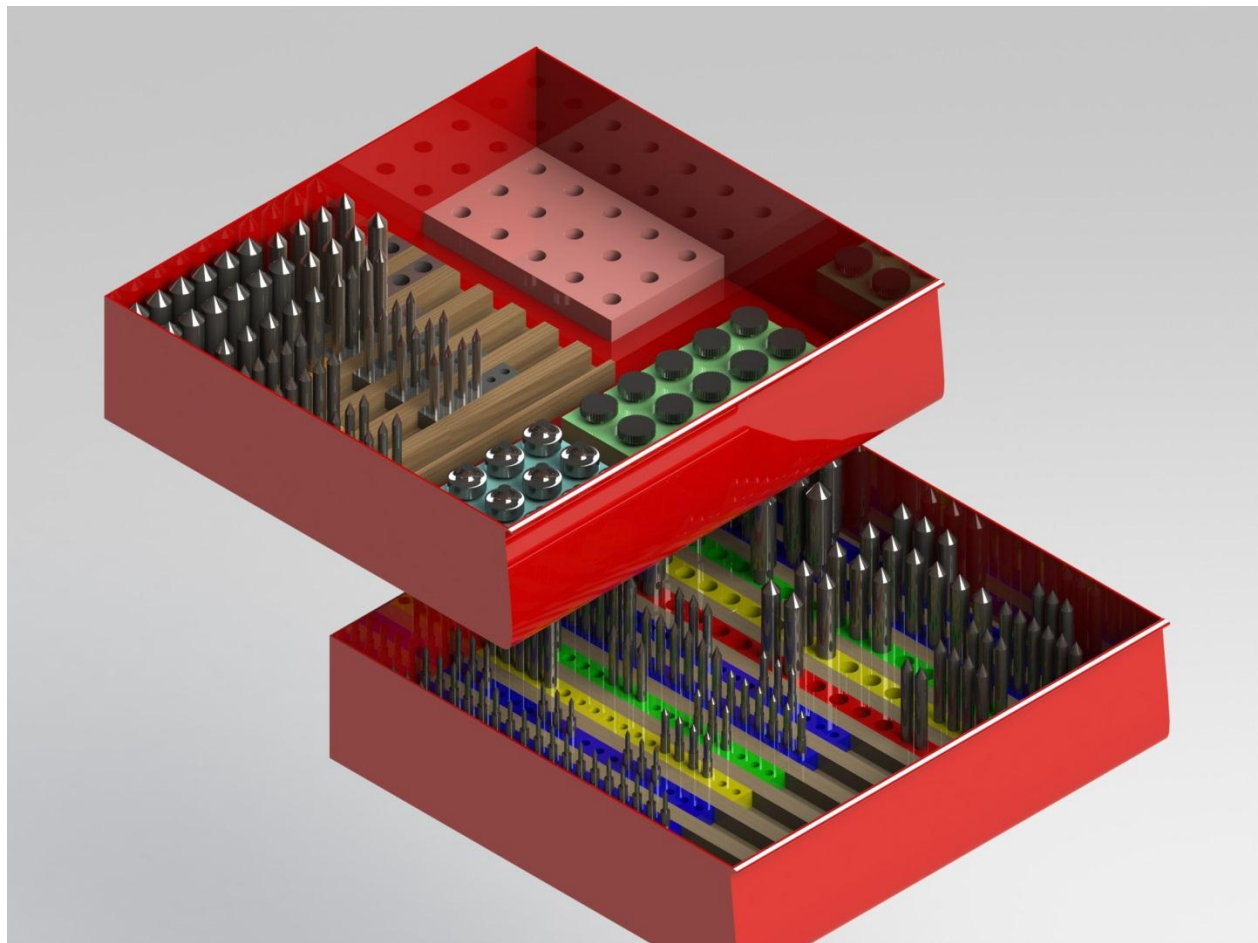


# 2012

End Mill Organization

Donenfeld, Tiffany  
Engel, Andrew  
Oliver, Ryan

University of Idaho  
College of Engineering



## END MILL STORAGE CURRENT STATE

Currently end mill storage in the Mechanical Engineering Machine Shop is spread out between four tool cabinets, thirteen different drawers, and one vertical storage rack. In the current storage method, storage drawers are not all adjacent to one another. Four specific problems exist: one, lack of differentiation between reground and standard sized end mills, two, lack of differentiation between different end mill types, three, lack of storage method which prevents chipping and dulling of stored end mills, and four, lack of a centralized storage area where all end mills can be found.



