the exchange of product model data</td>
</tr>
<tr>
<td>PLIB</td>
<td>ISO 13584</td>
<td>Parts library</td>
</tr>
<tr>
<td>MANDATE</td>
<td>ISO 15531</td>
<td>Industrial manufacturing management data exchange</td>
</tr>
<tr>
<td>OIL &amp; GAS</td>
<td>ISO 15926</td>
<td>Integration of lifecycle data for process plants including oil and gas production facilities</td>
</tr>
<tr>
<td>PSL</td>
<td>ISO 18629</td>
<td>Process specification language</td>
</tr>
<tr>
<td>IIDEAS</td>
<td>ISO 18876</td>
<td>Integration of industrial data for exchange, access, and sharing</td>
</tr>
<tr>
<td>OTD</td>
<td>ISO 22745</td>
<td>Open technical dictionary</td>
</tr>
<tr>
<td>ISO 20542</td>
<td>Reference model for systems engineering</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------------------</td>
<td></td>
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<tr>
<td>ISO 22720</td>
<td>ASAM Open Data Services</td>
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</tr>
<tr>
<td>IFC</td>
<td>ISO 16739</td>
<td>Industry Foundation Classes</td>
</tr>
</tbody>
</table>

ISO TC184/SC4 Standards ctd.
STEP – ISO 10303

- An International Standard for the computer-interpretable representation and exchange of industrial product data.

- The objective is to provide a mechanism that is capable of describing product data throughout the life cycle of a product, independent from any particular system.
Industrial Data: The Business Context

Today’s global enterprises are seeking:

- Improved time to market
- Ability to rapidly build alliances
- Improved product quality and reliability
- Delivery of improved customer satisfaction
- Reduced cost of production and support

…in an environment characterised by ....

- Increased product functionality and complexity
- Software linked to hardware configuration
- Demand for more complete product information
The Industry Response

- Installation of computer systems, offering:
  - Unambiguous product definition
  - Improved accuracy
  - Greater speed
  - Improved quality
  - Reduced costs of rework
  - Additional analysis

- New processes, such as concurrent engineering
Implications of C A E

- Increased use of computer systems for different applications
- Digital data as sole authority
- Product data held in digital form represents major investment
- Use of product data where and when it is needed, in a suitable form
  - throughout the extended enterprise
  - throughout the life of the product
- Barriers to communication can arise from:
  - Different ways of using the same system
  - Different systems hold data in different forms
  - New systems and technologies
The Resulting Business Problems

- Recreation or duplication of data leads to inconsistencies
- Increased partnership developments requiring effective data exchange
- Inflexibility in subcontracting
- Internal data management capabilities limit business process re-engineering
- Customer demand for data with the product
SC4 Mission Statement

◆ The mission of SC4 is to
  
  – develop and promulgate standards for the representation of scientific, technical and industrial data,

  – to develop methods for assessing conformance to these standards, and

  – to provide technical support to other organizations seeking to deploy such standards in industry
What is Industrial Data?

- **Product Definition data**
  - Long life span - 30-50 years
  - Large, complex products, needing configuration management

- **Component Libraries**
  - Different views - geometry, metadata
  - Different forms of lists - explicit, algorithm, class

- **Data Warehousing**
  - Simpler model, data driven

- **Manufacturing Management data**
  - Factory resource and control

- **Process Specification**
Example

- Aerospace has a number of key characteristics that demand the management and control of Product Data:
  - Long and complex supply chain ~ 10,000 suppliers
  - Long product lifecycle - several times that of software
  - Information delivered to customer with product
  - Global industry, global customers
Role of PDE (Product Data Exchange) Between Companies

Enables Consistent and Timely Data Sharing by Participants
Role of PDE Between Functions

Product Design

Engineering Analysis

Product Support

Manufacturing Planning

Manufacturing Control

Enables Complete and Accurate Data Exchange and Use
Model-Centric Standards-based Spacecraft Development

