Introduction to GTC hierarchy

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GTC Hierarchy Introduction

Communicating tool data among tool vendors and systems has always been quite a challenge. The introduction of the ISO 13399 standard has helped the communication process. In order to simplify the tool-data communication even more, Sandvik Coromant and Siemens PLM have developed a Generic Tool Catalog (GTC) as a complement to ISO 13399.

GTC is a vendor-neutral format for cutting-tool digital catalog exchange. Tool vendors can use GTC format to rationalize their data-exchange process and ensure an excellent communication quality. In this way, both time and money can be saved.
The GTC format definition consists of two main parts: the GTC hierarchy and the GTC package structure.
This document explains the concept and usage of GTC hierarchy, for the GTC package structure, please refer to another document 'GTC package specification'

1. Challenge

Sending and receiving tool data has always demanded a lot of manual work. It often includes reading from paper catalogs and manually putting tool data into tool libraries. Companies often use their in house standards for data description and management. Different organizations use different systems, which further complicates the process. The basic difficulty is the absence of standardized structures and definitions. Manual data management is both cost- and time ineffective. Not only does it require a lot of manual work, it also limits communication between vendors and users. Furthermore, manual data handling always comes with the risk of human error.

ISO 13399, a new generic standard for description of cutting tools, is a first step in addressing these issues. Its dictionary with classes and properties for describing cutting tools eliminates previous difficulties regarding product description. However, ISO 13399 has no hierarchical classification structure that indicates what kind of cutting-tool component a particular product is. To be able to find and use the right tools in a cost efficient way, there is a need to combine ISO 13399 with a classification hierarchy for cutting tools. The classification hierarchy should be generic and brand neutral while enabling for vendor specific classes.

2. Overcoming the challenge

By combining ISO 13399 with a neutral classification, cutting tool vendors, system vendors, end users and other stakeholders will benefit greatly. The main advantage is that tool data can be communicated easily. This way both time and financial resources can be saved. Therefore, Sandvik Coromant and

Siemens PLM have adopted the ISO 13399 standard fully and developed a first version of a GTC hierarchy. By taking this initiative, both companies demonstrate how ISO 13399 can be used for cutting tool catalog exchange.

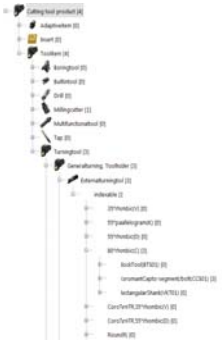
GTC hierarchy is a basic and easy to adopt classification with close connection to ISO 13399. It is to be maintained by a governance organization that understands the need of digital cutting-tool data description. The development of GTC hierarchy has been discussed with other tool vendors, CAM-system experts and end user that understand the need of such a system and support the initiative.

2.1 Purpose of GTC Hierarchy

The main purpose of GTC hierarchy is to offer a generic structure for classification of cutting-tool components.

GTC hierarchy should be seen as a complement to ISO 13399. It is intended to:

1. Help pre-map classes and properties to the receiving systems' internal classification and properties;
2. Be a hierarchical classification structure that simplify searching for products;
3. Serve as a base structure for manual entry of own-defined or non-classified tools into catalogs, and thereby assist when filling in essential properties.



2.2 GTC hierarchy and ISO 13399 in relation to other classifications

Other classifications exist in domestic business situations and when cutting tools are only a small part of another classification, e.g. purchasing systems or e-commerce.

A major effort has been made in Germany by introducing the national DIN 4000 standard. It has a hierarchical structure but no clear definitions of properties. The DIN 4000 has a strict way of describing what properties are connected to each tool type. Although this is convenient, the rigid structure is not flexible when introducing new tool kinds.

GTC hierarchy is built upon ISO13399. It has an information model enabling flexible description of new tool types. Companies that adopt GTC hierarchy can use it as a basic classification. Matching classes between GTC hierarchy and other classifications can be used if needed.

The DIN 4000 standard is also increasingly converging towards ISO 13399 with direct references to ISO 13399 symbols when possible. A closer connection between the two classifications is positive since it can provide the opportunity to use the strength of both classifications. Hopefully, a combination of strong qualities of both classifications can lead to one internationally recognized standard that meet the needs of all parties.