*This picture shows one of the drawers that end mills are currently being stored in. Very little organization is present, the mills are being stored with one another horizontally, and this picture overall captures the reason this project is needed.*

Reground end mills are end mills which were no longer cutting in a manner acceptable to Russ Porter, but were deemed useable if reground. An end mill may be sent for regrind if it has become dull from use or had a cutting flute chipped by dropping it etc. However, though reground end mills cut well they no longer are of a standard size, which must be taken into account during milling operations. Many end mills have been donated to the shop by the Boeing Company. The vast majority of these donated end mills need to be reground before they can be used to achieve a desirable finish on a piece of stock. Currently, reground end

mills, many of which are from Boeing, are stored in a 9 drawer cabinet outside Russ' office. No notification is given that many of these end mills are reground. Likewise no warning is posted reground mills may have *migrated* to different storage areas. No system is in place to distinguish the reground from the non-reground end mills.

End mills in use in the ME Machine Shop include: bull end, ball end, none-center cut, center cut, radius, chamfer, dovetail and slot. To an experienced machinist like Russ, a knowledgeable mentor or student the difference is quite obvious. However, to the novice learning in the shop, the subtleties between the different end mills is likely not apparent. A piece of stock can easily be ruined by using the wrong type of end mill for a particular application causing frustration, wasted time, and wasted material. No system is in place which points out where a specific end mill type can be found. Rather, finding a particular tool often has to be done for the first time by asking someone else where it is.



*This picture contains various types of end mills. You have some dovetail, slot, and center, and non-center cuts.*

Nearly all of the end mills currently stored in the ME Machine Shop are stored lying collectively in the bottom of cabinet draws by cutting diameter. This method of storage presents two problems. First, finding a desired end mill is difficult. Second, storing end mills in this fashion damages them. When returning an end mill to the draw it was found in it is all too tempting just to toss the end mill in and shut the drawer. Unfortunately tossing an end mill into a drawer can chip and dull the cutting surfaces requiring it to be reground. Additionally, just the action of the mill ends rolling and sliding in the drawer as it is pulled and pushed (some

drawers require considerable effort to move and then suddenly give) in and out cause the mill ends to dull.



*Here another drawer has been taken to show the current state of the end mill storage. This shows how poorly the current storage system is working and why it needs to be redone.*

Storage of the end mills in multiple cabinets and drawers which are not adjacent makes locating a desired end mill much more difficult than it needs to be. As it is unclear to the novice in the ME Machine Shop where a particular end mill is stored, finding a desired mill often involves asking someone who has used that particular end mill before and remembers where it was. Many of the drawers labeled as containing end mills are spread out across the shop in a manner that is not intuitive to look for.



---

## END MILL STORAGE FUTURE STATE

---

The current state of end mill storage has them scattered all over the shop. As described in the current state writeup, the end mills need to be all in one area, organized in some fashion, and take up less room. In order to get an idea of how they should be organized, and how many end mills there were, we had several conversations with Russ. These helped develop our design parameters. The final design will cut the number of drawers, allow for expansion, color code the different types of end mills for the user's ease, and prevent the end mills from hitting one another to protect from chipping and dulling.

The first major issue that was noticed was how many different places the end mills were located all over the shop. This led to the goal of consolidating all of the end mills in less space. To accomplish this, we needed a more space-efficient manner of storage. After looking at current storage methods in place around the shop, it was decided that storing the bits in a vertical direction would be the best way to utilize the space. We were originally designated a cabinet to store end mills in, but after spending some time designing for that cabinet, it became apparent that due to the drawer shapes, that cabinet would not work well. However, we found another cabinet with four larger drawers, containing several items which used space inefficiently. We talked to Russ, and he allowed us to change our plans to use these drawers, and move their current contents to the smaller cabinet. With these new parameters, we are now able to fit everything into three drawers all located together.

