The EB76 machine programs and thinks in Straight dimensions between bends. To determine these dimensions you can use two methods.

The first is to determine the arc length of each respective bend and then deduct ½ that value for each respective side of the bend. The formula is shown below.



Remember that 90 degree bends are the exception. Simply deduct the CLR of the tooling from each side.

The second alternative is to use the CLR of the tooling multiplied by the tangent of ½ the desired angle. A table of tangents is included.

ble of Tan(a)

https://www.grc.nasa.gov/www/k-12/airplane/tabltan.ht

<page-header></page-header>	• NOTING   • MARKA   • MOREFORMATION     • NETRONAL   • MOREFORMATION   • MOREFORMATION     • NETRONAL   • MOREFORMATION   • MOREFORMATION     • NETRONAL   • MOREFORMATION   • MOREFORMATION     • MARKA   • MOREFORMATION   • MOREFORMATION   MOREFORMATION     • MARKA   • MOREFORMATION   • MOREFORMATION   MOREFORMATION     • MARKA   • MOREFORMATION   • MOREFORMATION   MOREFORMATION     • MOREFORMATION   • MOREFORMATION   • MOREFORMATION   MOREFORMATION     • MOREFORMATION   • MOREFORMATION   • MOREFORMATION   MOREFORMATION     • MOREFORMATION   • MOREFORMATION   • MOREFORMATION   MOREFORMATION   MOREFORMATION     • MOREFORMATION   • MOREFORMATION   • MOREFORMATION   • MOREFORMATION   MOREFORMATION   MOREFORMATION   MOREFORMATION     • MOREFORMATION   • MOREFORMATION   • MOREFORMATION   • MOREFORMATION   MOREFORMOREFORMATION   MOREFORMATION   MOREFORM
Navigation Aerodynamics Index Propulsion Index Compressi Kite Index Wright Index Beginner's Guide Home Page	make copies of this form.

Example of 32 degree bend: 3.0(clr of bending die) x .2867 (tangent value of 16 degrees, ½ of 32) =0.8601 for the deduction to tangent.

The Springback program/function is designed to compensate for material elasticity and tensile.

Two angles are bent (a 20 degree and a 120 degree bend) the actual measured values are input into the respective fields.



In addition, the observed travel of the Y1 axis is put in the field named "Y motion". It is important to watch this axis during the test bend.

A test program is created with a 20 degree bend and a 120 degree bend. In Auto CYCLE it is possible to look at the position of all axes during the sequence.

	AUTOMATIC CYCLE	29.12.28 - 7:38:33 AN
	sents	•
Program selected	c:\cml56\job\DEM0.pol	MAIN
Comment		DISPLAY AXES
Toolset	c:\cml56\job\R76 1.5 TUBE.die	
Tube Springback	Teo mice Post	O DISPLATION MAN
Pieces to do	0 Done U Hind	DISPLAY BLOCKS
Status		1120
Message		
	STARTAUTO	PARAMETERS
	PRG CONTROL PRG SELECT O	
AUTO		

			AUTOMATIC CYCLE		<b>29.12.28</b> - 7:38:38 AM
No ala	arms presen	ts			
	Actual position	PROG position	Distance to go	Feed	MAIN
Y1	27.5016	27.5016	0.0000	680.0	
B	329.51	329.51	0.00	100.0	DISPLAYAXES
C	359.93	359.93	0.00	60.0	Die Contraction of the Contracti
X1 <sup>[mch]</sup>	0.0000	0.0000	0.0000	100.0	DISPLAY FUNCTIONS
X2	7.3618	7.3618	0.0000	0.0	
Y2	0.0030	0.0030	0.0000	0.0	DISPLAY BLOCKS
V3 <sup>(moh)</sup>	-1.8120	-1.8120	0.0000	0.0	1130
10					1121 1132

Before the 120 bend starts, look at the Y1 actual position and write it down. It is possible to stop midcycle in Automatic by lifting your finger off the center actuator button. The cycle will resume when depressed again.

Once the 120 bend is complete, lift your finger again and not the Y1 actual position. The difference in the Y1 position values is the value input on the springback file.

