



CADFIL-Axysm

The CADFIL®-Axysm package can generate winding programs for all rotationally symmetric components including pipes, spheres, gas bottles, golf shafts, storage tanks... the possibilities are endless. The following information briefly describes the basic stages of program generation and shows some of the many features of the system. Other software options exist for more complex parts such as pipe bends, Ts, and elliptical sections to name but a few of the options. Cadfil software operates on standard PC hardware using Windows.

The screenshot shows the 'Mandrel (X,R) Data Entry' dialog box with the following data table:

N	X	R	POINTS	RADIUS
1	0.000	50.000	0	0.000
2	100.000	50.000	8	200.000
3	300.000	250.000	4	100.000
4	395.000	181.225	9	-100.000
5	585.000	181.225	3	100.000
6	680.000	250.000	1	20.000
7	699.491	234.485	5	0.000
8	750.000	15.000	0	0.000
9	850.000	15.000	0	0.000

The dialog box also includes options for symmetry (No symmetry, X+ End Symmetry, X- End Symmetry), checkboxes for 'Point Labels' and 'Draw Expanded', and buttons for 'OK', 'Add Data', and 'Delete Data'. The main window shows a 2D wireframe model of a mandrel with a red fibre path overlaid.

The Mandrel Geometry and winding machine clearance envelope can be quickly entered and modified from a single easy to use dialogue box. The graphics and text windows are automatically updated.

Convex and concave arcs can be fitted between data positions and edited as required.

The clearance envelope allows close control whilst preventing machine collision with the mandrel. For simple shapes an envelope can be automatically created.

The screenshot shows the 'CADFIL60' software interface. The 'Cadfil Text Window' displays the following text:

```
READING FIBRE PATH DATA
Mesh calculation in progress
Mesh calculation finished
N 38 Alpha 166.8 Rad 41.1 Geodesic
N 38 Alpha 166.8 Rad 41.1 Geodesic
N 38 Alpha 166.8 Rad 41.1 Geodesic
Select hidden path display option
N 38 Alpha 166.8 Rad 41.1 Geodesic
Select options for fibre path laying
N 38 Alpha 166.8 Rad 41.1 Geodesic
```

The 'Cadfil Graphics Window' shows a 3D wireframe model of a sphere with a red fibre path overlaid. The 'Cadfil Menu' is visible on the left side of the interface.

Having created the mandrel geometry the user can interactively create non-slip geodesic fibre paths. Non-geodesic paths can be created using the friction facilities. In this way the user can control wind angles and turning diameters.

The 3D geometry and paths can be viewed from pre-set viewpoints or from any user-defined viewpoint.

For parts such as gradually tapered shafts (e.g. golf shafts) the user can generate constant wind angle (non-geodesic) paths using the constant angle option.

Having created fibre path with two turning points the software calculates the number of circuits required to cover the mandrel based on material parameters such as the fibre band width and the number and type of rovings to be used.

A band pattern table is created (see across) and the user can select the band structure required. If required the number of cycles can be adjusted to give alternative patterns.

The selected band structure can be viewed in the 3D viewing system (see below).

The user is given important data such as a thickness graph of the part and the amount of fibre used. Neutral file interfaces can be supplied to output data for Finite Element Software.

Machine positions are calculated using the envelope and saved to a data file. All CADFIL data files are text files and can be viewed if required.

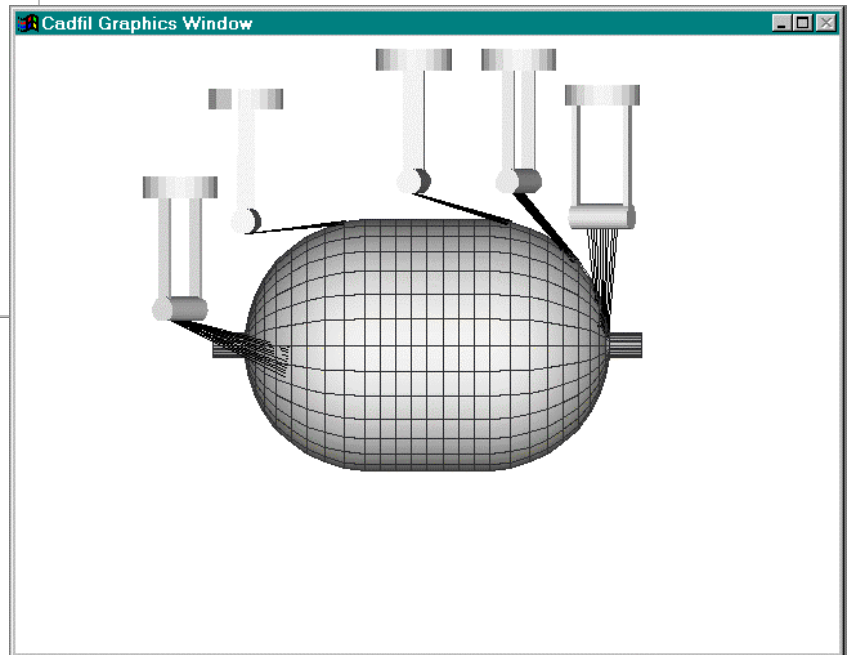
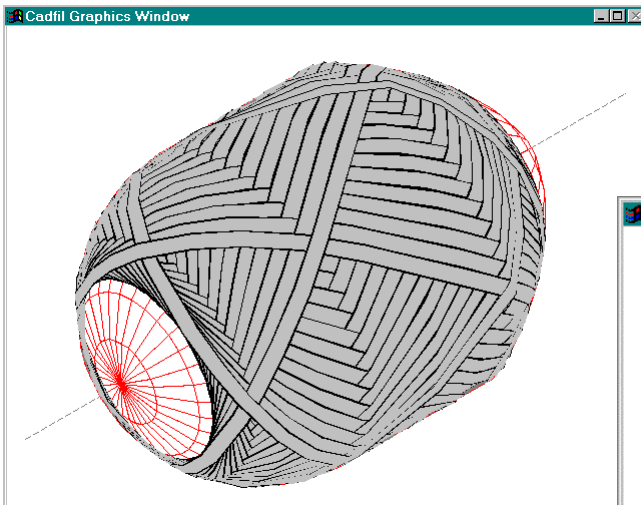
Band Pattern Selection

