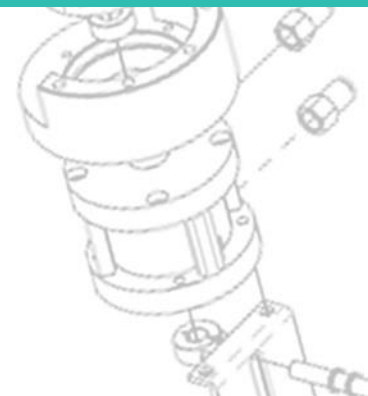
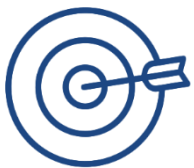




Programming Workbook

WORKBOOK



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INTRODUCTION

HOW TO USE THIS WORKBOOK: This workbook is designed as an aid for you to use after you've participated in the 3D AccuForm Synchro Training Course. After partaking in the training course, this workbook will guide you through the steps you need to take to set up your own 3D AccuForm Synchro machine for use.



Goals

Upon completion of this course, you will be able to:

- ① Set up your own 3D AccuForm Machine and have it ready for use to bend wire to your specifications.



Tip

This icon will be used throughout the workbook to give additional information.



Caution

This icon will be used throughout the workbook as a symbol to use caution when performing an action.



Note

This icon will be used throughout the workbook as a section for you to jot down notes to assist you with setting up your 3D AccuForm Machine.

PROGRAMMING



Workbook Snapshot

In the past several modules, we covered how to program a part using the 3D AccuForm Synchro machine. An overview of how to create common bends was provided along with step-by-step instructions that walk through how to create 2D and 3D parts using SmartEditor®. The programming steps covered demonstrated how to create the following forms:

1. Positive Bend
2. Curve
3. Pin Offset
4. Eye Loop
5. 3D Form

It's now time to put it all together and practice programming 2D and 3D parts that include a combination of the forms listed above.

The following pages contain sample part drawings. These drawings can be formed using SmartEditor® and confirmed using the machine animation feature. The drawings can also be used with any available tools on the machine.



Note

When creating the following samples, it may be necessary to slightly modify the parts to conform to the capabilities of the tools available.