Input the observed value on the front page of the spring back file. Y1 Motion During Deep Angle

		29.12.28 - 7:31
Comment		
Tube OD Tube thickness Bend die radius C axis deep angle C axis shadow angle Measured deep angle Measured shadow angle Y motion during deep angle	1.6600 0.1400 3.0000 120.00 20.00 116.70 17.60 5.9100	
	0.0000 0.00 0.00 0.00 0.00 0.000	Save
COEFF		ESC

Press SAVE and then CALCULATE COEFFICIENT

The screen will automatically roll to the second page

				Webback FR c			
							29.12.28 - 7:
Comment							
	a	b	A%mes	A%theo	Thickness	Tube radius	
Stack 1	1.0091	2.2402	3.3	27.7	0.110	3.03	
Stack 2							
Stack 3							-
Stack 4					•		
							1
							Sav

Press SAVE again

Please note the value populated in the TUBE RADIUS

In this example it is 3.03 The tooling has a stated radius of 3.0 This value is the calculated radius based upon the actual observed values input.

Theoretical 120 degree bend  $120 \times 3 \times .0175 = 6.3$ 

This is the theoretical arc length. The actual observed Y1 travel or arc length was 5.91

The program will use the radius of 3.03 for all corrections once applied.

With the springback file complete, it is now available for use on the polar files.

					29.12.28 - 7:37:28 AH
ent	RAIL				
et back	c:\cml56\job\R76 1.5 TUBB c:\cml56\job\1.25 PIPE.sp	E.die			
OD Thickness al	1.6600 0.1400 145.0000				
engin shape 2nd dimension	0.0000				Save
			BENDS DATA	GRAPHIC	ESC

Double click the yellow springback field. Click Springback files, select correct file and double click to attach to polar/program file.

Press SAVE when finished.

Press the CORR button on the bottom of the page. This will take you to the CORRECTIONS page

Comment     RAIL     Spring Back C       Calculated tube length     130.0198 (130.1303)     Enerds corrections     Enerds corrections     Reset SE       #     DBB/SB     DOB/SB     DBB     POB     DOB     Σ DBB     Σ DOB     3.06     1.0.0859     3.06     0.0000     0.000     -0.0859     0.00     3.06     2.0.1524     2.53     0.0000     0.000     -0.1524     0.00     3.06     2.0.000     0.000     0.000     -0.0859     0.00     3.06     Calculated     4.0.0859     0.00     0.000     2.53     Calculated     4.0.00     3.06     Calculated     Calculated     2.0.000     0.000     0.000     0.000     0.000     2.53     Calculated     4.0.0859     0.00     0.000     0	ACML56UO	BRAILPOL				POL	AR FILE				29.12.28 - 7:37:
Calculated tube rengin     Bends corrections     Ends corrections     Reset S.E       #     DBB/SB     DOB/SB     DBB     POB     DOB     Σ DBB     Σ POB     Σ DOB     Calculated tube rengin     Calculated tube rengin     Reset S.E       #     DBB/SB     DOB/SB     DBB     POB     DOB     Σ DBB     Σ POB     Σ DOB     Calculated tube rengin     Calculated tube rengin </th <th>Com</th> <th>ment</th> <th></th> <th>130 0199 (</th> <th>130,1303)</th> <th></th> <th></th> <th></th> <th></th> <th>RAIL</th> <th>Spring Back Calcu</th>	Com	ment		130 0199 (	130,1303)					RAIL	Spring Back Calcu
**     DBB/SB     DOB/SB	Calcu	lated tube I		BB PO	Bends corr B DOE	rections 3 Σ	DBB <u>S</u> P	OB ED	OB	-	Reset S.B. Co
11     0.0000     0.000     0.00     0.000     0.	# 1 2 3 4 5 6 7 8 9 10 11 12 13	-0.0859 -0.1524 -0.1524 -0.0859 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	3.06 2.53 3.06 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	-0.0859 -0.1524 -0.1524 -0.0859 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00	2.53 3.06 0.00 0.00 0.00 0.00 0.00 0.00 0.0		Calculate All C Reset All Ca Save

## Press SPRING BACK CALCULATION and CALCULATE ALL CORR. Press SAVE

Two corrections are automatically applied:

DBB/SB This is a Distance Between Bends correction. The values in this field are always a small negative number. In the picture above, Line 1 has a DBB/SB of -0.0859

How it works: On the LRA program page the first straight length is 6 inches (see below)

The machine will actually position for the first line at 6 minus 0.0859 = 5.9141

And the same calculation is performed for all successive lines.