**Fluid Dynamics**
- **Standard**: CFD
- **Software**: -
- **Status**: In Development, Boeing

**Optics**
- **Standard**: NODIF
- **Software**: - TBD, Minolta, Olympus

**Structural Analysis**
- **Standard**: AP209
- **Software**: MSC Patran, Thermal Desktop
- **Status**: In Production, Lockheed Martin, Electric Boat

**Thermal Radiation Analysis**
- **Standard**: STEP-TAS
- **Software**: Thermal Desktop, TRASYS
- **Status**: In Production, ESA/ESTEC, NASA/JPL & Langely

**Machining**
- **Standard**: STEP-NC/AP224
- **Software**: Gibbs, STEP-Tools, Boeing
- **Status**: In Development / Prototyped

**Propulsion**
- **Standard**: AP203, AP214
- **Software**: Pro-E, Cadds, SolidWorks, AutoCad, SDRC IDEAS, Unigraphics, others
- **Status**: In Production, Aerospace Industry Wide, Automotive Industry

**Electrical Engineering**
- **Standard**: AP210
- **Software**: Mentor Graphics
- **Status**: Prototyped, Rockwell, Boeing

**Cabling**
- **Standard**: AP212
- **Software**: -
- **Status**: Prototyped, Daimler-Chrysler, ProSTEP

**Software Engineering**
- **Standard**: UML - (AP233 interface In Development)
- **Software**: Rational Rose, Argo, All-Together
- **Status**: In Production, Industry-wide

**Mechanical Engineering**
- **Standard**: AP203, AP214
- **Software**: Pro-E, Cadds, SolidWorks, AutoCad, SDRC IDEAS, Unigraphics, others
- **Status**: In Production

**Systems Engineering**
- **Standard**: AP233
- **Software**: Statemate, Doors, Matrix-X, Slate, Core, RTM
- **Status**: In development / Prototyped, BAE SYSTEMS, EADS, NASA

**PDM**
- **Standard**: STEP PDM Schema/AP232
- **Software**: MetaPhase, Windchill, Insync
- **Status**: In Production, Lockheed Martin, EADS, BAE SYSTEMS, Raytheon

**Inspection**
- **Standard**: AP219
- **Software**: Technomatics, Brown, eSharp
- **Status**: In Development, NIST, CATIA, Boeing, Chrysler, AIAG

**Life-Cycle Management**
- **Standard**: PLCS
- **Software**: SAP
- **Status**: In Development, BAE SYSTEMS, Boeing, Eurostep

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Prof. Dr.-Ing. Reinhard Möller
Automatisierungstechnik / Prozessinformatik
Bergische Universität Wuppertal
Vorlesung CAD-M /CAD-E
2001-12-16 - Jim U'Ren, NASA-JPL
File: SLIDE_STEP-in-Spacecraft-Development-Ver4.ppt
Scope of STEP

STandard for the Exchange of Product Model Data

Describes product data throughout the product lifecycle.

ISO 10303

Product Life Cycle

- As Defined Configurations
- As Planned Configurations
- As Built Configurations
- As Maintained Configurations
Application protocols provide a standard data definition for a business function, process or application.

APs define a mapping from an Application Reference Model in user terms to a standardised interpretation of the Integrated Resources - equivalent to an Implementation Convention.

The Integrated Resources may expand over time.
Towards Standards-based PLM Frameworks

Model-centric view (vs. Tool-centric view)

**Traditional Tools**
- **Electrical CAD Tools**
  - Eagle
  - Mentor Graphics
- **Mechanical CAD Tools**
  - Pro/E
  - CATIA
- **Systems Engineering Tools**
  - Doors
  - Slate

**Standards-based Submodels**
- AP210
- AP203, AP214
- AP233, SysML

**Collective Product Model**
- Building Blocks:
  - Information models & meta-models
  - International standards
  - Industry specs
  - Corporate standards
  - Local customizations
  - Modeling technologies:
    - Express, XML, UML, OWL, COBs, ...
    - STEP-Book AP210, SDAI-Edit, STI AP210 Viewer, ...

