

SOLIDWORKS®

SOLIDWORKS Essentials

Dassault Systèmes SolidWorks Corporation
175 Wyman Street
Waltham, MA 02451 U.S.A.

© 1995-2017, Dassault Systemes SolidWorks Corporation, a Dassault Systèmes SE company, 175 Wyman Street, Waltham, Mass. 02451 USA. All Rights Reserved.

The information and the software discussed in this document are subject to change without notice and are not commitments by Dassault Systemes SolidWorks Corporation (DS SolidWorks).

No material may be reproduced or transmitted in any form or by any means, electronically or manually, for any purpose without the express written permission of DS SolidWorks.

The software discussed in this document is furnished under a license and may be used or copied only in accordance with the terms of the license. All warranties given by DS SolidWorks as to the software and documentation are set forth in the license agreement, and nothing stated in, or implied by, this document or its contents shall be considered or deemed a modification or amendment of any terms, including warranties, in the license agreement.

Patent Notices

SOLIDWORKS® 3D mechanical CAD and/or Simulation software is protected by U.S. Patents 6,611,725; 6,844,877; 6,898,560; 6,906,712; 7,079,990; 7,477,262; 7,558,705; 7,571,079; 7,590,497; 7,643,027; 7,672,822; 7,688,318; 7,694,238; 7,853,940; 8,305,376; 8,581,902; 8,817,028; 8,910,078; 9,129,083; 9,153,072; 9,262,863; 9,465,894; 9,646,412 and foreign patents, (e.g., EP 1,116,190 B1 and JP 3,517,643).

eDrawings® software is protected by U.S. Patent 7,184,044; U.S. Patent 7,502,027; and Canadian Patent 2,318,706.

U.S. and foreign patents pending.

Trademarks and Product Names for SOLIDWORKS Products and Services

SOLIDWORKS, 3D ContentCentral, 3D PartStream.NET, eDrawings, and the eDrawings logo are registered trademarks and FeatureManager is a jointly owned registered trademark of DS SolidWorks.

CircuitWorks, FloXpress, PhotoView 360, and TolAnalyst are trademarks of DS SolidWorks.

FeatureWorks is a registered trademark of HCL Technologies Ltd.

SOLIDWORKS 2018, SOLIDWORKS Standard, SOLIDWORKS Professional, SOLIDWORKS Premium, SOLIDWORKS PDM Professional, SOLIDWORKS PDM Standard, SOLIDWORKS Simulation Standard, SOLIDWORKS Simulation Professional, SOLIDWORKS Simulation Premium, SOLIDWORKS Flow Simulation, eDrawings Viewer, eDrawings Professional, SOLIDWORKS Sustainability, SOLIDWORKS Plastics, SOLIDWORKS Electrical Schematic Standard, SOLIDWORKS Electrical Schematic Professional, SOLIDWORKS Electrical 3D, SOLIDWORKS Electrical Professional, CircuitWorks, SOLIDWORKS Composer, SOLIDWORKS Inspection, SOLIDWORKS MBD, SOLIDWORKS PCB powered by Altium, SOLIDWORKS PCB Connector powered by Altium, and SOLIDWORKS Visualization are product names of DS SolidWorks.

Other brand or product names are trademarks or registered trademarks of their respective holders.

COMMERCIAL COMPUTER SOFTWARE - PROPRIETARY

The Software is a "commercial item" as that term is defined at 48 C.F.R. 2.101 (OCT 1995), consisting of "commercial computer software" and "commercial software documentation" as such terms are used in 48 C.F.R. 12.212 (SEPT 1995) and is provided to the U.S. Government (a) for acquisition by or on behalf of civilian agencies, consistent with the policy set forth in 48 C.F.R. 12.212; or (b) for acquisition by or on behalf of units of the Department of Defense, consistent with the policies set forth in 48 C.F.R. 227.7202-1 (JUN 1995) and 227.7202-4 (JUN 1995)

In the event that you receive a request from any agency of the U.S. Government to provide Software with rights beyond those set forth above, you will notify DS SolidWorks of the scope of the request and DS SolidWorks will have five (5) business days to, in its sole discretion, accept or reject such request. Contractor/Manufacturer: Dassault Systemes SolidWorks Corporation, 175 Wyman Street, Waltham, Massachusetts 02451 USA.