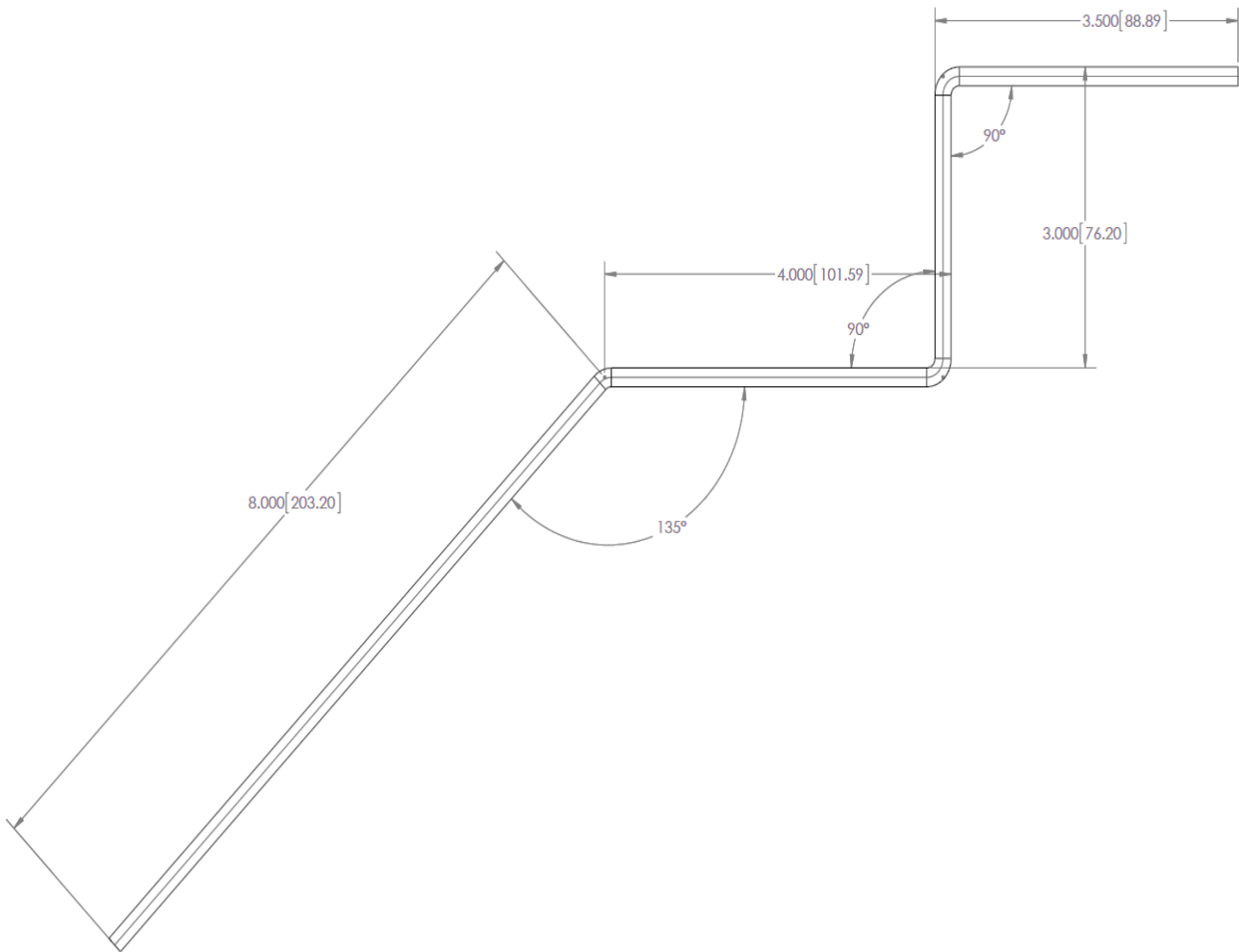
Tip

The sample part drawings are provided with a blank programming grid to record the program for future reference.



Create a 2D Part - #1 Activity

Use your own 3D AccuForm Machine, and the part print shown to program the part in SmartEditor®. For more detailed instruction, go to Module 13: Create a Positive Bend. Review the Programming Tips and Keyboard Shortcuts found in the Resources section of this workbook to assist you.



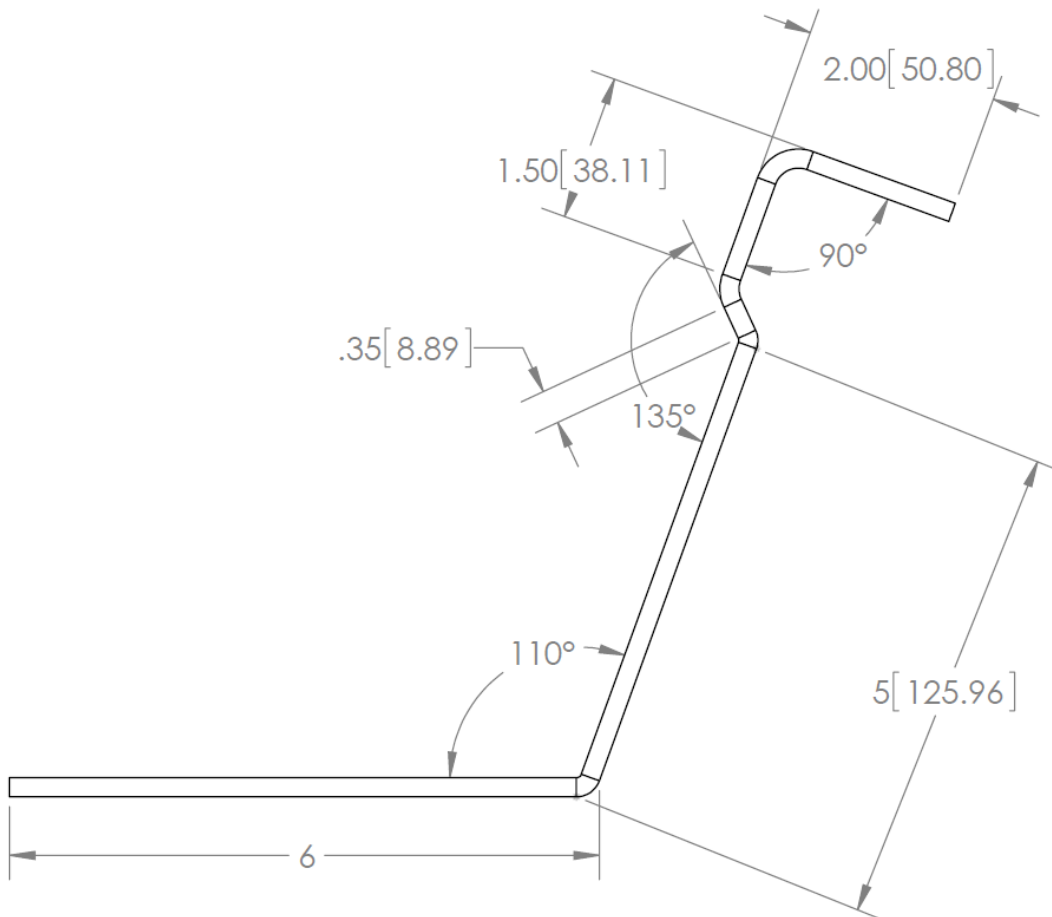
PROGRAMMING

	Step	Length	Spd	Angle	Mandrel	Spd	Flags	Radius
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Create a 2D Part - #2 Activity

Use your own 3D AccuForm Machine, and the part print shown to program the part in SmartEditor®. For more detailed instruction, go to Module 13: Create a Positive Bend and Module 15: Create a Pin Offset.