**Gap-Filling Tools**
- XaiTools
- PWA-B
- pgef
- EPM, LKSoft, STI, ...

**PWB Stackup Tool, ...**

**Engineering Framework Tool**

**Instance Browser/Editor**
### STEP, XML, UML Capabilities regarding Engineering/Technical Domains

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Aspect</th>
<th>Classical STEP</th>
<th>XML</th>
<th>UML</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Information Modeling</strong></td>
<td>Capability:</td>
<td>High (+)</td>
<td>High (-)</td>
<td>High (-)</td>
</tr>
<tr>
<td></td>
<td>Popularity:</td>
<td>Narrow</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Implementation Methods</strong></td>
<td>Capability:</td>
<td>High (-)</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Popularity:</td>
<td>Narrow: pre-web</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td><strong>Standardized Content</strong></td>
<td>Breadth:</td>
<td>High</td>
<td>Medium</td>
<td>Medium (s/w+)</td>
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<tr>
<td></td>
<td>Depth/Richness:</td>
<td>High</td>
<td>Medium+</td>
<td>Medium+</td>
</tr>
<tr>
<td></td>
<td>Coordination:</td>
<td>High</td>
<td>Low (islands)</td>
<td>Medium</td>
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<tr>
<td></td>
<td>Usage:</td>
<td>Broad (MCAD),</td>
<td>Broad (some),</td>
<td>Broad (some),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>plus Limited /</td>
<td>plus Emerging</td>
<td>plus Emerging</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Emerging (others)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** “Next-wave STEP” is adding XML and UML implementation methods (a.k.a. Parts 28 and 25)

**Complementary Strengths**
Application Protocols map the user view into the STEP data models

EXPRESS Data Definition Language

Product Data - the STEP Integrated Resources

STEP Physical File

SDAI Database

Binding C, C++ IDL

XML Early & Late
### APPLICATION PROTOCOLS AND ASSOCIATED ABSTRACT-TEST SUITES

<table>
<thead>
<tr>
<th>Application Protocols</th>
<th>Abstract-Test Suites</th>
</tr>
</thead>
<tbody>
<tr>
<td>I 201 Explicit draughting [ATS 301 = X]</td>
<td>C 221 Functional data &amp; their schem rep for process plant [X]</td>
</tr>
<tr>
<td>I 202 Associative draughting [X]</td>
<td>X 222 Design-manuf for composite structures [W]</td>
</tr>
<tr>
<td>I 203 Configuration-controlled design (c2=I,a1=I)[X]</td>
<td>X 223 Exch of design &amp; mfg product info for cast parts [@]</td>
</tr>
<tr>
<td>I 204 Mechanical design using boundary rep [I]</td>
<td>I 224 Mech pdt def for p. plg using mach’n’g feat (c2=X,e3=A)</td>
</tr>
<tr>
<td>X 205 Mechanical design using surface rep [W]</td>
<td>I 225 Building elements using explicit shape rep [C]</td>
</tr>
<tr>
<td>X 206 Mechanical design using wireframe [X]</td>
<td>X 226 Ship mechanical systems [C]</td>
</tr>
<tr>
<td>I 207 Sheet metal die planning and design [I]</td>
<td>I 227 Plant spatial configuration(e2=C) [X]</td>
</tr>
<tr>
<td>X 208 Life-cycle product change process [X]</td>
<td>X 228 Building services: HVAC [X]</td>
</tr>
<tr>
<td>I 209 Composite &amp; metal structural anal &amp; related design[X]</td>
<td>X 229 Design &amp; mfg product info for forged parts[X]</td>
</tr>
<tr>
<td>I 210 Electronicassy, interconnection &amp; packaging design [X]</td>
<td>X 230 Building structural frame: steelwork [X]</td>
</tr>
<tr>
<td>X 211 Electronic P-C assy: test, diag, &amp; remanuf[X]</td>
<td>X 231 Process-engineering data [X]</td>
</tr>
<tr>
<td>I 212 Electrotechnical design and installation [C]</td>
<td>I 232 Technical data packaging: core info &amp; exch [I]</td>
</tr>
<tr>
<td>X 213 Num control (NC) process plans for mach’d parts [X]</td>
<td>W 233 Systems engineering data repr (to be PAS 20542)[X]</td>
</tr>
<tr>
<td>I 214 Core data for automotive mech design processes (e2=E)[F]</td>
<td>X 234 Ship operational logs, records, and messages[X]</td>
</tr>
<tr>
<td>E 216 Ship moulded forms [X]</td>
<td>W 236 Furniture product and project data[W]</td>
</tr>
<tr>
<td>X 217 Ship piping [X]</td>
<td>W 237 Computational Fluid Dynamics</td>
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<tr>
<td>E 218 Ship structures [X]</td>
<td>A 238 Computer numerical controllers</td>
</tr>
<tr>
<td>X 219 Dimension inspection [X]</td>
<td>W 239 Product life-cycle support</td>
</tr>
</tbody>
</table>
### COMMON RESOURCES
(written 15384-20 logic, model of expr.(I) and 15531-12 Time (Xi))