Copyright Notices for SOLIDWORKS Standard, Premium, Professional, and Education Products

Portions of this software © 1986-2017 Siemens Product Lifecycle Management Software Inc. All rights reserved.

This work contains the following software owned by Siemens Industry Software Limited:

D-Cubed® 2D DCM © 2017. Siemens Industry Software Limited. All Rights Reserved.

D-Cubed® 3D DCM © 2017. Siemens Industry Software Limited. All Rights Reserved.

D-Cubed® PGM © 2017. Siemens Industry Software Limited. All Rights Reserved.

D-Cubed® CDM © 2017. Siemens Industry Software Limited. All Rights Reserved.

D-Cubed® AEM © 2017. Siemens Industry Software Limited. All Rights Reserved.

Portions of this software © 1998-2017 HCL Technologies Ltd.

Portions of this software incorporate PhysX™ by NVIDIA 2006-2010.

Portions of this software © 2001-2017 Luxology, LLC. All rights reserved, patents pending.

Portions of this software © 2007-2017 DriveWorks Ltd.

© 2011, Microsoft Corporation. All rights reserved.

Includes Adobe® PDF Library technology

Copyright 1984-2016 Adobe Systems Inc. and its licensors. All rights reserved. Protected by U.S. Patents 5,929,866; 5,943,063; 6,289,364; 6,563,502; 6,639,593; 6,754,382; Patents Pending.

Adobe, the Adobe logo, Acrobat, the Adobe PDF logo, Distiller and Reader are registered trademarks or trademarks of Adobe Systems Inc. in the U.S. and other countries.

For more DS SolidWorks copyright information, see Help > About SOLIDWORKS.

Copyright Notices for SOLIDWORKS Simulation Products

Portions of this software © 2008 Solversoft Corporation.

PCGLSS © 1992-2017 Computational Applications and System Integration, Inc. All rights reserved.

Copyright Notices for SOLIDWORKS PDM Professional Product

Outside In® Viewer Technology, © 1992-2012 Oracle

© 2011, Microsoft Corporation. All rights reserved.

Copyright Notices for eDrawings Products

Portions of this software © 2000-2014 Tech Soft 3D.

Portions of this software © 1995-1998 Jean-Loup Gailly and Mark Adler.

Portions of this software © 1998-2001 3Dconnexion.

Portions of this software © 1998-2014 Open Design Alliance. All rights reserved.

Portions of this software © 1995-2012 Spatial Corporation.

The eDrawings® for Windows® software is based in part on the work of the Independent JPEG Group.

Portions of eDrawings® for iPad® copyright © 1996-1999 Silicon Graphics Systems, Inc.

Portions of eDrawings® for iPad® copyright © 2003 - 2005 Apple Computer Inc.

Copyright Notices for SOLIDWORKS PCB Products

Portions of this software © 2017 Altium Limited.

Document Number: PMT1800-ENG

Contents

Introduction

About This Course	2
Prerequisites	2
Course Design Philosophy	2
Using this Book	2
About the Training Files	3
Conventions Used in this Book	4
Windows	4
Use of Color	5
Graphics and Graphics Cards	5
Color Schemes	5
More SOLIDWORKS Training Resources	6
Local User Groups	6

Lesson 1:

SOLIDWORKS Basics and the User Interface

What is the SOLIDWORKS Software?	8
Design Intent	10
Examples of Design Intent	11
How Features Affect Design Intent	11
File References	12
Object Linking and Embedding (OLE)	12
File Reference Example	13

Opening Files	14
Computer Memory	14
The SOLIDWORKS User Interface	15
Welcome Dialog Box	15
Pull-down Menus	16
Using the Command Manager	16
Adding and Removing CommandManager Tabs	17
FeatureManager Design Tree	17
PropertyManager	19
Full Path Name	19
Selection Breadcrumbs	19
Task Pane	20
Opening Labs with the File Explorer	21
Heads-up View Toolbar	21
Unselectable Icons	21
Mouse Buttons	22
Keyboard Shortcuts	22
Multiple Monitor Displays	23
System Feedback	23
Options	24
Search	26

Lesson 2:

