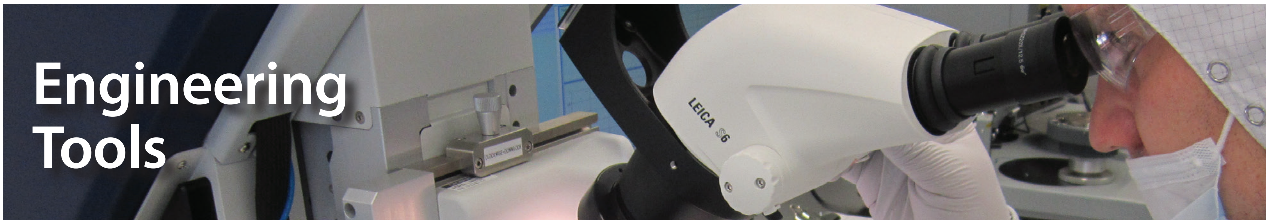

Engineering Tools

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Engineering Drawings "The Language of Engineering"

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SMART MICROSYSTEMS OFTEN encounters requests to fabricate parts without complete or any engineering drawings. This challenge is not unique to SMART and resonates across the industry. With the advancements in solid modeling and 3D printing, it may seem that engineering drawings are becoming obsolete, much like dinosaurs and Dodo birds. While there has been a shift towards paperless documentation due to improved modeling software, it does not signify the end of engineering drawings. These drawings remain crucial for mechanical components, sub-assemblies, and assemblies, as they contain vital information unavailable elsewhere.

Engineering drawings encompass various critical elements essential for fabricating a part, such as geometric dimensioning and tolerancing (GD&T), dimensional tolerances, drawing notes with fabrication and assembly instructions, and the title block. Although modern solid models may include tolerances and GD&T, they often lack the comprehensive perspective necessary for suppliers to fabricate the part. When an assembly involves a machined part, machinists require detailed instructions and dimensions from the drawing, rather than relying solely on a solid model.

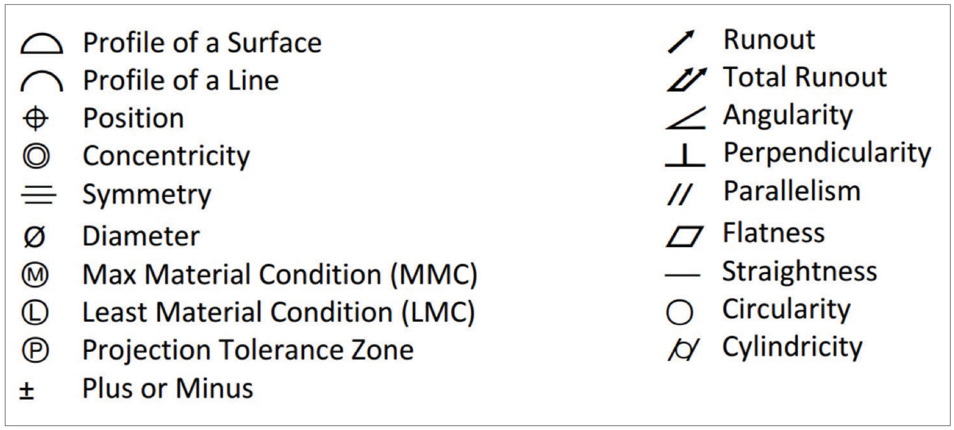


Figure 1. Some common GD&T symbols.

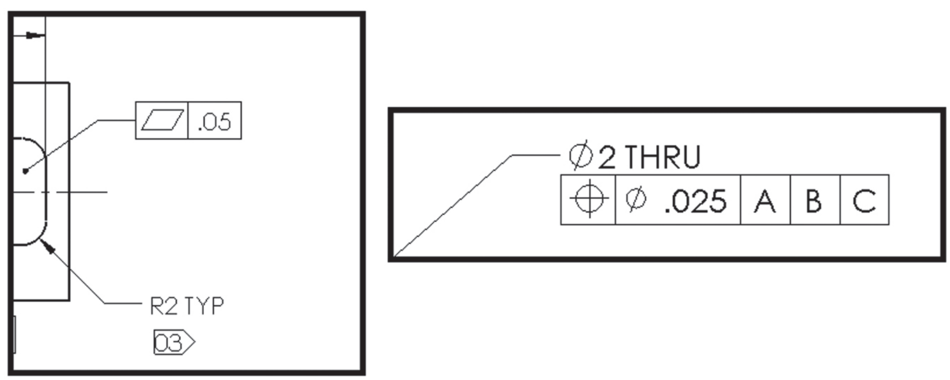


Figure 2. Sample images from an engineering drawing using GD&T symbols.

