Engineering Graphics with SOLIDWORKS 2015 and Video Instruction

A Step-by-Step Project Based Approach



David C. Planchard, CSWP, SOLIDWORKS Accredited Educator



Multimedia Disc

Includes Supplemental Files and Video Instruction

Better Textbooks. Lower Prices. www.SDCpublications.com

Visit the following websites to learn more about this book:



TABLE OF CONTENTS

Introduction	I-1
About the Cover	I-2
About the Author	I-2
Dedication	I-3
Contact the Author	I-4
Note to Instructors	I-4
Trademarks, Disclaimer and Copyrighted Material	I-4
References	I-5
Table of Contents	I-6
Overview of Chapters	I-15
Chapter 1: History of Engineering Graphics	I-15
Chapter 2: Isometric Projection and Multi View Drawings	I-15
Chapter 3: Dimensioning Practices, Tolerancing and Fasteners	I-16
Chapter 4: SolidWorks User Interface	I-17
Chapter 5: Introduction to SolidWorks Part Modeling	I-17
Chapter 6: Revolved Boss/Base Features	I-18
Chapter 7: Swept Boss/Base and Loft Boss/Base Features	I-18
Chapter 8: Assembly Fundamentals: Bottom-up method	I-18
Chapter 9: Drawing Fundamentals	I-19
Chapter 10: Introduction to the (CSWA) exam	I-19
Chapter 11: Additive Manufacturing	I-20
About the Book	I-21
Windows Terminology in SolidWorks	I-22
Chapter 1 - History of Engineering Graphics	1-1
Chapter Overview	1-3
History of Engineering Graphics	1-3
Global vs. Local Coordinate System	1-6
2D Cartesian Coordinate System	1-7
3D Cartesian Coordinate System	1-8
Absolute Coordinates	1-10
Relative Coordinates	1-10
Polar Coordinates	1-11
Cylindrical and Spherical Coordinates	1-11
Free Hand Sketching	1-12
General Sketching Techniques	1-13
Geometric Entities	1-14
Points	1-14
Lines	1-14
Planes	1-15
Circles	1-15
Arcs	1-16
Solid Primitives	1-16
Alphabet of Lines	1-17
Visible line	1-17
Hidden line	1-17
Dimension line	1-18

	1 10
Extension line	1-18
Leader line	1-19
Break line	1-20
Centerline	1-20
Phantom line	1-21
Section line	1-21
Cutting Plane line	1-22
Precedence of Line Types	1-23
Alphabet of Lines - Exercises	1-25
Projections in General	1-27
Projection Types	1-29
Parallel Projection	1-29
Perspective Projection	1-29
Orthographic Projection	1-29
Oblique Projection	1-29
Multiview Projection	1-30
Orient and Select the Front View	1-30
Orthographic Projection - Third Angle	1-31
Glass Box - Six Principal Views	1-32
Height, Width and Depth Dimensions	1-35
Transferring Dimensions	1-35
Sheet Media	1-36
ANSI Standard Sheet Sizes	1-36
Orthographic Projection - Exercises	1-37
Planes (Normal, Inclined and Oblique)	1-42
Plane - Exercises	1-43
Chapter Summary	1-49
Ouestions/Exercises	1-51
(
Chapter 2 - Isometric Projection and Multi View Drawings	2-1
Chapter Overview	2-3
Isometric Projections	2-3
Isometric Sketching	2-5
Circles Drawn in Axonometric Views	2-7
Additional Projections	2-9
Oblique Projections	2-9
Arrangement of Views	2-13
Two View Drawing	2-13
One View Drawing	2-16
Drawing - Evercises	2.10
Drawing Views - Advanced	2-17
Section View	2-21
Detail View	2-21
Detail View Proken out View	2-23
Drock or Proken View	2-24
Crop View	2-23
	2-20
Auxiliary view	2-27
Exercises	2-27
History of Computer Aided Design (CAD)	2-28
Boolean Operation	2-29
What is SolidWorks?	2-31