2.3 GTC hierarchy Philosophy

GTC hierarchy is a classification hierarchy for cutting-tool components. Thereby it is to be seen as chapters and subchapters of a generic and unbranded catalog. GTC hierarchy applies commonly used denominations in the cutting-tool industry to define tool kind, making it logical and easy to understand. It is easy to know where tools belong in the hierarchy, and how to expand the structure when it does not cover a new kind of tool. GTC hierarchy does not describe operation areas of each tool. No cutting data is provided. Instead it explains what each product is in commonly used denominations.

GTC hierarchy is a complement to ISO 13399. The structure and hierarchy branches of GTC hierarchy have a rule-based connection to ISO 13399 classes and properties. This means that when a cutting-tool component is described according to ISO 13399, it is possible to match it to the hierarchy leaf nodes of GTC hierarchy where it fits best. If the GTC hierarchy does not comply with ISO 13399 classes and properties, there is a reason to extend the ISO 13399 standard. Such questions will be handled by the ISO 13399 maintenance agency.

GTC hierarchy offers a natural way to navigate and search for cutting-tool components. It is possible to use limiting properties in the search.

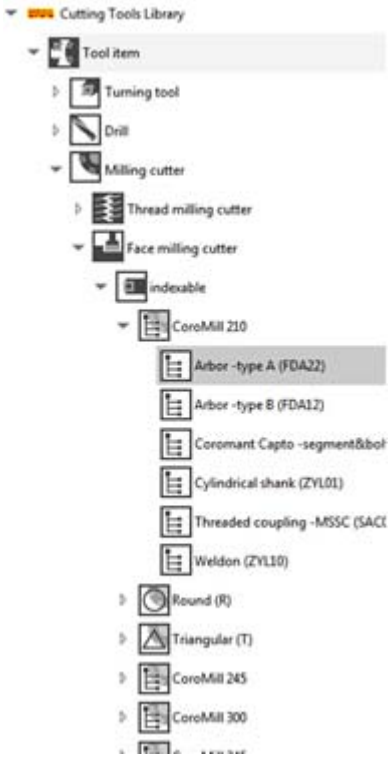
2.4. GTC hierarchy levels

The hierarchy is based on typical denomination used in the cutting-tool industry for describing tools. The denominations are of the type that is used when seeing or holding tools – "tool in hand". Hence, the hierarchy is not based on the cutting operation products perform.

If an item has multiple tools on it, e.g. a milling cutter and a turning tool on same tool body, it can be classified in two different nodes of the hierarchy. Different nodes can thus include different sets of properties and values for the same tool. The product data file (p21-file) holds all the information about the tool.

The hierarchy consists of:

- Fixed levels that describe what kind of cutting-tool component an item is. It is a vendor neutral level. At this level, no specific property values or dimensions are used. Information about what connection types the tool type has is not present.
- Rule based levels that can be seen as variants of the same tool type. The same type of tool is split up in different kinds of connections or insert shapes. These levels are affected by which assortment each vendor has. They manage the different properties depending on connection type. They also help the guided search by splitting up the hierarchy in smaller identifiable sections.



Example of branches in the GTC structure.

In a system application, the lowest levels can be left out. The navigation is then based on property search instead of usage of property. All nodes in the tree structure have a rule-based relation to classes and properties in ISO 13399. Each node in the tree has an id, a denomination and two date stamps for version handling (see separate part for versions). The nodes can hold icons that represent the content contained below it.
The highest level (root) is "Cutting Tool Library".

The second level shows the basic type of tool component, i.e. “Tool item”, “Adaptive item”, “Insert” (cutting item), “Assembly item” or “Accessory item”. This categorization is the same as the basic types of cutting-tool components defined in ISO 13399. A cutting tool may consist of “Tool item”, “Adaptive item”, “Assembly item” and “Inserts”. Equipment and hand tools used when assembling or setting the cutting-tool products in the workshop or tool room are called an “Accessory item”. For the moment, the GTC hierarchy does not cover “Accessory item” and “Assembly item”.

The third level divides the different tool components depending on type of cutting-tool product. As mentioned previously, only “Insert”, “Tool item” and “Adaptive item” are further divided in the GTC hierarchy structure.