Introduction to Sketching

2D Sketching	28
Stages in the Process	28
Saving Files	30
Save	30
Save As	30
Save As Copy to Disk	30
Save As Copy and Open	30
What are We Going to Sketch?	31
Sketching	31
Default Planes	31
Sketch Entities	33
Sketch Geometry	33
Basic Sketching	34
The Mechanics of Sketching	34
Inference Lines (Automatic Relations)	35
Sketch Feedback	37
Status of a Sketch	38
Rules That Govern Sketches	38
Design Intent	40
What Controls Design Intent?	40
Desired Design Intent	41

Sketch Relations	41
Automatic Sketch Relations	41
Added Sketch Relations	41
Examples of Sketch Relations	43
Selecting Multiple Objects	45
Dimensions	46
Dimensioning: Selection and Preview	47
Angular Dimensions	50
Instant 2D	51
Extrude	51
Sketching Guidelines†	54
Exercise 1: Sketch and Extrude 1	55
Exercise 2: Sketch and Extrude 2	56
Exercise 3: Sketch and Extrude 3	57
Exercise 4: Sketch and Extrude 4	58
Exercise 5: Sketch and Extrude 5	59
Exercise 6: Sketch and Extrude 6	60
Lesson 3:	
Basic Part Modeling	
Basic Modeling	62
Stages in the Process	62
Terminology	63
Feature	63
Plane	63
Extrusion	63
Sketch	63
Boss	63
Cut	63
Fillet and Rounds	63
Design Intent	63
Choosing the Best Profile	64
Choosing the Sketch Plane	65
Planes	65
Placement of the Model	65
Details of the Part	67
Standard Views	67
Main Bosses	67
Best Profile	67
Sketch Plane	68
Design Intent	68
Sketching the First Feature	69
Extrude Options	70
Renaming Features	70

Boss Feature	71
Sketching on a Planar Face	71
Sketching	71
Tangent Arc Intent Zones	72
Autotransitioning Between Lines and Arcs	72
Cut Feature	74
View Selector	75
Using the Hole Wizard	76
Creating a Standard Hole	76
Counterbore Hole	76
Filleting	78
Filleting Rules	78
Editing Tools	81
Editing a Sketch	81
Selecting Multiple Objects	81
Editing Features	82
Fillet Propagation	82
Rollback Bar	82
Detailing Basics	87
Settings Used in the Template	88
CommandManager Tabs	88
New Drawing	88
Drawing Views	89
Tangent Edges	91
Moving Views	92
Center Marks	93
Dimensioning	94
Driving Dimensions	94
Driven Dimensions	94
Manipulating Dimensions	96
Associativity Between the Model and the Drawing	99
Changing Parameters	99
Rebuilding the Model	99
Exercise 7: Plate	102
Exercise 8: Cuts	104
Exercise 9: Basic-Changes	107
Exercise 10: Base Bracket	109
Exercise 11: Part Drawings	113

Lesson 4: Symmetry and Draft

Case Study: Ratchet	116
Stages in the Process	116
Design Intent	117
Boss Feature with Draft	118
Building the Handle	118
Design Intent of the Handle	118
Symmetry in the Sketch	119
Symmetry after Sketching	120
Mid Plane Extrusion	121
Sketching Inside the Model	122
Design Intent of the Transition	122
Circular Profile	123
Sketching the Circle	124
Changing the Appearance of Dimensions	125
Extruding Up To Next	126
Design Intent of the Head	127
View Options	130
Display Options	131
Modify Options	131
Middle Mouse Button Functions	132
Reference Triad Functions	133
Keyboard Shortcuts	133
Using Model Edges in a Sketch	134
Sketching an Offset	135
Creating Trimmed Sketch Geometry	136
Trim and Extend	137
Modifying Dimensions	139
Measuring	142
Copy and Paste Features	144
Exercise 12: Pulley	147
Exercise 13: Symmetry and Offsets 1	150
Exercise 14: Ratchet Handle Changes	151
Exercise 15: Symmetry and Offsets 2	153
Exercise 16: Tool Holder	156
Exercise 17: Idler Arm	157
Exercise 18: Up To Surface	159

Lesson 5: Patterning

Why Use Patterns?	164
Pattern Options	168
Linear Pattern	169
Flyout FeatureManager Design Tree	170
Skipping Instances	171
Geometry Patterns	172
Performance Evaluation	173