**APPLICATION MODULES (Technical specifications)**
For status of the modules access the file via the SOAP home page.

**INTEGRATED-APPLICATION RESOURCES**

<table>
<thead>
<tr>
<th>No.</th>
<th>Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>101 Draughting (c1=I)</td>
</tr>
<tr>
<td>2</td>
<td>102 Ship structures</td>
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<tr>
<td>3</td>
<td>103 E/E connectivity</td>
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<tr>
<td>4</td>
<td>104 Finite element analysis</td>
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<td>5</td>
<td>105 Kinematics (c1=I, c2=I)</td>
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<tr>
<td>6</td>
<td>X 106 Building core model</td>
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<tr>
<td>7</td>
<td>C 107 Finite-element analysis</td>
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<tr>
<td>8</td>
<td>C 108 Prmctiz'n&amp;Constraints</td>
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<tr>
<td>9</td>
<td>C 109 Assembly model for products</td>
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<tr>
<td>10</td>
<td>W 110 Mesh-based computational fluid</td>
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</table>

**INTEGRATED-GENERIC RESOURCES**

<table>
<thead>
<tr>
<th>No.</th>
<th>Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41 Fund of prct desc &amp; spt (c2=I, c1=I)</td>
</tr>
<tr>
<td>2</td>
<td>42 Geom &amp; top rep (c3=I, c2=I, c1=I)</td>
</tr>
<tr>
<td>3</td>
<td>43 Repres specialization (c2=I, c1=I)</td>
</tr>
<tr>
<td>4</td>
<td>44 Product struct config (c1=I, c2=I)</td>
</tr>
<tr>
<td>5</td>
<td>45 Materials (c1=I)</td>
</tr>
<tr>
<td>6</td>
<td>46 Visual presentation (c1=I, c2=I)</td>
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<tr>
<td>7</td>
<td>47 Tolerances (c1=I)</td>
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<tr>
<td>8</td>
<td>X 48 Form features</td>
</tr>
<tr>
<td>9</td>
<td>49 Process structure &amp; properties</td>
</tr>
<tr>
<td>10</td>
<td>I 50 Mathematical constructs</td>
</tr>
<tr>
<td>11</td>
<td>E 51 Mathematical description</td>
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<tr>
<td>12</td>
<td>W 52 Mesh-based topology</td>
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<tr>
<td>13</td>
<td>W 53 Numerical Analysis</td>
</tr>
<tr>
<td>14</td>
<td>C 54 Classification Set theory</td>
</tr>
<tr>
<td>15</td>
<td>A 55 Procedural and hybrid represent.</td>
</tr>
<tr>
<td>16</td>
<td>W 56 State</td>
</tr>
<tr>
<td>17</td>
<td>W 57 Expression extensions</td>
</tr>
<tr>
<td>18</td>
<td>A 58 Risk</td>
</tr>
</tbody>
</table>