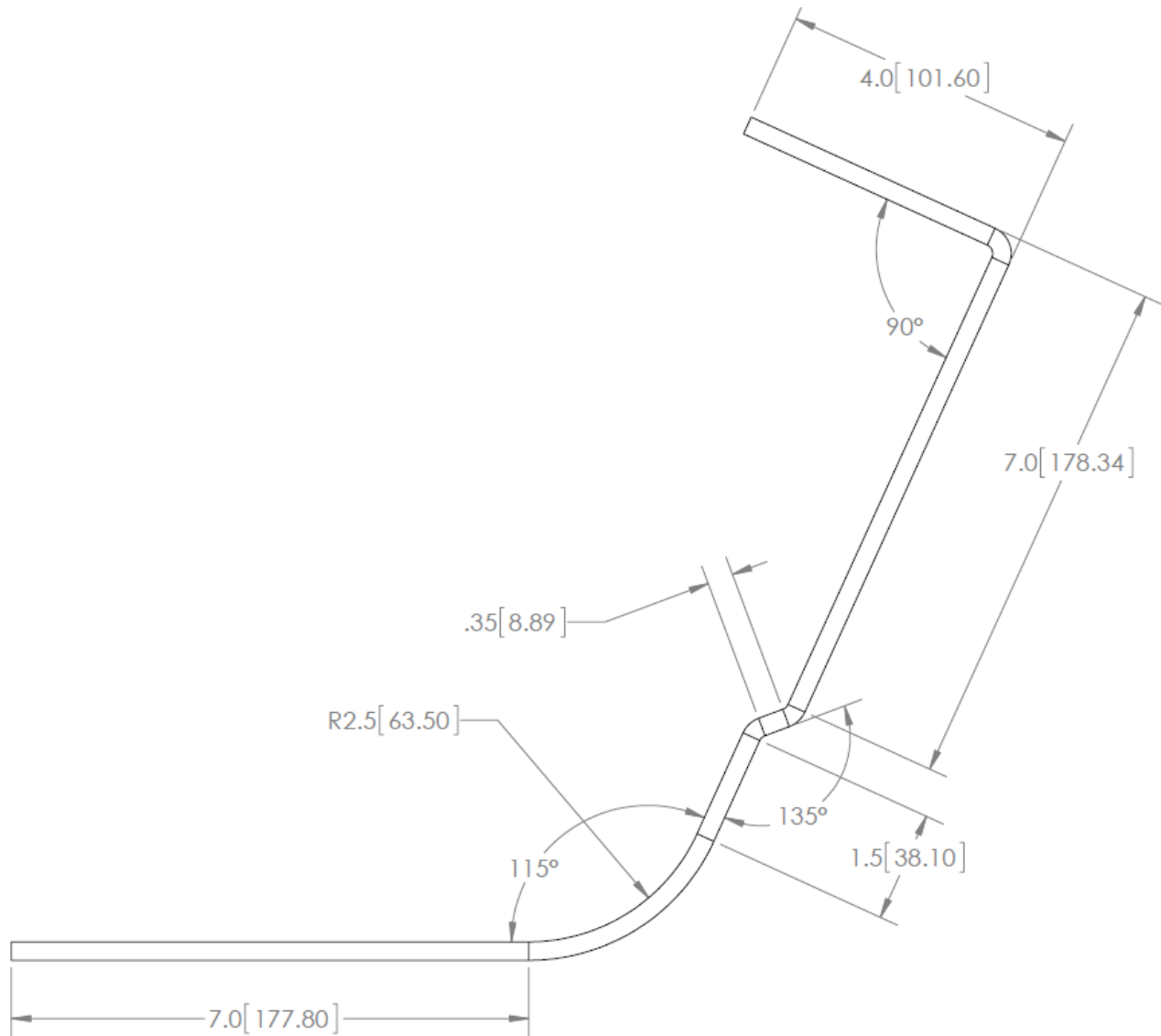
PROGRAMMING

	Step	Length	Spd	Angle	Mandrel	Spd	Flags	Radius
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Create a 2D Part - #3 Activity

Use your own 3D AccuForm Machine, and the part print shown to program the part in SmartEditor®. For more detailed instruction, go to Module 13: Create a Positive Bend, Module 14: Create a Curve and Module 15: Create a Pin Offset.

