10.1.4 Co-ordinated Linear Motion

To drive a tool along a specified path, a machining system must often co-ordinate the motion of several axes. We use the term "co-ordinated linear motion" to describe the situation in which, nominally, each axis moves at constant speed and all axes move from their starting positions to their end positions at the same time. This produces motion in a straight line, hence the word "linear" in the term. In actual motions, it is often not possible to maintain constant speed because acceleration or deceleration is required at the beginning and/or end of the motion. It is feasible, however, to control the axes so that, at all times, each axis has completed the same fraction of its required motion as the other axes. This moves the tool along the same path, and we also call this kind of motion co-ordinated linear motion.

Co-ordinated linear motion can be performed either at the prevailing feed rate, or at rapid traverse rate. If physical limits on axis speed make the desired rate unobtainable, all axes are slowed to maintain the desired path.

10.1.5 Feed Rate

The rate at which the controlled point or the axes move is nominally a steady rate which may be set by the user. In the Interpreter, the interpretation of the feed rate is as follows unless inverse time feed rate (G93) mode is being used:

For motion involving one or more of the linear axes (X, Z), the feed rate means length units per minute along the programmed linear XZ path.

10.10.1 Set Feed Rate -F

To set the feed rate, program `F~`

Depending on the setting of the Feed Mode toggle the rate may be in units-per-minute or units-per-rev of the spindle.

The units are those defined by the G20/G21 (G70/G71) mode.

Depending on the setting in Config>Ports & Pins-Spindle a revolution of the spindle may be defined as a pulse appearing on the Index input or be derived from the speed requested by the S word or *Set Spindle speed* DRO.

The feed rate may sometimes be overidden as described in M48 and M49 above.

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10.7.2 Linear Motion at Feed Rate - G1

. (a) For linear motion at feed rate (for cutting or not), program `G1 X~ Y~ Z~ A~ B~ C~`, where all the axis words are optional, except that at least one must be used. The G1 is optional if the current motion mode is G1. This will produce co-ordinated linear motion to the destination point at the current feed rate (or slower if the machine will not go that fast).

10.7.28 Set Feed Rate Mode - G93, G94 and G95

Three feed rate modes are recognized: inverse time, units per minute and units per revolution of spindle. Program `G93` to start the inverse time mode (this is very infrequently employed). Program `G94` to start the units per minute mode. Program `G95` to start the units per rev mode.

In inverse time feed rate mode, an F word means the move should be completed in [one divided by the F number] minutes. For example, if the F number is 2.0, the move should be completed in half a minute.

In units per minute feed rate mode, an F word on the line is interpreted to mean the controlled point should move at a certain number of inches per minute, millimetres per minute, or degrees per minute, depending upon what length units are being used and which axis or axes are moving. In units per rev feed rate mode, an F word on the line is interpreted to mean the controlled point should move at a certain number of inches per spindle revolution, millimetres per spindle revolution, or degrees per spindle revolution, depending upon what length units are being used and which axis or axes are moving.

When the inverse time feed rate mode is active, an F word must appear on every line which has a G1, G2, or G3 motion, and an F word on a line that does not have G1, G2, or G3 is ignored. Being in inverse time feed rate mode does not affect G0 (rapid traverse) motions. It is an error if:

- inverse time feed rate mode is active and a line with G1, G2, or G3 (explicitly or implicitly) does not have an F word.