**APPLICATION-INTERPRETED CONSTRUCTS**

<table>
<thead>
<tr>
<th>No.</th>
<th>Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>501 Edge-based wireframe</td>
</tr>
<tr>
<td>2</td>
<td>502 Shell-based wireframe</td>
</tr>
<tr>
<td>3</td>
<td>503 Geom-bounded 2D wireframe</td>
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<tr>
<td>4</td>
<td>504 Draughting annotation</td>
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<tr>
<td>5</td>
<td>505 Drawing structure &amp; admin.</td>
</tr>
<tr>
<td>6</td>
<td>506 Draughting elements</td>
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<tr>
<td>7</td>
<td>507 Geom-bounded surface</td>
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<tr>
<td>8</td>
<td>508 Non-manifold surface</td>
</tr>
<tr>
<td>9</td>
<td>509 Manifold surface</td>
</tr>
<tr>
<td>10</td>
<td>510 Geom-bounded wireframe</td>
</tr>
<tr>
<td>11</td>
<td>511 Topological-bounded surface</td>
</tr>
<tr>
<td>12</td>
<td>I 512 Faceted B-representation</td>
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<tr>
<td>13</td>
<td>I 513 Elementary B-rep</td>
</tr>
<tr>
<td>14</td>
<td>I 514 Advanced B-rep</td>
</tr>
<tr>
<td>15</td>
<td>I 515 Constructive solid geometry</td>
</tr>
<tr>
<td>16</td>
<td>X 516 Mechanical-design context</td>
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<tr>
<td>17</td>
<td>I 517 Mech-design geom presentation(c1=I)</td>
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<tr>
<td>18</td>
<td>I 518 Mech-design shaded presentation</td>
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<td>19</td>
<td>I 519 Geometric tolerances (c1=I)</td>
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<td>20</td>
<td>I 520 Assoc draughting elements</td>
</tr>
<tr>
<td>21</td>
<td>@521 Manifold subsurfaces</td>
</tr>
<tr>
<td>22</td>
<td>E 522 Machining features</td>
</tr>
<tr>
<td>23</td>
<td>A 523 Curve swept solid</td>
</tr>
</tbody>
</table>

**IMPLEMENTATION METHODS**

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<tr>
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<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21 Clear-text encoding exc hr (c1=I,c2=I)</td>
</tr>
<tr>
<td>2</td>
<td>22 Standard data access interface</td>
</tr>
<tr>
<td>3</td>
<td>23 C++ language binding (to #22)</td>
</tr>
<tr>
<td>4</td>
<td>24 C language binding (to #22)</td>
</tr>
<tr>
<td>5</td>
<td>C 25 EXPRESS to OMG XML</td>
</tr>
<tr>
<td>6</td>
<td>X 26 IDL language binding (to #22)</td>
</tr>
<tr>
<td>7</td>
<td>I 27 JAVA language binding (to #22)</td>
</tr>
<tr>
<td>8</td>
<td>@28 XML rep for EXPRESS-schemata &amp; data</td>
</tr>
<tr>
<td>9</td>
<td>X 29 Ltwt Java binding (to #22)</td>
</tr>
</tbody>
</table>

**Legend: TS Status**
- 0-10 =O=prop-->apvl for ballot
- 10-20=A=NP blt circ-->NP apvl
- 20-60=D=DTS dev-->reg as TS
- >60 =T=TS Published

---

**CONFORMANCE TESTING METHODOLOGY & FRAMEWORK**

1. 1 General concepts on testing labs and clients
2. 33 Abstract test methods for Part 2 implement.
3. 34 Abstract test methods for Part 2 implement.