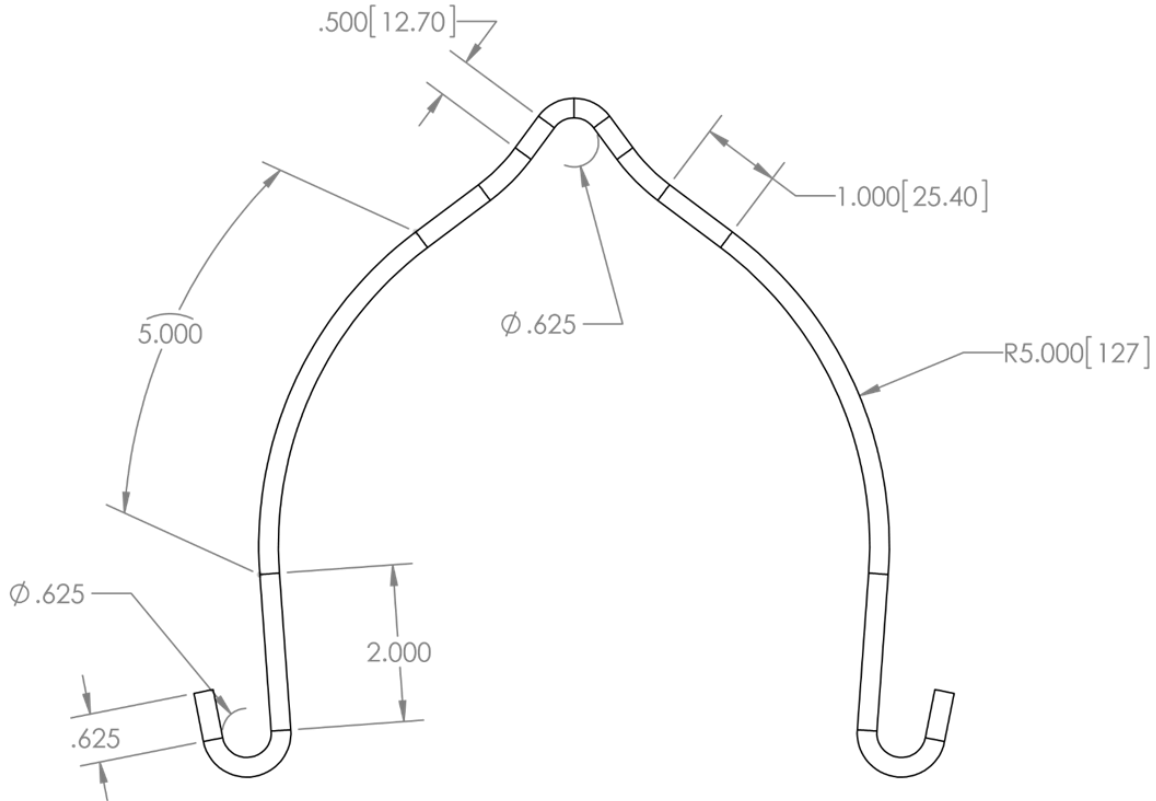


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Create a 2D Part - #4 Activity

Use your own 3D AccuForm Machine, and the part print shown to program the part in SmartEditor®. For more detailed instruction, go to Module 13: Create a Positive Bend and Module 14: Create a Curve.