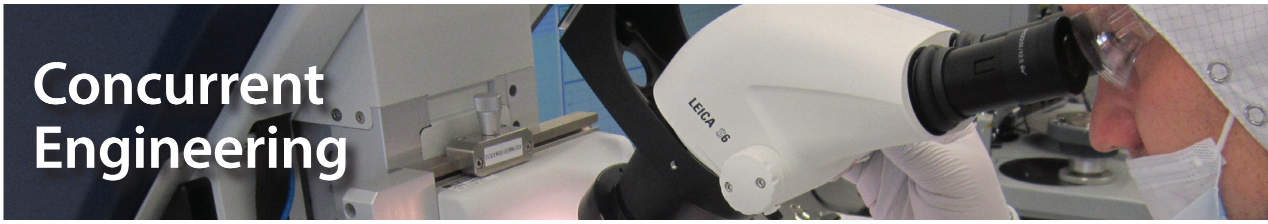
GD&T symbols play a pivotal role in engineering drawings, serving as a system to define and communicate engineering tolerances. These symbols are typically tied to datums, which flow from the top down in accordance with the part drawing requirements derived from the higher assembly. Understanding concepts like flatness, parallelism, perpendicularity, concentricity, and position through a common language like GD&T helps ensure proper fabrication of assemblies.

Another crucial aspect of engineering drawings is dimensional tolerancing. These tolerances communicate the acceptable range for a feature dimension during part fabrication. Derived from the higher assembly, dimensional tolerances directly impact cost and manufacturability. It is generally advisable to set tolerances no tighter than necessary to achieve the desired fit, form, and function of the higher assembly. Tighter tolerances increase costs and reduce manufacturability. Careful consideration of tolerance stacks within an assembly drawing is also important. If the overall tolerance of the assembly is tighter than the cumulative tolerances of its individual components, it may become impractical to manufacture in volumes greater than one, potentially compromising functionality.

Drawing notes hold significant importance as they provide critical fabrication and assembly information. Often overlooked, these notes should be present on every drawing and numbered for easy reference. Drawing notes may contain specific instructions, cautionary requirements, plating specifications, or compliance details with relevant standards. They serve as the final authority on critical assembly or fabrication instructions.

Although seemingly unimportant, the title block of a drawing carries essential information. It includes general tolerance details, the document's dimensional units, the issuing authority, and the most recent revision. The title block acts as a record of the work scope and requires appropriate updates if revisions are made, ensuring accurate documentation and reassessment of the work scope.

Engineering drawings are invaluable tools for several reasons. The process of generating these documents compels engineers and design



Concurrent Engineering

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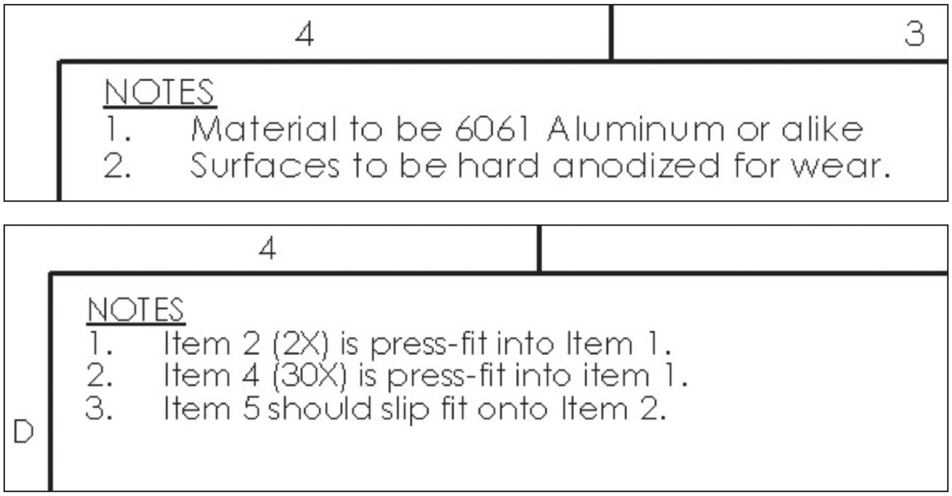


Figure 3. Sample engineering drawing notes - arguably the most critical instructions and requirements of any engineering drawing package.

