

MachineMate Part Program Conversion Utility

MACHINEMATE INC has developed a utility for converting part programs that had been written for other CNC controls.

All CNC controls have slight differences in their part program formats even though they use the RS274D standard. **MACHINE**MATE CNC also has slight differences in its part program format compared to that of other vendor's controls.

There are three main differences:

- Only one G or M code can be specified per NC statement.

The **MACHINE**MATE control has an 'open' architecture. This rule enables subsequent behaviors within the system to be tailored by the control integrator.

The integrated soft PLC will get strobes for specific characters present in the NC statement – from A to Z. Typically these letters are M, S, T and U but the control is not restricted to those letters. By having one letter code per statement, the PLC can get its access to the active NC block information without holding back the CNC performance. The control also has the capability for an integrator to integrate its own DLL-resident code into the CNC kernel; this DLL integration feature is called 'compile cycles.' This low-level integration into the control software is less complicated given this rule for the NC statements.

Since the block-to-block cycle time is so fast in the **MACHINE**MATE, this rule does not affect the block execution speed (like it could on most older CNC's).

- Canned cycles (G81 to G89) get their parameters from specific cycle parameters rather than from certain NC blocks in the line.

The canned cycles are implemented using subprograms, enabling a customer to easily tailor any canned cycle as needed or even to write a new one. This 'open' architecture (of cycle parameters rather than letter-codes) requires no overhead for the CNC translation of certain letters only with certain G8x-codes.

Also, this rule enables the PLC to affect the behavior of the CNC (within this control's 'open' architecture). The PLC can easily read and write the cycle parameters. Since the canned cycles use cycle parameters, the PLC can affect the execution of the canned cycles using this method, if required.

If the canned cycle parameters were given in different NC blocks having a variety of letters (e.g., R, Z, K, etc.) whose meaning depends on the accompanying G-code, then the PLC application would be incapable of manipulating those part program parameters. This difficulty arises since these letters often have other meanings in other NC statements (e.g., Z could represent the Z-axis end point, not the final hole depth for a G81) so the PLC would have been unable to change a parameter's value during its block's execution.

Since some controls generate a cycle on the G8x line itself, the utility has an option to do the same in the output program if required.

- Every NC statement has an NC block beginning with an N number. Some controls do not enforce this NC block sequence number rule but it is enforced in the **MACHINE**MATE control.

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This utility creates an output program from the input program according to the above three rules. In the case of the canned cycle parameters, the utility program must have the control type specified so that the original control's canned cycles can be interpreted for the **MACHINEMATE** set of canned cycles. Since the cycle parameters are in an integer format, the utility program must also have the decimal point format specified so that its data conversions are correct.

There are several options available for the **MACHINEMATE** control that affect this part program compatibility and conversion. These options are part of the conversion dialog since their presence (or not) in the control will affect the format that is expected in the part program.

- The **MACHINEMATE** control has an option to accept the canned cycle parameters as letter fields (like Z or R) rather than as cycle parameters. The **MACHINEMATE** option internally converts the specific canned cycle letter fields into the correct cycle parameters so that the canned cycles themselves are unaffected by the option. For this letter conversion to be correct, the utility must have the correct control type so that the letter translations are correct. If the utility makes the conversion with this option enabled but the **MACHINEMATE** does not have this option active, then syntax errors will result from running the output program. (This option removes the control's inherent flexibility of adding new parameters to rewritten canned cycles.)
- The **MACHINEMATE** control has an option to convert a T-code into a combination of codes: T-code (for turret position) and the accompanying D-code and H-code (for tool compensation data). There are two variations within this option: either the D/H code is a one-digit field (usually from a Txy format) or a two-digit field (from a Txxyy format). If the utility makes the conversion with this option enabled and the control also has this option active, then the T/D/H codes in the program will be incorrect.
- The utility has two options when converting a program for a lathe. First, if the original program is in diameter programming (X is the diameter not radius) and if the utility must convert I values for circles then this is required information. Second, if the original program is in radius programming (X is the radius not diameter) then this option converts those X commands to diameter (doubles the X value).

There are a number of controls that have their part programs quickly converted to the **MACHINEMATE** format. These controls have the same set of standard G and M codes (RS274), similarly formatted canned cycles (though there are variations among them with different G8x code assignments) and compatible G2/G3 I/J/K statements:

- AMCB
- Dynapath series 5
- Fadal
- Fagor
- Fanuc
- Haas
- Mazak
- Meldas
- Osp
- Prototrak
- Yasnac

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- 1400
- GL8000 (but G2/G3 I and J values are different in G91)

There are several other formats that can be converted - but with manual adjustments required in many cases, depending on the content. These controls used a different format for the I/J/K values with the G2/G3 statements and some used a different format for the canned cycle parameters. These are:

- AB8200, AB8400, AB8400LP
- Acramatic
- Anilam
- Bendix series 5
- Boss
- GE1050
- Hurco
- Siemens7T
- Teammate 2

The programs for this set above can require substantial editing because of their incompatible (with respect to many other controls) canned cycle formats and the I/J/K values for G2/G3 motions. If the original part program is doing simple linear motions or is in absolute programming (G90) all or most of the time, then the program will require minimal editing.

The AB8400LP and Siemens 7T might be unique since these conversions were tied to several special rules for particular customers so these conversion algorithms might not be universal. The Bendix 5 conversion can read a data file defining the S-value conversions. The Teammate 2 conversion can read a data file defining compensations in X or Z for specific T-codes.

During the format conversion, the utility attempts to convert the parameters that it can. Some controls use G20/G21 for inch/metric so those are converted to G70/G71. Some controls use absolute position values for the I/J/K center of arcs and circles whereas most (including the first list above) always use incremental (like **MACHINEMATE**). If the G2/G3 motions occur in G90 (absolute positioning), the utility will try to calculate the appropriate I/J/K values (i.e., the incremental distances). Some controls use incremental distances for some of the canned cycle parameters, such as the final depth, whereas most controls (see above, like **MACHINEMATE**) use an absolute position for depth and retract. If the G8x canned cycles occur in G90 (absolute), the utility will try to calculate the appropriate cycle parameters from current axis values. Because these calculations require both the G90 and the accompanying axis position(s), the utility might not have enough information in all cases for the calculation. The program segments in G91 (incremental) might not have the parameters converted. The output program has comments to highlight those parameters to be edited.

Any particular control type might have variations (or different models) that did not have identical program formats. Also, the original part program might have a G or M code that the utility is not configured for. Those codes will be copied to the output with no conversion or comment. The utility performs its modifications to the original part program based on the three primary rules described above (adjusted by the options indicated and tailored for the specific control type). The utility attempts to complete the conversion by checking the expected parameters based on the control type specified. The information that describes the syntax for the canned cycles and I/J/K parameters for the various

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control types and has been used for the development of this utility probably does not address all variations of the respective controls. The user always makes the decision whether the converted part program needs modifications and how extensive those changes are.

The utility will attempt a conversion of all these formats because some part programs might have none or few of those NC statements that have the incompatible syntax (so even manual editing might be acceptable). Only the user knows how acceptable is the particular conversion.

If a conversion is required for another control's format or if a certain control and syntax combination needs an adjustment, please contact **MACHINE**MATE INC at 920-907-0001 or at info@machinemate.com.