Design Intent	2-33
Design Intent in the Sketch	2-33
Design Intent in the Feature	2-34
Design Intent in the Part	2-34
Design Intent in the Assembly	2-35
Design Intent in the Drawing	2-35
Chapter Summary	2-36
Questions/Exercises	2-37
Chapter 3 - Dimensioning Practices, Scales, Tolerancing and Fasteners	3-1
Chapter Overview	3-3
American National Standards Institute (ANSI)	3-3
Dimensioning	3-4
Location	3-4
Size	3-4
Measurement - units	3-5
Metric/SI	3-5
English	3-5
Dual	3-6
Scales	3-7
Architect's Scale	3-7
Engineer's Scale	3-7
Linear Encoder	3-7
Vernier Scale	3-7
Standards for Dimensioning	3-8
Linear Dimension	3-8
Stagger Dimension	3-8
Aligned Dimension	3-9
Angular Dimension	3-9
Chamfer Dimension	3-10
Slot Dimension	3-10
Radius Dimension	3-11
Simple Hole Dimension	3-12
Fastener Dimension	3-13
Cylindrical Dimension	3-13
Equally Spaced Hole Dimension	3-15
Hole Dimension Location	3-15
Point/Center of a Circle Dimension	3-16
Arc Dimension	3-16
Order of Preference - Linear Dimension Line	3-17
Precision	3-17
Size Dimension	3-18
Continuous Dimensions	3-19
Principles of good Dimensioning	3-20
Precision and Tolerance	3-26
Tolerance for a Drawing	3-27
General Tolerance - Title Block	3-27
Local Tolerance - Dimension	3-28
Limit Tolerance	3-28
Unilateral Tolerance	3-29
Bilateral Tolerance	3-29

Formatting Inch Tolerance	3-29
Metric Dimension Specifications	3-30
Toleranced Parts and Important Terms	3-30
Fit - Hole Tolerance	3-32
Fit Types between Mating Parts	3-32
Clearance Fit	3-33
Interference Fit	3-33
Transition Fit	3-33
Fasteners in General	3-34
Representing External (Male) Threads	3-37
Cutting External (Male) Threads	3-38
Die	3-38
Lathe	3-38
Representing Internal (Female) Threads	3-39
Cutting Internal (Female) Threads	3-39
Taper	3-40
Plug	3-40
Bottoming	3-40
American National Standard and Unified Screw Threads	3-41
Single vs. Double or Triple Threads	3-41
Pitch and Major Diameter	3-42
Thread Class of Fit	3-42
Class 1	3-42
Class 2	3-42
Class 3	3-42
General Thread Notes	3-43
Dimensioning a CounterBore Hole	3-44
Dimensioning a CounterSink Hole	3-44
Chapter Summary	3-45
Questions/Exercises	3-46
Chapter 4 - Overview of SolidWorks and the User Interface	4-1
Chapter Objective	4-3
What is SolidWorks	4-3
Start a SolidWorks Session	4-4
Menu Bar Toolbar	4-5
Menu Bar Menu	4-5
Drop-down Menu	4-6
Create a new Part	4-6
Novice Mode	4-7
Advanced Mode	4-7
Graphic Interface	4-8
Open a Part	4-9
FeatureManager	4-10
Rollback Bar	4-10
Heads-up View toolbar	4-12
Zoom to Fit	4-12
Zoom to Area	4-12
Zoom In	4-12
Rotate	4-12
Standard Views	4-13

SolidWorks Help	4-13
SolidWorks Tutorials	4-14
Additional User Interface Tools	4-14
Right-click Context toolbar	4-15
Consolidated Toolbar	4-15
System Feedback Icons	4-15
Confirmation Corner	4-16
Heads-up View Toolbar	4-16
CommandManager	4-19
Part (default tab)	4-19
Drawing (default tab)	4-20
Assembly (default tab)	4-21
Float/Dock	4-22
Selection Enhancements	4-22
FeatureManager Design Tree	4-23
Fly-out FeatureManager	4-25
Task Pane	4-26
SolidWorks Resources	4-26
Design Library	4-27
File Explorer	4-27
Search	4-28
View Palette	4-28
Appearances, Scenes and Decals	4-29
Custom Properties	4-29
SolidWorks Forum	4-29
Motion Study tab	4-30
3D Views tab	4-31
Dynamic Reference Visualization	4-31
Mouse Movements	4-32
Chapter Summary	4-33
Chapter 5 - Introduction to SolidWorks Part Modeling	5-1
Chapter Overview	5-3
File Management	5-4
Start a SolidWorks Session and Open a New Part Document	5-5
Part Template	5-5
BATTERY Part	5-11
BATTERY Part-Extruded Boss/Base Feature	5-13
BATTERY Part-Fillet Feature	5-17
BATTERY Part-Extruded Cut Feature	5-19
BATTERY Part-Second Fillet Feature	5-21
BATTERY Part Extruded Boss/Base Feature	5-22
BATTERYPLATE Part	5-28
Save As, Delete, Modify and Edit Feature	5-29
BATTERYPLATE Part-Extruded Boss/Base Feature	5-31
BATTERYPLATE Part-Fillet Features: Full Round, Multiple Radius Options	5-32
Multi-body Parts and Extruded Boss Feature	5-35
Chapter Summary	5-36
Questions/Exercises	5-39