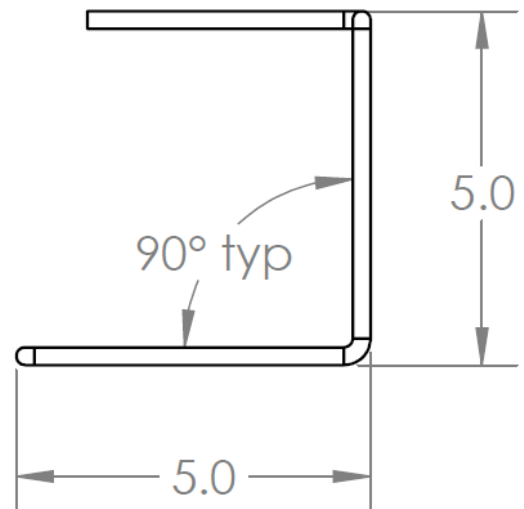
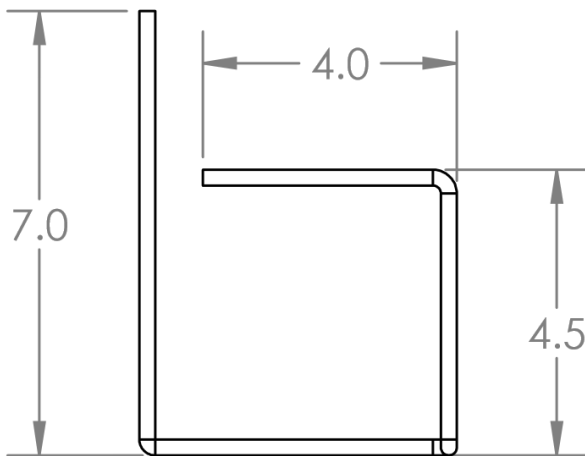
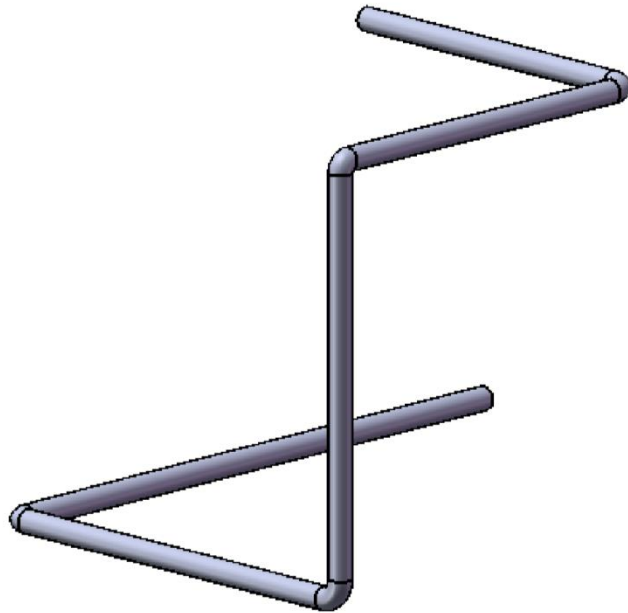


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Create a 3D Part - #1 Activity

Use your own 3D AccuForm Machine, and the part print shown to program the part in SmartEditor®. For more detailed instruction, go to Module 17: Create a 3D Form.



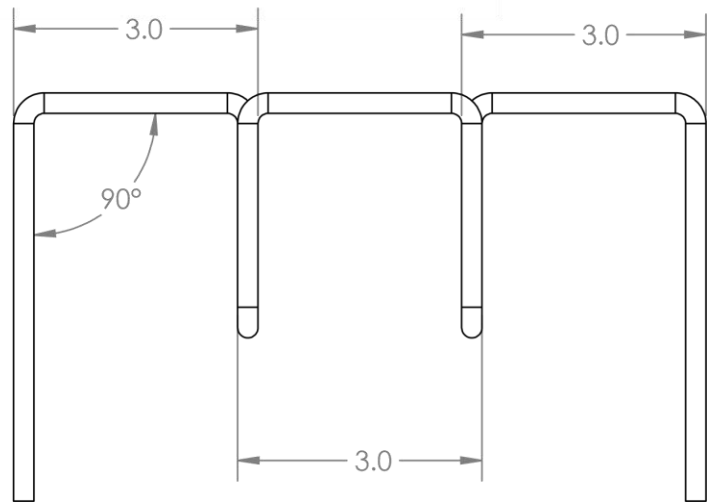
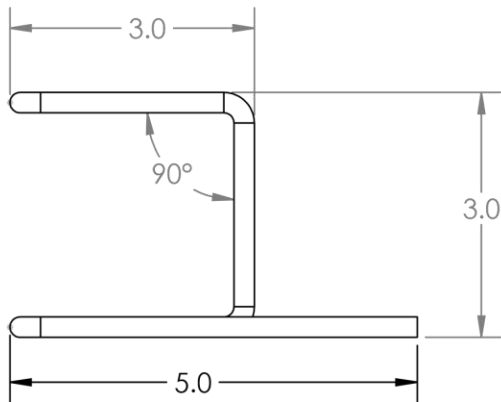
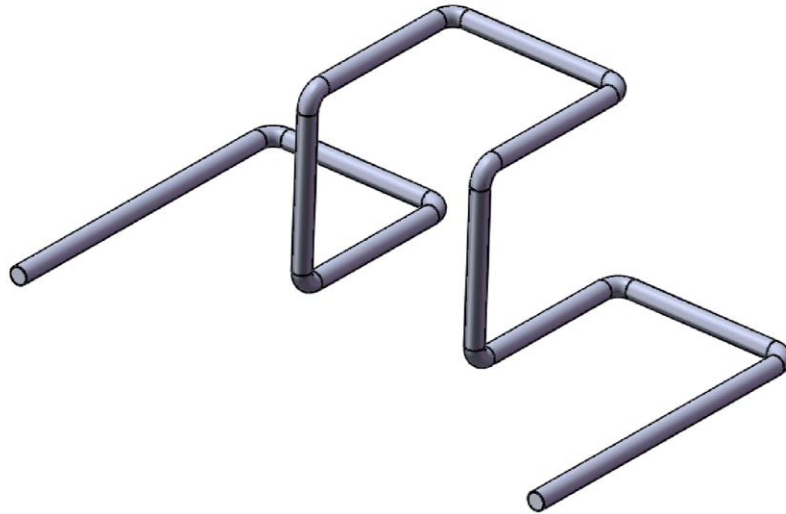
PROGRAMMING