The cutting-tool vendors explicitly define which leaf node that tools belong to within an assortment file. In the lowest levels of the catalog hierarchy, the leaf levels, there is a list of important properties that describe the specific tool. These leaf nodes can also hold an appropriate class drawing to help the user understand the meaning of the properties. Only the most essential properties appear in the leaf nodes. It could, for instance, be properties needed for building and using a cutting-tool assembly or for searching for the cutting-tool components that are used in the assembly. It is essential to define the properties that are needed. An important step is to enable end users to help limit the amount of properties to only those that are necessary.

2.5 GTC hierarchy usable formats

As a first intermediate solution, the GTC hierarchy is defined in Excel format with defined columns. It will as soon as possible be changed to an XML structure with a specified schema.

2.6 Version handling for GTC hierarchy

2.6.1 PLIB versioning

New versions of the PLIB-file are to be released by the ISO 13399 maintenance agency. The file name of the PLIB-file contains a version number, which is raised for every new revision.

The PLIB-file is available on the ISO 13399 maintenance agency homepage (http://www.unm.fr) under “Activities” → “Maintenance agencies” → “ISO 13399 Cutting Tool Reference Dictionary”.

2.6.2 GTC hierarchy versioning

A simple mechanism for version management of the GTC hierarchy has been defined. It consists of two things:

1. A version number of the GTC hierarchy version and release, such as GTC hierarchy V1R7. In this example, V1 stands for version number one and R7 stands for release number seven. Versions are to be updated when major changes have been implemented. Releases are to be updated when minor corrections have been made. Each GTC hierarchy version refers to a PLIB version which it is based on.

2. A time stamp on each node in the hierarchy, making it possible to check which nodes in the hierarchy that have been changed in new versions and/or releases. Examples of changes are new-, moved- and removed nodes and changes in the property list in a leaf node. A new version date for a node is not made when changing an icon or class drawing, which does not have any effect on the structure itself.

3. Conclusion

From manually sending and receiving cutting-tool data, ISO 13399 has offered new opportunities for fast and cost-efficient data exchange. Cutting-tool vendors can now use an international standard for description of cutting tools. Doing so eliminates the need of manual data handling and enables higher communication quality between vendors and end users.

GTC is introduced in order to complement ISO 13399. It is a Generic Tool Catalog. The hierarchical catalog structure defines cutting-tool components.

Combined with ISO 13399, GTC contributes with the following:

- High quality data exchange;
- Cost- and time efficient communication;
- Easily extendable structure;
- Global technical data download;
- No risk of human error.

The more ISO 13399 is used in combination with GTC, the less time it takes to exchange cutting-tool data between various stakeholders. Communication is made easy when users can obtain product data directly from cutting-tool vendors through the GTC system. In this way, new products are visible without any packaging by the system vendor. All product data is available globally for quick download via system services or movable media storages.

GTC is developed and functioning. Yet the biggest challenge remains: to involve all players in the cutting-tool industry.

Definitions and abbreviations

CAM (Computer-Aided Manufacturing) – The use of numerical control computer software applications to create detailed instructions that drive machine tools in manufacturing.

GTC (Generic Tool Catalog) – A vendor-neutral format for cutting-tool digital catalog exchange.

GTC hierarchy – A hierarchal classification developed as a complement to ISO 13399 to describe various cutting-tool component types.

GTC governance organization – A group of stakeholders led by a neutral organization responsible for management of GTC.

GTC hierarchy leaf node – Nodes at the lowest levels in the GTC hierarchy. They hold properties used to describe the cutting-tool components.

GTC hierarchy node – Nodes used to define a distinct tool type in the GTC system. GTC nodes can also be called GTC classes.

Hierarchy branch – Branches in GTC hierarchy that describes various types of cutting-tool components.

ISO 13399 class – Information objects used to describe cutting-tool components with e.g. item types and features. The classes can hold one or more properties. They are defined in the ISO 13399 standard.

ISO 13399 maintenance agency – An institution for ensuring effective use of international ISO-standards. It handles changes and developments of the standard and publishes new PLIB-files.

Property – Object that is clearly defined by a definition. A property has an id, a preferred name and a symbol that represents it. Properties can, when used, be given a value that is geometrical or non-geometrical.

PLIB (reference data) – The decoder file for the product data. It contains the reference data to ISO 13399 and makes the properties in the .p21-file readable.

.p21-file (ISO 10303-21) – Text file that defines the encoding mechanism for how to represent data according to a given schema, but not the schema itself. Contains product data and links to other files that are needed.