Chapter 6 - Revolved Boss/Base Features	6-1
Chapter Overview	6-3
LENS Part	6-4
LENS Part Revolved Boss/Base Feature	6-7
LENS Part-Shell Feature	6-8
LENS Part-Extruded Boss/Base Feature and Convert Entities Sketch tool	6-9
LENS Part-Extruded Boss/Base Feature	6-9
LENS Part-Hole Wizard Feature	6-10
LENS Part-Revolved Boss Thin Feature	6-12
LENS Part-Extruded Boss/Base Feature and Offset Entities	6-14
LENS Part-Extruded Boss/Base Feature and Transparent Optical Property	6-16
LENS Part-Transparent Optical Property	6-16
BULB Part	6-18
BULB Part-Revolved Base Feature	6-19
BULB Part-Revolved Boss Feature and Spline Sketch tool	6-21
BULB Part-Revolved Cut Thin Feature	6-23
BULB Part-Dome Feature	6-25
BULB Part-Circular Pattern Feature	6-26
BULB Part-Seed Cut Feature	6-28
BULB Part-Extruded Cut Feature	6-28
BULB Part-Circular Pattern Feature	6-29
Customizing Toolbars and Short Cut Keys	6-30
Chapter Summary	6-32
Ouestions/Exercises	6-33
	0.00
Chapter 7 - Swept, Lofted, Rib, Mirror and Additional Features	7-1
Chapter Overview	7-3
O-RING Part	7-4
O-RING Part-Swept Base Feature	7-4
SWITCH Part	7-8
SWITCH Part-Lofted Base Feature	7-8
SWITCH Part-Shape Feature	7-12
Four Major Categories of Solid Features	7-15
LENSCAP Part	7-15
LENSCAP Part-Extruded Boss/Base Feature	7-16
LENSCAP Part-Extruded Cut Feature	7-16
LENSCAP Part-Shell Feature	7-16
LENSCAP Part-Revolved Cut Thin Feature	7-19
LENSCAP Part-Thread Path Feature	7-20
LENSCAP Part-Helix/Spiral Curve Feature	7-20
LENSCAP Part-Swent Boss Feature	7-20
HOUSING Part	7-26
HOUSING Part-Extruded Boss/Base Feature	7-20
HOUSING Part-L ofted Boss Feature	7_29
HOUSING Part-Second Extruded Boss/Base Feature	7-33
HOUSING Part-Shell Feature	7-34
HOUSING Part-Third Extruded Boss/Base Feature	7-34
HOUSING Part-Draft Feature	7-35
HOUSING Part-Thread Feature	7-30
HOUSING Part-Swent Ross Feature	7-38
HOUSING Part-Handle Swept Boss Feature	7-30
noosnoo ran-nandie Swept Doss readic	7-43