**DESCRIPTIVE MESSAGES**

1. Overview and fundamental principles
2. EXPRESS language for man (c1=I, c2=I, c3=I, c4=I) [ISO 10303-21]
3. EXPRESS grammar module (c1=I, c2=I) [ISO 10303-24]

---

**STEP on a Page: IRs, etc.**

© LFA
### APPLICATION MODULES (Technical specifications)

<table>
<thead>
<tr>
<th>T 1001</th>
<th>Appearance assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>T 1002</td>
<td>Colour</td>
</tr>
<tr>
<td>T 1003</td>
<td>Curve appearance</td>
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**Legend: TS Status**
- 0-10 = O=prop-->apvl for ballot
- 10-20 = A=NP blt circ-->NP apvl
- 20-60 = D=DTS dev-->reg as TS
- >60 = T=TS Published
AP 203: Configuration Controlled 3D Designs of Mechanical Parts & Assemblies

Configuration Management
- Authorisation
- Control (Version/Revision)
- Effectivity
- Release Status
- Security Classification
- Supplier

Geometric Shapes
- Advanced BREP Solids
- Faceted BREP Solids
- Manifold Surfaces with Topology
- Wireframe with Topology
- Surfaces and Wireframe without Topology

Product Structure
- Assemblies
- Bill of Materials
- Part
- Substitute Part
- Alternate Part

Specifications
- Surface Finish
- Material
- Design
- Process
- CAD Filename
AP 202: Associative Draughting

**Drawing Structure**
- Drawing Revision
- Sheet Revisions
- Views
- Drafting Specifications
- Contract
- Security Classification
- Approvals
- Responsible Organizations

**Product Relation**
- Part
- Responsible Organization

**Geometric Shapes**
- Advanced BREP Solids
- Facetted BREP Solids
- Elementary BREP Solids
- Manifold Surfaces w/ Topology
- Wireframe with Topology
- Surfaces and Wireframe Without Topology
- Geometrically Bounded 2D Shape

**Associativity**
- From Geometric Model to:
  - Dimensions
  - Callouts
  - Fill Areas

**Grouping**
- Layers
- Groups

**Annotation**
- Text
- Annotation Curves
- Symbols
- Subfigures
- Fill Areas
- Dimensions
AP224 Mechanical Product Definition for Process Planning Using Machining Features

Machining Features
- Slot
- Hole
- Thread
- Outer Round
- Chamfer

Feature Definition Items & Profiles
- Path
- Taper
- Profile
- Bottom Condition

Part Administration Data
- Approval
- Person in Organization
- Order
- etc.

Manufacturing Part Properties
- Material Property
- Surface Finish
- Process Property
- Hardness

Tolerances
- Geometric
- Material Condition Modifier
- Linear Dimension
- Tolerance Range

Shape Representation
- Brep Model
- Explicit Base Shape
- Block Base Shape
- Ngon Base Shape
- Cylindrical Base Shape

Prof. Dr.-Ing. Reinhard Möller
Automatisierungstechnik / Prozessinformatik
Bergische Universität Wuppertal
Vorlesung CAD-M /CAD-E
AP 214: Core Data for Automotive Mechanical Design Processes

Geometry
- Solids Data
- Surface Data
- Wireframe
- Measured Data

Presentation
- Drawing
- Visualization

Analysis
- Simulation

Manufacturing
- NC-Data
- Process Plans

Technology Data
- Material Data
- Form Features
- Tolerance Data
- Surface Conditions

Specification/Configuration
- Product Structure Data
- Management Data

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Vorlesung CAD-M /CAD-E
STEP AP210 (ISO 10303-210)
Domain: Electronics Design