The next issue that emerged was the disorganization of the mills. With so many different types and sizes end mills, even before considering any of the specialty mills, it was easy to overlook some small detail of the mill type and size and mess up an entire project quickly. To solve the organization issue, we developed a concept of a rack holder that the end mills slipped into. This allows mills up to 5" to be placed in the holder and waste less of the space than if they were lying down. We also implemented a plan for removable inserts in a fixed base, to make our design more useful for future issues such as expansion of inventory. This allows Russ to make changes in sizes and inventory without having to start all over with a new base.

Another organizational issue was with the different types of bits located around the shop. The solution for this was to color code the different types of bits as well as the holders for easy replacement. This will help to cut down on confusion for those new to the shop as well as time spent looking for the correct bit by experienced machinists. By color coding the chuck end of the bit with fingernail polish, replacement of the bit in the drawer will be easy and clear for everyone who uses them. The base inserts will be painted to correspond with the correct type of end mill so that it is easy to spot which type of mill you want.

Now that the main issues had been addressed, some other things came up as the design was evolved. One of the issues that became visible both through using of the mills and talking to Russ was that the mills tend to get beat up, and then replaced. However, it is often a

subjective judgement by a user as to whether or not a mill is still in acceptable condition. To help solve this issue, we recommend a place where users can put mills that they are uncertain about the condition of. Russ will be able to look at these mills and pull them out of commission if needed or put them back for continued use. Normally he just goes through all of the mills once or twice a semester and that takes a lot of his time. By implementing this area, Russ will be able to address non-usable mills quickly and replace them in a timely manner, saving both his time and the time of others.

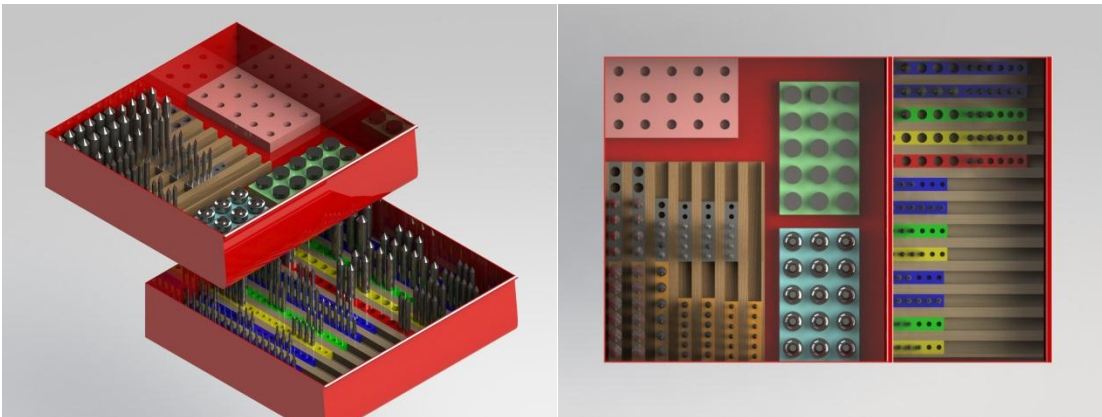
---

## KAIZEN PROJECT : ORGANIZATION OF ENDMILLS : SUMMARY OF FEATURES

---

### Summary of final design elements:

- Slotted base in the bottom of each drawer
- Removable inserts which fit into the slots in the base, allowing insert customization to the size and type of mill desired.
- Vertical storage to maximize drawer space efficiency.
- Bit and insert coloring according to a color code system that allows visual identification of mill types.
- Consolidated mill storage, so that inventory can be searched through in a speedy and accurate manner. Reduction of cabinets to one, and drawers to three.
- “Junk Bin” on top of mill cutter cabinet for storage of possibly damaged/worn cutters, allowing easy, regular, and efficient checking by Russ.
- NOTE: End mills over five inches still require a system of flat storage. This can be implemented in the third drawer.
- PROOF OF CONCEPT RENDERINGS:



### Possible Recommendations for Future Improvement:

- Empty blocks @ mill station tables for storage of mills during projects. Possibly magnetic, so that they can be moved on and off and carried between the mill cabinet and the shop.
- Pre-filled blocks of mill selection to allow easy grabbing of a variety of mills for a machining project.
- Make empty blocks a stepped shape to accommodate varying lengths of bits.
- Russ suggested: “tongs” for removing bits from racks to prevent people from cutting their fingers on the bits.
- Magneticizing storage blocks – create a mechanical magnet activation like the one on the bases for the gooseneck dial indicators.