Circular Patterns	175
Reference Geometry	176
Axes	176
Planes	178
Mirror Patterns	182
Patterning a Solid Body	183
Using Pattern Seed Only	184
Up To Reference	186
Sketch Driven Patterns	188
Points	189
Automatic Dimensioning of Sketches	191
Exercise 19: Linear Patterns	194
Exercise 20: Sketch Driven Patterns	195
Exercise 21: Skipping Instances	196
Exercise 22: Linear and Mirror Patterns	197
Exercise 23: Circular Patterns	198
Exercise 24: Axes and Multiple Patterns	199

Lesson 6: Revolved Features

Case Study: Handwheel	204
Stages in the Process	204
Design Intent	205
Revolved Features	205
Sketch Geometry of the Revolved Feature	205
Rules Governing Sketches of Revolved Features	207
Special Dimensioning Techniques	207
Diameter Dimensions	208
Creating the Revolved Feature	209
Building the Rim	211
Slots	211
Multibody Solids	214
Building the Spoke	214
Edge Selection	219
Chamfers	221
RealView Graphics	221
Edit Material	224
Mass Properties	227
Mass Properties as Custom Properties	228
File Properties	228
Classes of File Properties	228
Creating File Properties	229
Uses of File Properties	229
SOLIDWORKS SimulationXpress	231
Overview	231
Mesh	231

Using SOLIDWORKS SimulationXpress	232
The SimulationXpress Interface	233
Options	233
Phase 1: Fixtures	234
Phase 2: Loads	234
Phase 3: Material	235
Phase 4: Run	235
Phase 5: Results	236
Phase 6: Optimize	237
Updating the Model	238
Results, Reports and eDrawings	239
Exercise 25: Flange	241
Exercise 26: Wheel	242
Exercise 27: Guide	245
Exercise 28: Ellipse	249
Exercise 29: Sweeps	250
Slide Stop	250
Cotter Pin	250
Paper Clip	251
Mitered Sweep	251
Exercise 30: SimulationXpress	252
Lesson 7:	
Shelling and Ribs	
Shelling and Ribs	256
Stages in the Process	256
Selection Sets	257
Analyzing and Adding Draft	257
Draft Analysis	257
Other Options for Draft	258
Shelling	260
Order of Operations	260
Face Selection	260
Ribs	262
Rib Sketch	262
Section View	264
Converting Edges	266
Full Round Fillets	268
Thin Features	269
Exercise 31: Pump Cover	274
Exercise 32: Tool Post	275
Exercise 33: Compression Plate	278
Exercise 34: Blow Dryer	280
Exercise 35: Angles	283
Exercise 36: Arm	284
Exercise 37: Blade	285

Lesson 8: Editing: Repairs

Part Editing	288
Stages in the Process	288
Editing Topics	288
Information from a Model	288
Finding and Repairing Problems	289
Settings	289
What's Wrong Dialog	290
Flat Tree View	292
Where to Begin	293
Sketch Issues	294
Box Selection	295
Lasso Selection	295
Check Sketch for Feature	296
Repair Sketch	297
Repairing Sketch Plane Issues	302
FeatureXpert	305
Freezing Features	306
Exercise 38: Errors1	307
Exercise 39: Errors2	308
Exercise 40: Errors3	309
Exercise 41: Adding Draft	310

Lesson 9: Editing: Design Changes

Part Editing	312
Stages in the Process	312
Design Changes	312
Required Changes	313
Information From a Model	313
Part Reviewer	313
Dependencies	316
Rebuilding Tools	318
Rollback to Feature	318
Freeze Bar	318
Rebuild Feedback and Interrupt	318
Feature Suppression	319
General Tools	319
Deletions	319
Reorder	320
SketchXpert	322

Sketch Contours	328
Contours Available	328
Shared Sketches	330
Copying Fillets	331
Replace Sketch Entity	332
Exercise 42: Changes	335
Exercise 43: Editing	337
Exercise 44: SketchXpert	338
Exercise 45: Contour Sketches	340

Lesson 10: Configurations

Configurations	344
Terminology	344
Using Configurations	345
Accessing the ConfigurationManager	345
Adding New Configurations	346
Defining the Configuration	348
Changing Configurations	350
Renaming and Copying Configurations	350
Managing Configuration Data	351
Other Methods to Create Configurations	355
Modify Configurations	355
Design Tables	356
Other Uses of Configurations	356
Modeling Strategies for Configurations	357
Editing Parts that Have Configurations	358
Design Library	359
Default Settings	359
Multiple References	361
Dropping on Circular Faces	362
In the Advanced Course	364
Exercise 46: Configurations 1	365
Exercise 47: Configurations 2	367
Exercise 48: Configurations 3	368