Number of cycles to

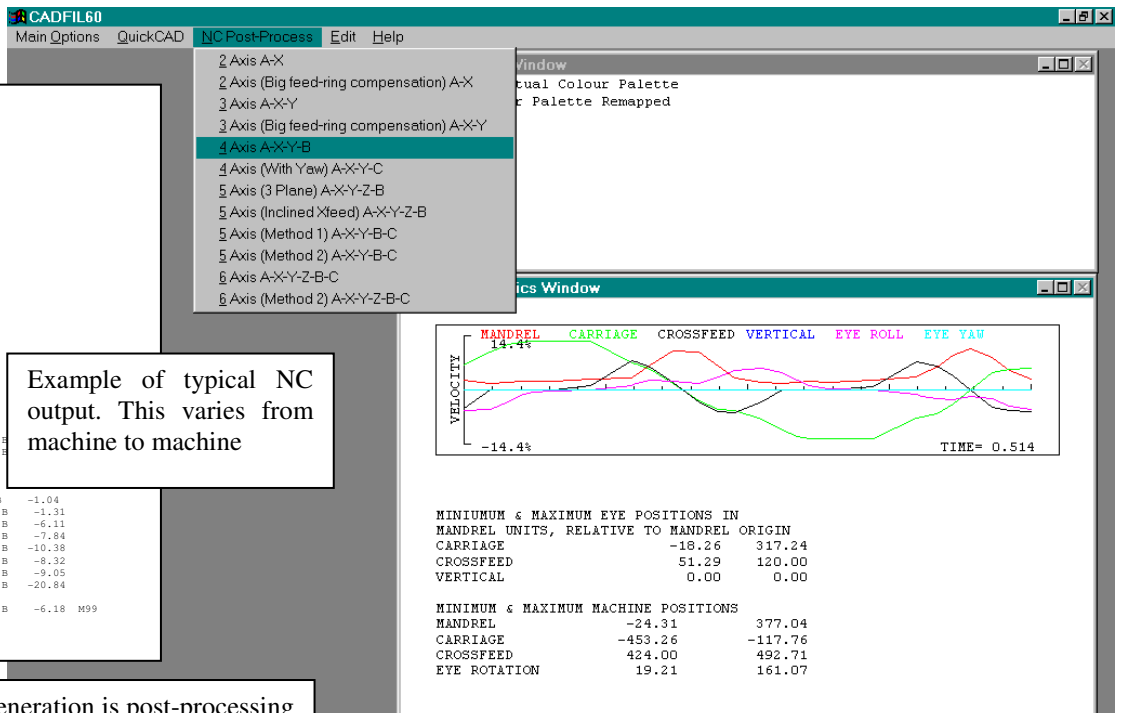
Initial Rotation

OPTION NO.	BAND PATTERN	NO. OF CYCLES	TARGET REVS	ANGULAR CHANGE	PROG. 1-PROG FACTOR
1	19	50	1. 151.20	0.38	1.0007 0.0007
2	21	50	1. 136.80	-14.02	0.9726 0.0274
3	13	50	1. 165.60	14.78	1.0289 0.0289
4	3	50	1. 122.40	-28.42	0.9444 0.0556
5	13	50	1. 194.40	43.58	1.0853 0.0853
6	23	50	1. 93.60	-57.22	0.8880 0.1120
7	19	50	1. 208.80	57.98	1.1135 0.1135
8	9	50	1. 79.20	-71.62	0.8598 0.1402
9	21	50	1. 223.20	72.38	1.1417 0.1417
10	11	50	1. 64.80	-86.02	0.8316 0.1684
11	3	50	1. 237.60	86.78	1.1699 0.1699
12	7	50	1. 50.40	-100.42	0.8034 0.1966
13	23	50	1. 266.40	115.58	1.2263 0.2263
14	17	50	1. 21.60	-129.22	0.7470 0.2530
15	9	50	1. 280.80	129.98	1.2545 0.2545
16	1	50	1. 7.20	-143.62	0.7188 0.2812
17	11	50	1. 295.20	144.38	1.2826 0.2826