HOUSING Dort Extra dod Cut Easture with UnToSurface Option	7 49
HOUSING Part-Extruded Cut Feature with OptoSurface Option	/-48
HOUSING Patt-Filst KID Feature	7-50
HOUSING Part-Linear Pattern Feature	7-50
HOUSING Part-Second Rid Feature	1-33
Chapter Summers	7-57
Chapter Summary	7-59
Questions/Exercises	/-01
Chapter 8 - Assembly Modeling - Bottom up method	8-1
Chapter Overview	8-3
Assembly Modeling Overview	8-3 8-4
FLASHLIGHT Assembly	8-6
Assembly Techniques	8-0 8-7
Assembly Techniques	8-8
Assembly Templates A SM_IN_ANSI	8-8
Assembly Templates ASM MM ISO	8.0
I ENSANDELL B Sub assambly	8 10
DATTEDVANDDI ATE Sub accombly	8-10 8-14
CADANDI ENS Sub accombly	0-14 9 16
ELASHI ICHT Assembly	8-10 8-20
FLASHLIGHT Assembly Interformed Issues	8-20
FLASHLIGHT Assembly Funded View	8-20 8-27
FLASHLIGHT Assembly Explored view	8-27
Charter Summers	8-30
Chapter Summary	8-33
Questions/Exercises	8-34
Chapter 9 - Fundamentals of Drawing	9-1
Chapter Overview	9-3
New Drawing and the Drawing Template	9-4
Title Block	9-7
Company Logo and Save Sheet Format	9-11
BATTERY Drawing	9-15
BATTERY Drawing - Insert a View	9-16
BATTERY Drawing - Detail View	9-10 9_10
BATTERY Drawing - View Display	9-20
BATTERY Drawing - View Display BATTERY Drawing - Insert Model Items and Move Dimensions	9.20
BATTERY Drawing - Insert a Note	0.23
Now Assembly Drawing and Exploded View	9-23
FLASHLIGHT Drawing Bill of Materials	9-23
FLASHLIGHT Drawing-Balloons	9_27
Part Numbers	9.20
FLASHLIGHT Drawing ConfigurationManager	9-29
FLASHLIGHT Drawing - ConfigurationWanager	9-30
O RING Part Design Table	9-30 0.20
O-RING Drawing	9-32 0 24
O PING Drawing Design Table	5-54 0.24
Contar of Mass point	5-34 0.26
Chapter Summery	7-30 0 27
Quastions/Exercises	9-37 0.20
Questions/Exercises	9-38

Chapter 10 - Introduction to the Certified Associate - Mechanical Design (CSWA)	
Exam	10-1
Chapter Objective	10-3
Introduction	10-3
Intended Audience	10-4
CSWA Exam Content	10-5
About the Exam	10-9
Exam day	10-9
Drafting Competencies	10-10
Basic and Intermediate Part Creation and Modification	10-12
Advanced Part Creation and Modification	10-18
Assembly Creation and Modification	10-24
Chapter 11 - Additive Manufacturing - 3D Printing	11-1
Chapter Objective	11-3
Additive Manufacturing	11-3
Saving a SolidWork Model to STL File Format	11-4
Preparing the 3D Printer	11-6
Non-Heated Build Plate	11-6
Heated Build Plate	11-6
Clean Build Surface	11-7
Level Build Plate	11-7
Control Build Area Temperature	11-7
3D Printer Filament	11-8
Preparing the Part model for Printing	11-10
Add/Insert	11-10
Scale	11-10
Part Orientation - Example 1	11-11
Part Orientation - Example 2	11-13
Key 3D Printing Terms	11-15
Rafts	11-15
Supports	11-16
Resolution	11-17
Slicer Engine	11-17
Quality	11-17
Infill	11-17
Number of Shells	11-17
Layer Height	11-18
Slicer Temperature	11-18
Slicer Speed	11-18
Slicer Profile	11-18
3D Printer Filament Materials	11-19
ABS - Storage	11-19
ABS - Smell	11-19
ABS - Part Accuracy	11-19
PLA - Storage	11-20
PLA - Smell	11-20
PLA - Part Accuracy	11-20
Material Summary of ABS and PLA	11-20
ABS	11-20
PLA	11-20

Introduction

Index	I-1
Glossary	G-1
SolidWorks Document types	A-6
Helpful On-Line information	A-5
Windows Shortcuts	A-4
SolidWorks Keyboard Shortcuts	A-3
Types of Decimal Dimensions (ASME Y14.5)	A-2
ECO Form	A-1
Appendix	
Chapter Summary	11-24
General Printing Tips	11-22
Understand Fit Tolerances for Interlocking Parts	11-21
Knowing the Printer's Limitation	11-21
Removing the Part from the 3D Printer	11-21

View the video instruction for additional help. Additional projects are included in the exercise section. Copy the components from the Homework folder. Create an ANSI Assembly document. Create and insert all needed components and mates to assemble the assembly and to simulate proper movement per the provided avi file located in the folders.