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Create a 3D Part - #2 Activity

Use your own 3D AccuForm Machine, and the part print shown to program the part in SmartEditor®. For more detailed instruction, go to Module 17: Create a 3D Form.

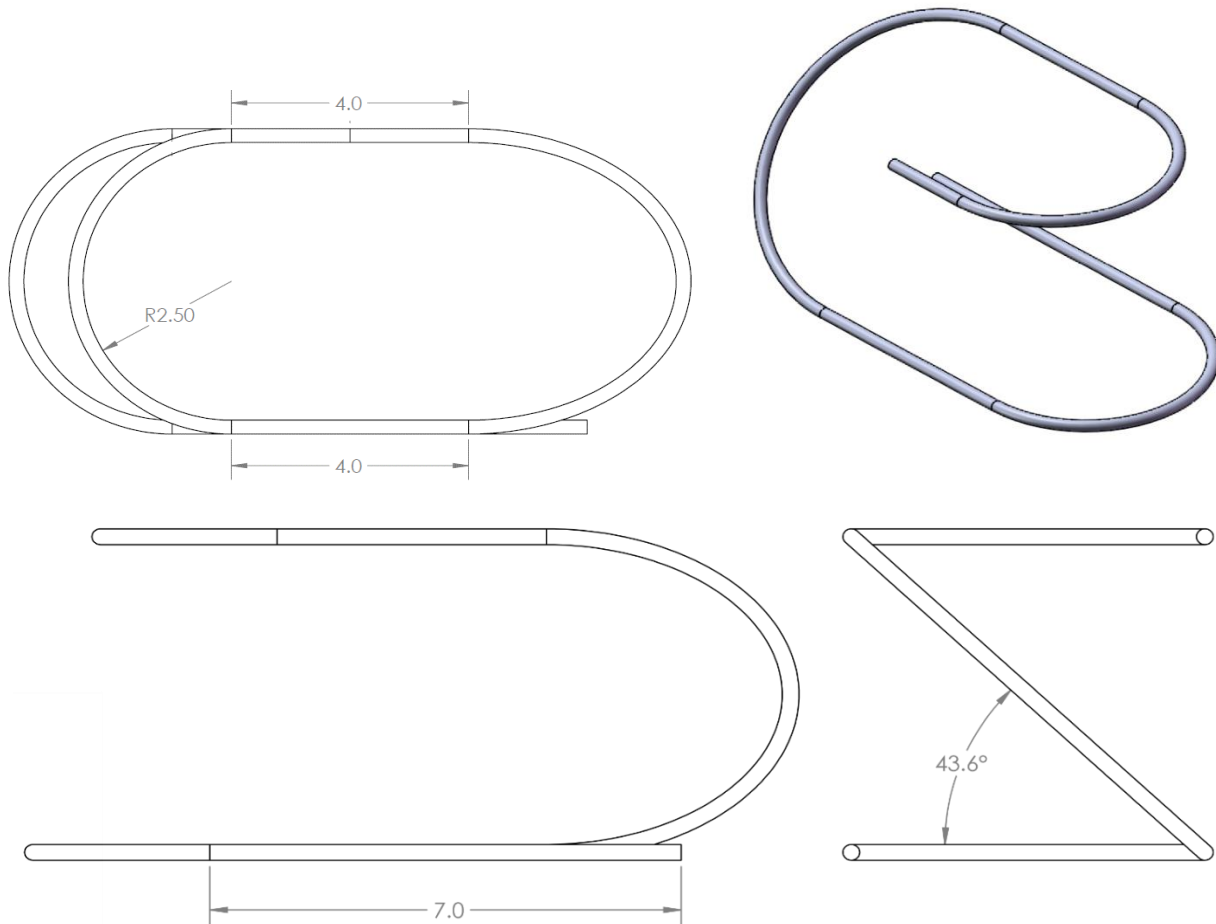


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Create a 3D Part - #3 Activity

Use your own 3D AccuForm Machine, and the part print shown to program the part in SmartEditor®. For more detailed instruction, go to Module 17: Create a 3D Form.