## IT IS IMPORTANT TO LOOK AT THE VALUES IN THE DBB/SB COLUMN AND ENSURE THEY ARE SMALL NEGATIVE VALUES!!!!

ML56L	JOBRAILPOL				POLAR FI	LE		<mark>29.12.28</mark> - 7:37:28 8
Con	nment						RA	IL
				Bends D	Data Polar		d	
ŧ	Length	Rotation	Angle	Radius	Arc Length	139 0000	134 2876	
1	6.0000	0.00	90.00	3.0000	4.7124	125 8676	124.1921	Delete
2	8.4200	90.00	32.00	3.0000	4 7124	39.5821	34.8697	
3	84.6100	180.00	90.00	0.0000	0.0000	14.8697	14.8697	
4	20.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	Mirror
5	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	
6	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	
7	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	Reverse
8	0.0000	0.00	0.00	0.0000	0.0000 0	0.0000	0.0000	
9	0.0000	0.00	0.00	0.0000	0.0000 0	0.0000	0.0000	
10	0.0000	0.00	0.00	0.000	0.0000	0.0000	0.0000	Save
11	0.0000	0.00	0.00	0.000	0.0000	0.0000	0.0000	
12	0.0000	0.00	0.00	0.000	0 0.0000	0.0000	0.0000	
13	0.0000	0.00	0.00	0.000	0 0.0000	) 0.0000	0.000	

The second correction is for Degree of Bend DOB/SB

Based upon the actual measured values of the test angles (20 and 120), the program compensates for the bend angle.

		FOL	AR FILE		RAIL	29.12.28 - 7:37:28 # Spring Back Calculation
Calculated tube length       #     DBB/SB     DOB/SB       1     -0.0859     3.06       2     -0.1524     2.53       3     -0.1524     3.06       4     -0.0859     0.00       5     0.0000     0.00       6     0.0000     0.000	130.0199     (130.7       BBB     POB       0.0000     0.1       0.0000     0.1       0.0000     0.1       0.0000     0.1       0.0000     0.1       0.0000     0.1       0.0000     0.1       0.0000     0.1       0.0000     0.1       0.0000     0.1       0.0000     0.1       0.0000     0.1	DOB     Σ       00     0.00       00     0.00       00     0.00       00     0.00       00     0.00       00     0.00       00     0.00       00     0.00       00     0.00       00     0.00       00     0.00       00     0.00       00     0.00	DBB Σ PC -0.0859 -0.1524 -0.1524 -0.0859 0.0000 0.0000 0.0000	DB Σ DC 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	B -   3.06 -   2.53 -   3.06 -   0.00 -   0.00 -   0.00 -   0.00 -   0.00 -   0.00 -	Reset S.B. Corr. Calculate All Corr Reset All Corr.
7     0.0000     0.000       8     0.0000     0.000       9     0.0000     0.000       10     0.0000     0.000       11     0.0000     0.000       12     0.0000     0.00       13     0.0000     0.00       14     0.0000     0.00	0.0000     0       0.0000     0       0.0000     0       0.0000     0       0.0000     0       0.0000     0       0.0000     0       0.0000     0       0.0000     0       0.0000     0       0.0000     0       0.0000     0	0.00     0.00       0.00     0.00       0.00     0.00       0.00     0.00       0.00     0.00       0.00     0.00       0.00     0.00       0.00     0.00       0.00     0.00       0.00     0.00       0.00     0.00       0.00     0.00	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0.00 0.00 0.00 0.00 0.00 0.00	0.00 0.00 0.00 0.00 0.00 0.00	Save
	үвс	CORE	BEND	DS DATA	GRAPHIC	ESC

## IF DISTANCES BETWEEN BENDS ARE NOT CORRECT:

- 1. CHECK VALUES INPUT ON LRA PAGE FOR ACCURACY
- 2. <u>CHECK VALUES ON DBB/SB COLUMN ON CORRECTIONS PAGE</u>
- 3. <u>REPEAT SPRINGBACK TEST PROCEDURE AND BE AWARE OF Y1 MOTION DURING DEEP ANGLE</u> <u>AND ACCURATELY MEASURE ANGLES PRODUCED.</u>