Click on pattern, then OK to select or Set new cycle range and click Re-calculate Cancel sets no pattern modification



The machine positions can be displayed in 3D around the mandrel or if required the user can define the machine fibre dispensing head using brick and cylinder solid shapes and perform a full 3D animation including all machine motions such as eye roll and eye yaw. An example of this is shown in the panel opposite.



Example of typical NC output. This varies from machine to machine

```

%
O0000
N 10 G01 G94 G105 F 2000
(CADFIL V6.00, DATE 30/10/98)
(PAYOUT FILE NAME NEW3.PAY)
(BAND PATTERN 5)
(NO. OF CYCLES PER LAYER )
( 105)
(NUMBER OF LAYERS )
( 1)
.
.
N 15 G90
N 20 X -22.14 Y 446.85 B 90.00
N 25 M00
N 30 M21
#1 = 103
N 35 M98 P1030001
N 40 M28
(TOTAL ROTATION : 4257978.425)
(TOTAL TIME MINS: 5.49)
(NO. OF POINTS : 28)
N 40 M22
N 45 M00
N 50 M30

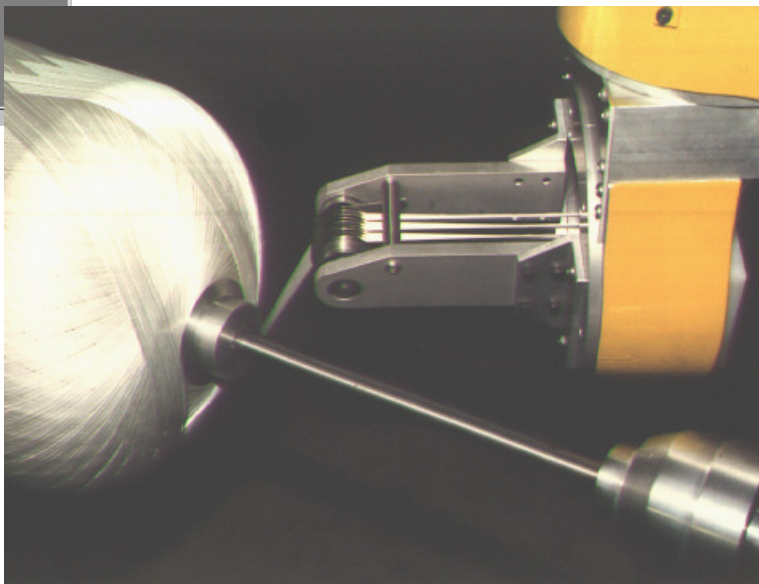
O0001
N 10 G01 G91 F 29000 A 10.46 X 23.46 Y
N 15 F 19877 A 4.90 X 24.87 Y 0.00 H
N 20 F 16557 A 3.58 X 18.95 Y 0.00 H
.
.
N 105 F 15523 A 19.04 X -75.75 Y 6.62 B -1.04
N 110 F 26524 A 3.16 X -5.74 Y 7.64 B -1.31
N 115 F 27866 A 10.37 X -14.66 Y 19.55 B -6.11
N 120 F 27604 A 15.72 X -13.64 Y 18.18 B -7.84
N 125 F 21916 A 26.79 X -9.26 Y 12.36 B -10.38
N 130 F 18451 A 36.94 X 0.00 Y 0.00 B -8.32
N 135 F 23042 A 25.78 X 11.10 Y -14.81 B -9.05
N 140 F 29000 A 17.70 X 16.07 Y -21.42 B -20.84
#1=#1 - 1
N 145 F 29000 A 2.54 X 3.95 Y -5.27 B -6.18 M99
%

```

The last stage of program generation is post-processing where the path is converted to machine control data. Numerous control options can be set dependant on the axes available on the machine. Different speed control options can be set to reduce winding time or limit axis accelerations. The software calculates the winding time.

Cadfil is supplied configured for the customers winding machine. Cadfil can be supplied with multiple machine configurations so that the user can select which machine is to be used. Cadfil can be configured for all filament winding machines types and control systems from 2 to 6 axes of control.

The picture opposite shows Cadfil in action on a 6-axis machine. The Cadfil control strategy eliminates band narrowing over the ends of the vessel



All Cadfil software is complete with datakey and a comprehensive online manual. Telephone support and software upgrades for the first 12 months are also included in the purchase price. Cadfil-Axsym also includes QuickCAD options for simple parametric program generation for pipes and dome ended vessels (Cadfil-Lite).

For further information on CADFIL-Axsym or other filament winding software contact:

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