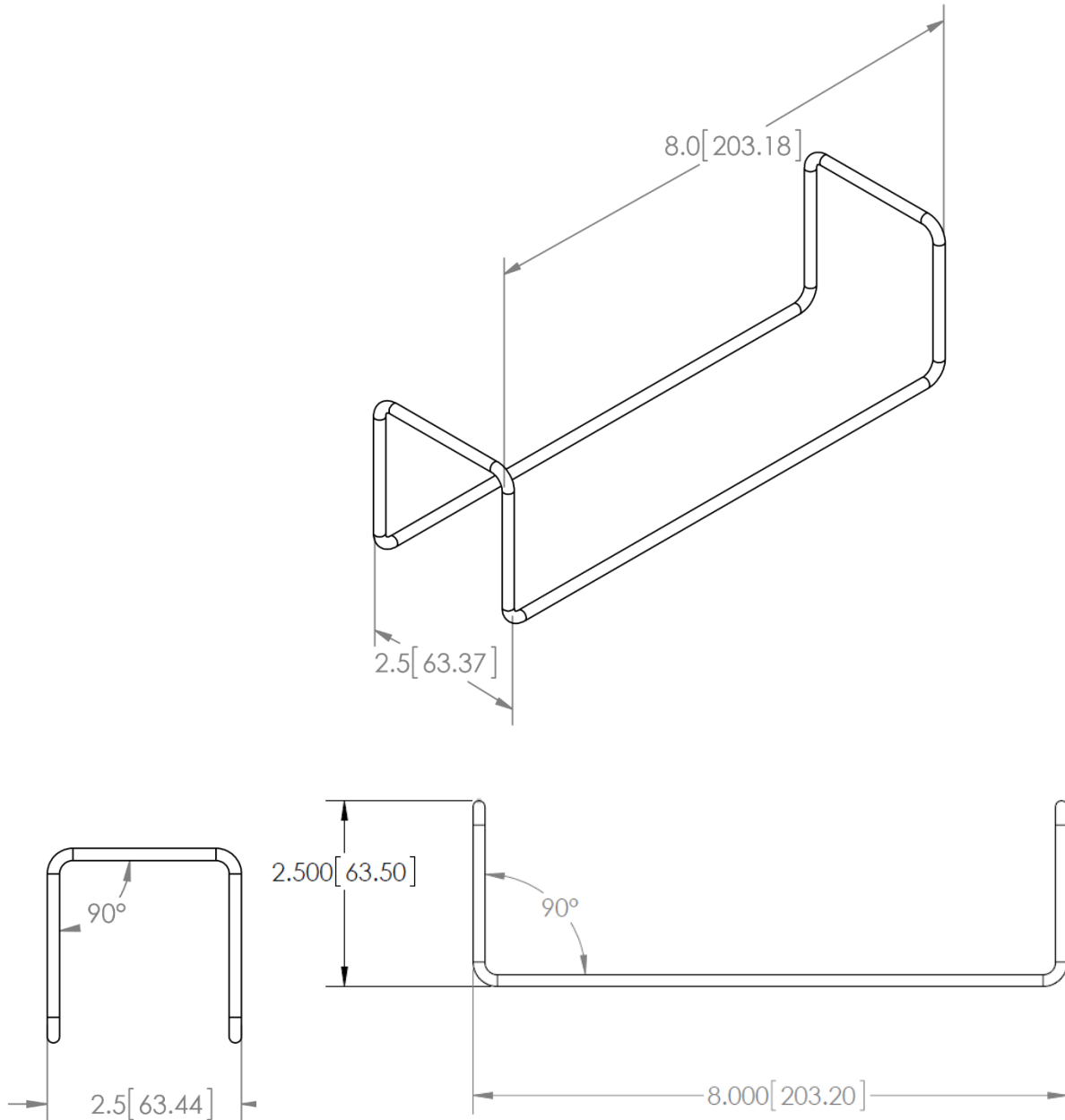
PROGRAMMING

	Step	Length	Spd	Angle	Mandrel	Spd	Flags	Radius
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Create a 3D Part - #4 Activity

Use your own 3D AccuForm Machine, and the part print shown to program the part in SmartEditor®. For more detailed instruction, go to Module 17: Create a 3D Form.



