

## Engineering Notebook

An engineering notebook is a crucial part of the development of new items and the refinement of existing items. The engineering notebook not only documents the development of items, but allows for proof of development of ideas and provides a record of details that can be referred back to when necessary. Legally, engineering notebooks can be used when there is a question on the ownership of intellectual property, so it is important the notebook's chronological order can not be modified. For this reason, many prefer bound notebooks (such as composition notebooks) over electronic, three-ringed or spiral-bound notebooks.

Engineering notebooks entries typically start with the date of the entry, include detailed notes on the planning session/work session/scrimmage/competition, subtitles to help organize sections, detailed, labeled diagrams, results of any tests and trials, and comments and suggestions for future development. These entries should NOT be in a diary format, they should be documentation of the work done and the information which helps solve the design problem. The engineering notebook needs to show the iterations that happen throughout the design process.

Typically with the VEX Robotics Competition there are two major design problems. Designing a strategy to play the game and designing a robot to carry out the game strategy. The game strategy should include the competition game and if participating, the Driver's skills competition and/or the Programming skills competition. The robot design should include the structural component development (drive frame, support towers, arms, claws, buckets, cages, lifts, conveyor belts, etc. wheels), the actuators (motors, servos, pneumatics, rubber bands, surgical tubing, etc.) the control system ( micro-controller, batteries/power expanders, joystick, sensors) and programming.

The engineering notebook is required for any team who wants to be competitive for the Design award and is required as part of the World Championship Excellence award "have signed up for a Design Award interview (with their engineering notebook)"

The following is the description from the Design award engineering notebook:

### **Design Award - Engineering Notebook**

One of the primary missions of the VEX Robotics Competition is to help students acquire real world life skills that will benefit them in their academic and professional future. The Engineering Notebook is a way for teams to document how the VEX Robotics Competition experience has helped them to better understand the engineering design process while also practicing a variety of critical life skills including project management, time management, brainstorming and teamwork. The Engineering Notebook requirement of the Design Award has no specified format; each notebook should be created through a concerted effort by a team to document their design decisions. Throughout the season, many larger events will send their Design Award winner to World Championship, and as a result, teams should start their notebooks early and update them often. At the 2013 VEX Robotics World Championship, only teams that have kept Engineering Notebooks will be eligible for the Design Award.

Engineering is an iterative process. Iteration requires a student to recognize and define a problem, brainstorm and work through various stages of the design process, test their designs,

continue to improve their designs, and continue the process until a solution has been identified. During this process, students will come across obstacles, encounter instances of success and failure, and learn many lessons. It is this process that students should document in their Engineering Notebook.

Additionally, the Engineering Notebook is an opportunity to document everything a team does so that it can serve as a historical guide of lessons learned and best practices. Students may include a plethora of things in their Engineering Notebook including: team meeting notes, design concepts and sketches, pictures, notes from competitions, biographies of team members (students, teachers and mentors), team members' observations and thoughts, team organization practices, and any other documentation that a team finds useful.

### **Judging of Engineering Notebooks**

Creating and maintaining an Engineering Notebook is in no way "required or mandated" for teams participating in the overall VEX Robotics Competition. Although the Engineering Notebook is not required, maintaining an Engineering Notebook is highly recommended because the process can have many benefits for the team. For instance, the development of technical writing skills is a valuable tool to acquire. There is only one award given at the VEX World Championship (and some local events) which requires teams present their Engineering Notebook to the judges - the Design Award. However, all teams are encouraged to create an Engineering Notebook and bring it to events to show and discuss with Judges. If an event has scheduled judging sessions teams should bring their engineering notebook to the session. Judges are always interested in learning and seeing the various skills students acquire and demonstrate through their participation in the VEX Robotics Competition. Teams are welcome to bring support materials, flyers, team promotional materials and items such as an Engineering Notebook to events to share with judges. It is encouraged that all members of a team contribute to this project throughout the season.