~950 standardized concepts (many applicable to other domains)
Development investment: O(100 man-years) over ~10 years

Configuration Controlled Design of Electronic Assemblies, their Interconnection and Packaging

Interconnect Assembly
Printed Circuit Assemblies (PCAs/PWAs)
Product Enclosure
Die/Chip
Packaged Part
External Interfaces
Printed Circuit Substrate (PCBs/PWBs)

2003-04 - Adapted from 2002-04 version by Tom Thurman, Rockwell-Collins
STEP AP210 Scope

- **Scope is “As-Required” & “As-Designed” Product Information**
  - Design “In Process” & “Release”
  - Design views (white boxes) & usage views (black boxes)
  - Design at individual or multiple levels: microsystems, packages, PCAs, units, …

- **Sharing Partners:**
  - Engineering Domains
  - Design / Analysis
  - Manufacturing / Analysis

- **Sharing Across Several Levels of Supply Base**
STEP AP210 Models

Functional Models
- Functional Unit
- Interface Declaration
- Network Listing
- Simulation Models
- Signals

Requirements Models
- Design
- Constraints
- Interface
- Allocation

Component / Part Models
- Analysis Support
- Package
- Material Product
- Properties
- “White Box”/ “Black Box”
- Pin Mapping

Assembly Models
- User View
- Design View
- Component Placement
- Material product
- Complex Assemblies with Multiple Interconnect

Interconnect Models
- User View
- Design View
- Bare Board Design
- Layout templates
- Layers
  - planar
  - non-planar
  - conductive
  - non-conductive

Configuration Mgmt
- Identification
- Authority
- Effectivity
- Control
- Net Change

GD & T Model
- Datum Reference Frame
- Tolerances

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Vorlesung CAD-M /CAD-E
Rich Features in AP210: PWB traces
AP210 STEP-Book Viewer - www.lksoft.com
Z-dimension details...
Rich Features in AP210: PCB Assembly: 3D & 2D
STEP-Book AP210 Browser - www.lksoft.com

PDES Inc. EM Pilot
Test Case: Cable Order Wire (COW) Board
The 3D shape is generated from these “smart features” which have electrical functional knowledge. Thus, the AP210-based model is much richer than a typical 3D MCAD package model.

210 can also support the detailed design of a package itself (its insides, including electrical functions and physical behaviors).
3D Mechatronics via AP210

JMID-210
AP210 for Circuit Board Warpage Analysis:
Using Rich Product Models to Drive Analysis Complex Idealizations

Grid (Sieve) Size

Analysis template attributes
- Thermal loading profile
- Boundary Conditions (mostly displacement)
- Idealize PWB stackup as a layered shell

Effective Material Property Computation

Top view of “effective” grid elements in top layer of the PCB

Side view of the PCB with “effective” grid elements across the stratum

Given:
- Thermal loading profile
- Boundary Conditions (mostly displacement)
- Idealize PWB stackup as a layered shell
AP 212: Electrotechnical Design and Installation

Electrotechnical Systems
- Buildings
- Plants
- Transportation Systems

Data Supporting
- Terminals and Interfaces
- Functional Decomposition of Product
- 3D Cabling and Harnesses
- Cable Tracks and Mounting Instructions

Equipment Coverage
- Power-transmission
- Power-distribution
- Power-generation
- Electric Machinery
- Electric Light and Heat
- Control Systems

Electrotechnical Plant
- Plant, e.g., Automobile
- Unit, e.g., Engine Control System
- Subunit, e.g., Ignition System

Electrotechnical Equipment in Industry
Scope of STEP today

Product Structure
Product Representations
Product Performance
Support Performance
Support Environment
Failure Analysis
Maintenance Analysis
Task Resource Data

Change Directives

Standard Commercial Transactions
Feed & Extract
Query

Maintain/Dispose
Use

Derived Disposable Data

Support and Operational Feedback

Life Cycle Data

SC4 in the Enterprise