Lesson 11: Global Variables and Equations

Using Global Variables and Equations	370
Renaming Features and Dimensions	370
Dimension Name Format	370
Design Rules Using Global Variables and Equations	373
Wall Thickness	373
Draft Angle	373
Rib thickness	373
Fillets	373

Global Variables	373
Creating Global Variables	373
Equations	375
Creating an Equality	375
Using the Modify Dialog	377
Using Operators and Functions.	380
Operators.	380
Functions.	380
File Properties.	381
Measure.	381
Equation Solve Order	381
Direct Input of Equations	382
Editing Equations	386
Exercise 49: Using Global Variables and Equations	388
Exercise 50: Using Global Variables	393
Exercise 51: Using Equations.	394
Lesson 12:	
Using Drawings	
More About Making Drawings.	396
Stages in the Process.	396
Section View	397
View Alignment	400
Model Views	401
Broken View	402
Detail Views	403
Drawing Sheets and Sheet Formats	404
Adding Drawing Sheets	404
Annotations.	407
Properties in Drawings	407
Notes	407
Copying Views	408
Datum Feature Symbols	409
Surface Finish Symbols	410
Dimension Properties	411
Centerlines	412
Geometric Tolerance Symbols	412
Dimension Text.	415
Exercise 52: Details and Sections.	416
Exercise 53: Broken Views and Sections	418
Exercise 54: Drawings	419

Lesson 13:**Bottom-Up Assembly Modeling**

Case Study: Universal Joint	422
Bottom-Up Assembly	422
Stages in the Process	422
The Assembly	423
Creating a New Assembly	424
Position of the First Component	425
FeatureManager Design Tree and Symbols	426
Degrees of Freedom	426
Components	426
Component Name	426
State of the component	427
Adding Components	429
Insert Component	429
Moving and Rotating Components	430
Mating Components	431
Mate Types and Alignment	432
Mating Concentric and Coincident	435
Width Mate	439
Rotating Inserted Components	442
Using the Component Preview Window	443
Parallel Mate	444
Dynamic Assembly Motion	445
Displaying Part Configurations in an Assembly	445
The Pin	446
Using Part Configurations in Assemblies	446
The Second Pin	448
Opening a Component	448
Creating Copies of Instances	450
Component Hiding and Transparency	451
Component Properties	453
Sub-assemblies	454
Smart Mates	455
Inserting Sub-assemblies	457
Mating Sub-assemblies	458
Distance Mates	459
Unit System	459
Pack and Go	461
Exercise 55: Mates	462
Exercise 56: Gripe Grinder	464
Exercise 57: Using Hide and Show Component	466
Exercise 58: Part Configurations in an Assembly	468
Exercise 59: U-Joint Changes	470

Lesson 14: Using Assemblies

Using Assemblies	474
Stages in the Process	474
Analyzing the Assembly	477
Mass Properties Calculations	477
Checking for Interference	478
Open Part	480
Checking for Clearances	481
Static vs. Dynamic Interference Detection	482
Performance Considerations	483
Changing the Values of Dimensions	485
Exploded Assemblies	486
Setup for the Exploded View	486
Assembly Explode	491
Rotations in Exploded Views	493
Changing the Explode Direction	493
Using Auto-Spacing	495
Explode Line Sketch	497
Explode Line Selections	497
Adjusting the Explode Lines	501
Animating Exploded Views	503
Bill of Materials	504
Assembly Drawings	507
Adding Balloons	509
Editing the Exploded View	509
Exercise 60: Using Collision Detection	512
Exercise 61: Finding and Repairing Interferences	513
Exercise 62: Checking for Interferences, Collisions and Clearances	515
Exercise 63: Exploded Views and Assembly Drawings	517
Exercise 64: Exploded Views	518

Appendix A: Templates

Options Settings	520
Changing the Default Options	520
Suggested Settings	520
Document Templates	520
How to Create a Part Template	521
Organizing Your Templates	522
Drawing Templates and Sheet Formats	523
Default Templates	523