Key Criteria:

- 1) Engineering Notebook is a clear, complete document of the team's design process
- 2) Team is able to explain their design and strategy throughout the season
- 3) Team demonstrates personnel, time and resource management through the season
- 4) Teamwork and interview quality

Intro to Robotics  
engineering notebook rubric  
(this is the rubric for Mr Kelly's ITR class)

Criteria	4	3	2	1
Game Strategy for Autonomous period	See GSAP	Missing 1 of criteria for a 4 or sub standard	Missing 2 of criteria for a 4 or sub standard	Missing 3 of criteria for a 4 or sub standard
Game Strategy for Operator Control period	See GSOCP	Missing 1 of criteria for a 4 or sub standard	Missing 2 of criteria for a 4 or sub standard	Missing 3 of criteria for a 4 or sub standard
Game Strategy for Driver Skills	See GSDS	Missing 1 of criteria for a 4 or sub standard	Missing 2 of criteria for a 4 or sub standard	Missing 3 of criteria for a 4 or sub standard
Game Strategy for Programming Skills	See GSPS	Missing 1 of criteria for a 4 or sub standard	Missing 2 of criteria for a 4 or sub standard	Missing 3 of criteria for a 4 or sub standard
Documentation of Structural components	See DSC	Missing 1 of criteria for a 4 or sub standard	Missing 2 of criteria for a 4 or sub standard	Missing 3 of criteria for a 4 or sub standard
Documentation of actuator use	See DAU	Missing 1 of criteria for a 4 or sub standard	Missing 2 of criteria for a 4 or sub standard	Missing 3 of criteria for a 4 or sub standard
Documentation on Control system	See DCS	Missing 1 of criteria for a 4 or sub standard	Missing 2 of criteria for a 4 or sub standard	Missing 3 of criteria for a 4 or sub standard
Documentation of Programming	See DP	Missing 1 of criteria for a 4 or sub standard	Missing 2 of criteria for a 4 or sub standard	Missing 3 of criteria for a 4 or sub standard
Engineering notebook layout	See ENL	Missing 1 of criteria for a 4 or sub standard	Missing 2 of criteria for a 4 or sub standard	Missing 3 of criteria for a 4 or sub standard

GSAP include: (for every autonomous sequence available)

- Sequence of events during the autonomous period
- outline of scoring path on the map of field
- method of control for path including variables (ex, dead reckoning forward for .5 seconds)
- expected points scored
- evidence of modification a game evolves
- notes of lessons learned from a competition

GSDOP include:

- Plan for scoring

- plan for defense
- Ideal sequence of events, mapped out on the field and points scored
- Alliance options (things to help or be helped by an alliance)
- evidence of modification as game evolves
- notes of lessons learned from a competition

GSDS includes

- Plan for scoring
- Ideal sequence of events, mapped out on the field
- plan for preloads
- expected points scored
- evidence of modification as game evolves
- notes of lessons learned from a competition

GSPS includes

- sequence of events
- outline of scoring path on the map of field
- method of control for path including variables (ex, dead reckoning forward for .5 seconds)
- expected points scored
- evidence of modification as game evolves
- notes of lessons learned from a competition

DSC includes

- concept drawings
- Labeled diagrams of structural components
- drive base design and justification
- all supporting structures, such as towers or platforms
- all manipulators such as plows, claws, arms , conveyors, etc.
- provide evidence that designs were researched ex you tube videos, VEX forum, etc.
- evidence of modification as design evolves

DAU includes

- listing of all activators, placement, and type (269 motors, 393 motors, old style 3 wire motors, servos, pneumatics, elastics, surgical tubing)
- justification of why an activator was selected
- document any gear/sprocket ratios (even if it is 1:1), including if the 393 is in high speed or low torque setup.
- Record motor performance as to how frequently they time out due to heat or other reason,
- evidence of modification as design evolves

DCS includes

- map of control system inputs and outputs
- Diagram of joystick functions and partner joystick if used
- Current firmware version and records of upgrades and/or downgrades
- Types of batteries and placement as well as power expander if present.
- List of any sensors and their intended purpose
- evidence of modification as design evolves

DP includes (note these could be in a supplementary set of papers/files)

- print out of fully commented autonomous program

- print out of fully commented operator control
- print out of any user functions
- print out of variables and constants
- evidence of modification as program evolves

ENL includes

- uses a notebook/file that sequence is not easily modified (such as a composition notebook)
- every entry is dated
- pages are numbered
- titles and subtitles are used
- adequate “white space” is used (everything is not crammed together)
- writing is legible
- ALL diagrams/drawings include labels and/or captions