Arc statements G02 and G03

The arcs G02 and G03 are one shot commands. They are used one time and then turned off.

G02 is used to generate a clockwise arc.
G03 is used to generate a counterclockwise arc.

\[
\begin{align*}
    \text{G02 } & \quad \text{Xn Zn In Kn} & \quad \text{or} & \quad \text{G03 } \quad \text{Xn Zn In Kn} \\
    \text{G02 } & \quad \text{Xn Zn Rn} & \quad \text{or} & \quad \text{G03 } \quad \text{Xn Zn Rn}
\end{align*}
\]

The programming of an arc is much different when written in diameter or radius modes.

-------------------   Radius mode   G73   -------------------

Before you execute this command position the tool at the start of the arc.

The values given to the variables will effect the travel of the slide differently depending on whether the program is in absolute (G90) or incremental (G91).

Absolute Mode (G90) with G73 - radius programming active:

- \( X \): the position of the end of the arc from absolute zero in \( X \)
- \( Z \): the position of the end of the arc from absolute zero in \( Z \)
- \( I \): the position of the center of the arc from absolute zero in \( X \)
- \( K \): the position of the center of the arc from absolute zero in \( Z \)

or

- \( R \): The length of the radius to be used to connect the start and end points

Incremental Mode (G91) - not commonly used!:

- \( X \): the distance from the start of the arc to the end in \( X \)
- \( Z \): the distance from the start of the arc to the end in \( Z \)
- \( I \): the distance from the start of the arc to the center in \( X \)
- \( K \): the distance from the start of the arc to the center in \( Z \)
- \( R \): The length of the radius to be used to connect the start and end points

There are two versions of the arc statement. One uses \( I \) and \( K \) to define the location of the center of the arc. When using this version it is important to calculate the values of all three locations exactly. If any of the values are off by .00005 the arc statement will not work. If the version with \( R \) is used there is a little flexibility built in. The arc used will be the one that best fits the end points and arc length.
**Arc statements G02 and G03**

**Using R version:**

Before the arc statement is used the tool must be moved to the start location of the arc. Then the arc statement follows with the end of the arc location (X and Z) and the length of the connecting arc’s radius.

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**SIZE OF RADIUS** to be used to fill between the start and end of the arc, R in the arc statement

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**START OF ARC:** move tool to this location before the arc move

---

**END OF ARC:** defined by the X and Z values in the arc statement

---

**Examples of arc statements using R**

Following are three examples of arc statements using the arc statement with R. These sample programs are showing only a finish pass. The are done in the radius mode - G73

---

G90G94F300G73
M03S2500
M08
T1
X0Z1
Z.1
G95F.003Z0
X.1
G02X.25Z-.15R.15
Z.-3
X.275
G00Z1
M30

G90G94F300G73
M03S2500
M08
T1
X0Z1
Z.1
G95F.003Z0
X.15
G02X.3Z-.2R1.5
Z.-.3
X.325
G00Z1
M30

G90G94F300G73
M03S2500
M08
T1
X0Z1
Z.1
G95F.003Z0
X.2
Z.-2
G02X.2Z-.5R635
Z.-.7
G00X.3
Z1
M30
Arc statements G02 and G03

Description of arcs using I and K in G73 (radius mode)

- X
- Z
Start
Center
- X
- Z
End

G02 - Clockwise Arc

Values of Z and X when in Absolute G90

Values of I and K when in Absolute G90

Values of Z and X when in Incremental G91

Values of I and K when in Incremental G91

G02 - Clockwise Arc

Using G02 - Clockwise arc

Center of arc

.15r

Start of arc

End of arc

G90 G94 G73
T1F300
X0 Z1
X1 Z0
G02 X25 Z-15 I1.1 K-0.15
Z-5
or the arc statement could be:
G02 X25 Z-15 R15
Arc statements G02 and G03

**G73 - Radius Mode**

Using G03 - Counter clockwise arc while in G73 - radius mode

G90 G94 G73
T1F300
X0 Z.1
X-.1 Z0
G03 X-.25 Z-.15 I-.1 K-.15
Z-.5
or the arc statement could be:
G03 X-.25 Z-.15 R.15
Arc statements G02 and G03

---------------------- Diameter mode ----------------------

Arc moves in diameter programming have minor differences from radius programmed arcs.

**G02 and G03 arc moves in diameter mode (G72) and absolute (G90)**

Note:
- Using arc statements in the diameter mode (G72) be sure you are in absolute (G90)
- Position tool at start point before using arc move
- This format follows the Fanuc format more closely than previously

G02XnZnInKn • G03XnZnInKn

G02 Clockwise arcs
G03 Counter Clockwise arcs
Xn Diameter value at the end of the arc
Zn Location of end of the arc in Z from the part zero
In Incremental distance from arc start to the arc center in X
Zn Incremental distance from arc start to the arc center in Z
or
R The length of the radius to be used to connect the start and end points

**Examples of arc statements using R in diameter mode:**

For an explanation on usage please refer to the section at the beginning of this chapter on using the R in the radius mode. The format is the same except the values of X are given in diameters (G72 mode).

```
G90G94F300G72 M03S2500 M08 T1 X0Z1 Z.1 G95F.003Z0 X.2 G02X.5Z-.15R.15 G00Z1 M30
G90G94F300G72 M03S2500 M08 T1 X0Z1 Z.1 G95F.003Z0 X.3 G02X.6Z-.2R1.5 Z-.3 X.65 G00Z1 M30
G90G94F300G72 M03S2500 M08 T1 X0Z1 Z.1 G95F.003Z0 X.4 G02X.4Z-.5R.635 Z-.7 G00X.6 Z1 M30
```

*Note: The lengths of the radius are in diameters (G72 mode).*
Arc statements *G02* and *G03*

Arc statements using *I* and *K* in diameter mode (*G72*):

- **Start**
- **Center**
- **End**

**G02** - Clockwise Arc

**End of arc** (*Xn Zn*): This is the same. This is the location of the end of the arc.

**Arc center** (*In Kn*): This is different. With diameter programming the arc center is defined as the incremental distance from the arc start to the center.

Values of *Z* and *X* when in Absolute *G90*

Values of *I* and *K* Incremental from start
Arc statements G02 and G03

The following picture shows an example of an arc that is machined with G02 - CW using I & K.

For this example first we show the three important locations that must be defined to write the arc statement:

- **Center of arc**
- **Start of arc**
- **End of arc**

The starting point of the arc is where X=.2 (diameter value) and Z=0. So these values will be used to write the position move before the arc statement:

**X.2Z0**

The end of the arc is defined from the absolute zero for the part. As shown on the following figure X=.5 and Z=-.15. These are used for the X and Z values in the G02.

**End of arc**

The I and K values are the incremental distances from the start of the arc to the center. In the following
**Arc statements G02 and G03**

Figure you can see that start and arc center in X are at the same diameter value so the distance between them is zero (I0). In the Z axis the distance is -.15. *Note: the value of this is minus because of the direction, not the end location.*

So the program lines could be:

```
X0Z0
X.2
G02 X.5 Z-.15 I0 K-.15
```

For the next example we will show a G03:

```
X0Z0
X.2
Z-.3
G03 X.4 Z-.4 R .1 K0
X.5
Z-.5
```