Tool and Material Library Interaction

The Synergy tool library is a combination of two pieces of data,
First a material, found in /usr/weber/util/tooldata/materials
Second, a tool found in /usr/weber/util/tooldata/tools_in (or tools_mm for metric parts)

These files are read into the system when a user chooses them from a menu in Synergy. The material has all the data necessary to calculate feeds and speeds in both inch and metric. The tools are either inch or metric. Meaning that if you want to use a Metric tool you must convert into inches and make an entry in the tools_in library and vice versa.

The Feeds and speeds are a calculation based upon (for inch)
Speed= (12 x Machinability factor x Surface speed)/(PI x Diameter)
Feed= Manufacturability x In/rev x Speed

And for metric,
Speed= (1000 x Machinability factor x Surface speed)/(PI x Diameter)
Feed= Manufacturability x Mm/rev x Speed

For brevity, Inches/rev and MM/rev will be referred to as IPR.

Surface speed is pulled from the material and is either Surface Feet or Surface Meters per minute (sfpm or smpm). There are different types of surface footage for different operations.

For brevity, Surface Feet (and Meters)/min will be referred to as SFPM.

Machinability factor is a value used to modify the surface footage on a per tool basis. i.e. Maybe smaller tools want to reduce the standard surface footage.

Manufacturability is a modifier for the IPR. i.e. The IPR is drastically different between aluminum and hardened steel.

IPR is calculated in two ways. First, for milling type tools and counterbores they are based upon the number of flutes, or teeth, and a value for inches or millimeters per tooth, or IPT. Drilling type tools have the IPR already predefined in the tool. So, different size tools may run at different IPR's.

Each tool in the tool library has a Synergy tool type. These tool types should not be changed and new ones should not be added. They are
ENDMILL
BALLMILL
TAPERMILL
BULLMILL
CHAMFERMILL
TWIST DRILL
CENTER DRILL
COUNTERSINK
COUNTERBORE
TAP
REAMER
BORING BAR
THREADER

Inside of each tool is a material type. This type is typically HSS, CARBIDE, CARBIDE INSERT or, DIAMOND. This value is used to get a particular value out of the material. The surface footage for a particular tool is one such example. The value for material type in the tool can be changed to expand the list of surface footages in the material.

The following is a breakdown of how each type of tool calculates its feeds and speeds.

ENDMILL, BALLMILL, TAPERMILL, BULLMILL, CHAMFERMILL

These tools are calculated using the IPT and SFPM from the material and the machinability factor and Manufacturability from the tool. They use the following fields from the material;

Finish(sfpm)(HSS):
Rough(ipt)(HSS):

Where HSS is any one of the previously described material types.
The tool values used are;
Number flutes:
Machinability factor:
Manufacturability:

The Machinability factor is in the tool as a modifier to the SFPM in the material. The Manufacturability is in the tool as a modifier to the IPT in the material. In this way there is a check and balance between the tool and the material.

TWIST DRILL, CENTER DRILL, COUNTERSINK
These tools do not calculate values for IPR. They get their IPR from the tool directly and the SFPM from the material.
From the material;

Twist Drill(sfpm)(HSS):
TdrillManufacturability:

And from the tool;
Machinability factor:
Feed(ipr):

The Machinability factor is in the tool as a modifier to the SFPM in the material. The Manufacturability is in the material as a modifier to the IPR in the tool. This is different from the endmills because the controlling factor for the ENDMILL IPR is the IPT in the material. Therefore its modifier must be in the tool. The drills have their IPR in the tool so their modifier is in the material.

COUNTERBORE
These tools are calculated in the exact same way as the ENDMILL etc. except they use the following fields from the material;

Counterbore/spotface(sfpm)(HSS):
Counterbore/spotface(ipt)(HSS):

TAP
These tools calculate similar to the twist drills. However, their IPR is based upon the pitch of the tool. There is no manufacturability modifier for the taps since the pitch of the tool is an absolute.
There is only one field that a tap looks for in a material and it takes on the form;
Tap(sfpm)(HSS):

The taps are unique in their nature. Since they are the most sensitive to feeds and speeds they have the most freedom in calculations. The tap SFPM can be subcategorized in the material. So, you can get a specific SFPM for a tap of a certain diameter, thread, and material. You can also define a SFPM for a range of diameters irregardless of thread. The following hierarchy describes the different uses of the tap SFPM.

Tap[Dia](Thread)(sfpm)(HSS) ONE diameter. ONE Thread.
Tap[Dia](Trange)(sfpm)(HSS) ONE diameter. SOME threads.
Tap[Dia](sfpm)(HSS) ONE diameter. Thread doesn't matter.
Tap[Drange](Thread)(sfpm)(HSS) SOME diameters. ONE Thread.
Tap[Drange](Trange)(sfpm)(HSS) SOME diameters. SOME Threads.
Tap[Drange](sfpm)(HSS) SOME diameters. Thread doesn't matter.

Tap(Thread)(sfpm)(HSS) Certain thread ALL diameters.
Tap(Trange)(sfpm)(HSS) Some threads ALL diameters.
Tap(sfpm)(HSS) All other taps of a certain material

The tool uses two fields;
Machinability factor:
and either
Pitch: ***(for metric tools)***
Or,
Threads-inch: ***(for inch tools)***

The IPR (MMPR) of a metric tools is the Pitch and the IPR of an inch tool is the inverse of the Threads/Inch.

REAMER
These tools are calculated in the exact same way as the TWIST DRILL etc. except they use the following fields from the material;

Reaming(sfpm)(HSS):
ReamManufacturability:

BORING BAR
These tools are calculated in the exact same way as the TWIST DRILL etc. except they use the following fields from the material;

Boring(sfpm)(HSS):
BoreManufacturability:

THREADER
These tools are calculated are calculated in the exact same way as the ENDMILL etc. except they use the following fields from the material;

Thread Milling(sfpm)(HSS):
Thread Milling(ipt)(HSS):

When the calculations or finished then the Feed rate is placed in to the tool under;
Feed(ipm): ***(or mmpm for metric)***

And the speed under;
Speed(rpm):

SETTING STANDARD FEEDS AND SPEEDS

As of Synergy 14.50, milling feeds and speeds no longer need to be calculated. The fields;

Feed:

And,

Speed:

may be added to the tool. This will ensure that a particular tool will always have the same feed and speed. This way no calculation will be done.

Additionally, the materials have a new field added to them, **Material type:** This field can be used by the tool to sub-categorize feeds and speeds. The field

Feed(1018):

And,

Feed(6061):

may be added to a tool. This will read one speed for 1018 and a different speed for 6061. All other feeds would then default to whatever is in the **Feed:** field. If Feed: is not specified then the feeds default to the calculations.

The same is true for the speeds. Substitute the word Speed for Feed in the field names. Endmills can have the field Zfeed also specified in the same way. In endmills, Feed specifies side to side cutting rates and Zfeed specifies downward cutting rates.