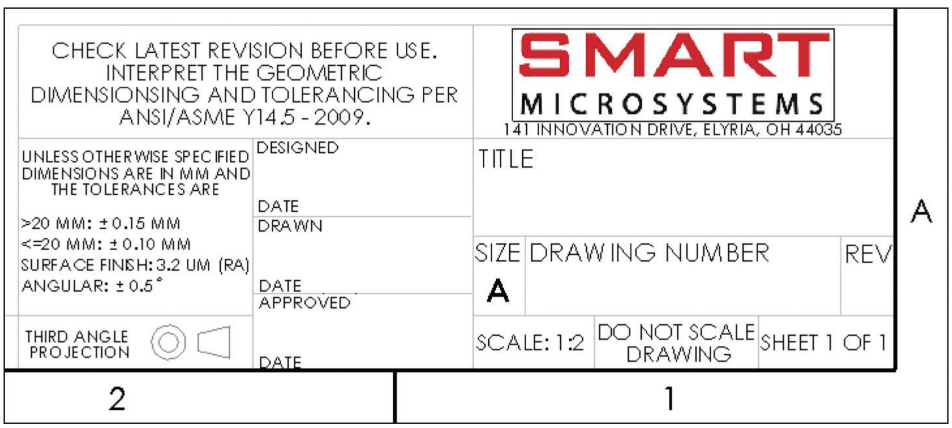
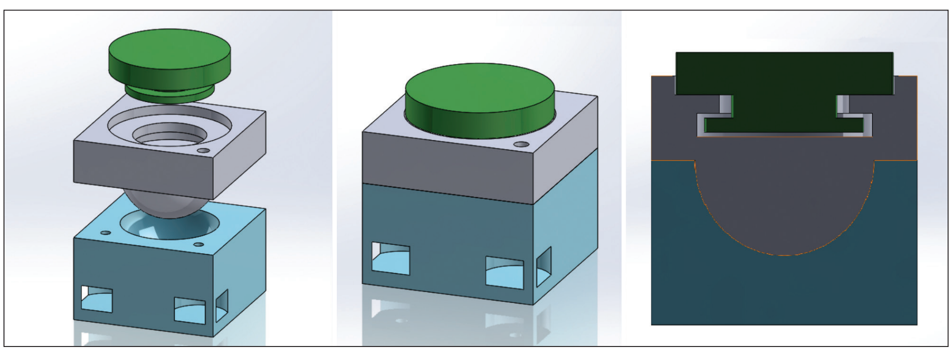


Figure 4. Sample engineering drawing title block.



3D Modeled Assembly (Exploded View)	3D Modeled Assembly (Isometric View)	3D Modeled Assembly (Cross-Sectioned View)

Figure 5. 3D modeled assembly views generated using 3D CAD software.

teams to critically analyze every aspect of the part and the manufacturing process. Creating a comprehensive engineering drawing requires careful consideration of fabrication, assembly, and measurement methods. Measurement capability is paramount in the engineering realm, as anything that cannot be measured is deemed nonexistent. Therefore, a thorough engineering drawing is essential for successful manufacturing. There are no substitutes or shortcuts; a thoughtful and complete engineering drawing is indispensable.

WILLIAM BOYCE is the Engineering Manager at SMART Microsystems. Mr. Boyce earned a Bachelor of Science in Engineering degree from the University of Rhode Island and has served in the field for over 20 years as a mechanical design engineer, process engineer, team leader, engineering Manager, and Global Engineering Director. In addition to his current role at SMART, he has held positions at General Dynamics, Texas Instruments, Sensata Technologies and TT Electronics. Mr. Boyce has also been a member of the IMAPS New England Chapter for over 10 years as a session chair. He is EIT certified, a Six Sigma Green Belt, and an industry recognized expert in Al wire bonding.