PROGRAMMING

Step	Length	Spd	Angle	Mandrel	Spd	Flags	Radius
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RESOURCES

Programming Tips

The following is a list of common tips to be utilized in helping create more efficient programs.

- When creating a new program, slow down the feeds and bends. This is to give yourself enough time to react and stop the machine if the program is not correct. This also allows you to observe the movements of the machine while the part is being formed.
- Use the following acronym to remember the typical order of operations when creating parts:

S	Shape	Create the shape first
A	Arm	Adjust the arm for optimized final production run
L	Length	Correct all lengths
S	Speed	Adjust and optimized the speed of the program
A	Angles	Correct all bends in program
A	Arm	Make minor adjustments in z-axis positions to make the part flat



Tip

This order of operations is only a guideline and can be tweaked as necessary to most efficiently make the part. Overlapping of the corrective actions may be required to form the part to completion.

- Make a small, hand-bent wire model to help visualize 3D pieces and understand machine movements that must be made to form the part.
- There must be a short straight length before, and between, each bend. This is so the bending pin will engage the wire properly. The minimum amount needed is dependent on the radius of rotation for the tools being used.



Tip

Experiment using the “BPO” flag to create short distances in between bends to create wire forms that the tools would be otherwise incapable of forming.

- The minimum straight length on the last segment of the part is dependent on the cutters being used. There are many custom cutters to fit different applications.



Tip

In order to create the shortest end length possible, try rotating the Z-Axis to allow the wire to feed farther back into the slot in the cutter.

- The inside bend radii will closely match that of the bending tools being used; slight variation may occur due to spring back.



Tip

Try generating a tight radius to form a bend radius that the tools would be otherwise unable to produce.

- The minimum size of a generated radius is determined by the machine capacity, wire diameter and tools being used. Due to potential limitation of the feeder pushing the wire to create the curve, it may not always be possible to form small rings/arcs.



Tip

The machine has an option to form radii using incremental bends. This gives the ability to make smaller rings that are not able to be “push” generated by the feeder.

- If forming a full ring, it typically will not be perfectly flat. This is due to the start of the ring going over the wire and tools. Custom tools and cutters can help flatness. Special ring tools may also be necessary to achieve the desired results.



Tip

Try incorporating a small amount of Z-Rotation while forming the ring to help control the flatness of the part.

- When bringing the formed part over the wire line, additional hardware may be required to direct the wire to the same position every time. This includes special tools, ramps, hold downs, etc.
- Watch the feed rollers while the machine is bending parts. During bending, the feed rollers should never turn in the reverse direction. If this action is observed, increase the Feed Wire with Analogy parameter in the tool file.
- Axis positioning errors are caused by the movement of the motor not matching the movement of the encoder. This can typically be caused by the machine pulling on the wire. It can also be caused by the wire slipping through the feeder system or getting jammed somewhere.



Tip

Check all setup aspects of the machine. IE: Dancer arm pressure, feed roller pressure, encoder roller pressure, arm wire guide rollers, cutters, straightener roller tension, etc. Make sure wire path is free from obstructions and jams. Once setup is verified, if problem still occurs, make sure wire isn't being pulled by the machine during bending. See Item 10 for further info.

- When attempting to flatten wire forms, make the initial z-axis change large enough to visually observe the adjustment (typically 3° to 5°). This will make it easier, and faster, to see if the change has been made in the correct direction. Then fine tune the adjustment.

SmartEditor® Shortcuts

Machine Controls

Key	Command
CTRL+F1	Run
F2	Stop/Reset
CTRL+F3	Step
F4	Hold
CTRL+F8	Cut
CTRL+F10	Home

Software Shortcuts

Key	Command
F1	Display Help Contents
CTRL+F9	Straight Setup
SHIFT+F5	Machine Parameters
F5	Tool Parameters
CTRL+N	New Standard Program
CTRL+O	Open Program
CTRL+S	Save Program
CTRL+I	Insert Row (one above)
CTRL+D	Delete Row (row selected)
CTRL+L	Display Windows Calculator
F11	Display SmartEditor® I/O screen

Flags

Key	Displayed Flag	Command
T	T1, T2, T3, T4, T0	Tool Position
P	P0, P1, P1 P0, P2, P2 P0...	Bending Pin
M	M1, M2, M3	Mandrel
SHIFT+M	M	Mandrel Only bend
Z	Z	Designates a Z-Axis Rotation
B	B	Feed wire back (negative feed)
O	BPO	Bending Pin Offset
W	W	Wait
R	R	Radius (Absolute Offset)
D	RD	Radius (Calculated Offset)
F	RF	Radius Blend
E	E	Eyeloop command
C	C	Cut the wire
K	K	Kick part
N	NR	Do not use Bend Relief