
INTERNATIONAL STANDARD



1056

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Numerical control of machines — Punched tape block formats — Coding of preparatory functions G and miscellaneous functions M

Commande numérique des machines — Formats de blocs des bandes perforées — Codage des fonctions préparatoires G et des fonctions auxiliaires M

First edition — 1975-02-15

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UDC 681.327.44 : 681.323 : 621.9-52

Ref. No. ISO 1056-1975 (E)

Descriptors : data processing, numerical control, punched tapes, data layout, control procedures, coding.

Price based on 10 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 1056 was drawn up by Technical Committee ISO/TC 97, *Computers and information processing*, and circulated to the Member Bodies in January 1974.

It has been approved by the Member Bodies of the following countries :

Australia	Japan	Thailand
Belgium	Mexico	Turkey
Czechoslovakia	Netherlands	United Kingdom
France	Romania	U.S.A.
Germany	South Africa, Rep. of	U.S.S.R.
Hungary	Spain	Yugoslavia
Ireland	Sweden	
Italy	Switzerland	

No Member Body expressed disapproval of the document.

This International Standard cancels and replaces ISO Recommendation R 1056-1969, of which it constitutes a technical revision.

Numerical control of machines — Punched tape block formats — Coding of preparatory functions G and miscellaneous functions M

0 INTRODUCTION

The International Standards

ISO 1057, *Numerical control of machines — Interchangeable punched tape variable block format for positioning and straight-cut machining*,

ISO 1058, *Numerical control of machines — Punched tape variable block format for positioning and straight-cut machining*,

ISO 1059, *Numerical control of machines — Punched tape fixed block format for positioning and straight-cut machining*, and

ISO 2539, *Numerical control of machines — Punched tape variable block format for contouring and contouring/positioning machining*,

specify the block formats of punched tapes used for the numerical control of machines (addresses, blocks, words, etc.). However, for the “preparatory function” G and “miscellaneous function” M words, it was found better to establish a separate International Standard the content of which may be used for each type of formats.

1 SCOPE AND FIELD OF APPLICATION

This International Standard defines the coding of “preparatory functions” G and “miscellaneous functions” M used for the numerical control of machines, by means of a two-digit code.

2 CODING OF PREPARATORY FUNCTIONS G

2.1 Table

Code	Function retained until cancelled or superseded by subsequent command of the same letter designation	Function affects only the block within which it appears	Function
G00	a		Point-to-Point, Positioning
G01	a		Linear Interpolation
G02	a		Circular Interpolation Arc CW
G03	a		Circular Interpolation Arc CCW
G04		X	Dwell
G05	*	*	Unassigned ¹⁾
G06	a		Parabolic Interpolation
G07	*	•	Unassigned
G08		X	Acceleration
G09		X	Deceleration
G10	*	*	Unassigned ²⁾
G11	*	*	Unassigned ²⁾
G12	*	*	Unassigned ³⁾
G13 to G16	} *	*	Unassigned ⁴⁾
G17	c		XY Plane Selection
G18	c		ZX Plane Selection
G19	c		YZ Plane Selection
G20	*	*	Unassigned ²⁾
G21	*	*	Unassigned ²⁾
G22	*	*	Unassigned ⁵⁾
G23	*	*	Unassigned ⁵⁾
G24	*	*	Unassigned
G25 to G29	} *	*	Permanently Unassigned
G30	*	*	Unassigned ²⁾
G31	*	*	Unassigned ²⁾
G32	*	*	Unassigned
G33	a		Thread Cutting, Constant Lead
G34	a		Thread Cutting, Increasing Lead
G35	a		Thread Cutting, Decreasing Lead
G36 to G39	} *	*	Permanently Unassigned

1) Previously "Hold".
2) Previously "Interpolation — long and short dimensions".
3) Previously "3D-Interpolation".
4) Previously "Axis selection".
5) Previously "Coupled motion — positive and negative".
* The choice of a particular case must be designated in the Format Specification.

Code	Function retained until cancelled or superseded by subsequent command of the same letter designation	Function affects only the block within which it appears	Function
G40	d		Cutter Compensation/Tool Offset Cancel
G41	d		Cutter Compensation – Left
G42	d		Cutter Compensation – Right
G43	• (d)	*	Tool Offset Positive ^{1) 2)}
G44	* (d)	*	Tool Offset Negative ^{1) 2)}
G45	* (d)	*	Tool Offset +/+ ^{1) 2) 3)}
G46	* (d)	*	Tool Offset +/- ^{1) 2) 3)}
G47	* (d)	*	Tool Offset -/- ^{1) 2) 3)}
G48	* (d)	*	Tool Offset -/+ ^{1) 2) 3)}
G49	* (d)	*	Tool Offset 0/+ ^{1) 2) 3)}
G50	* (d)	*	Tool Offset 0/- ^{1) 2) 3)}
G51	* (d)	*	Tool Offset +/-0 ^{1) 2) 3)}
G52	* (d)	*	Tool Offset -/0 ^{1) 2) 3)}
G53	f		Linear Shift Cancel ⁴⁾
G54	f		Linear Shift X ⁴⁾
G55	f		Linear Shift Y ⁴⁾
G56	f		Linear Shift Z ⁴⁾
G57	f		Linear Shift X Y ⁴⁾
G58	f		Linear Shift X Z ⁴⁾
G59	f		Linear Shift Y Z ⁴⁾
G60	h		Positioning Exact ¹⁴⁾ (Fine)
G61	h		Positioning Exact ²⁴⁾ (Medium)
G62	h		Positioning Fast ⁴⁾ (Coarse)
G63		X	Tapping ⁴⁾
G64	*	*	Unassigned ⁵⁾
G65	}	*	Unassigned ⁶⁾
to G67			
G68	* (d)	X	Tool Offset Inside Corner ²⁾
G69	* (d)	X	Tool Offset Outside Corner ²⁾
G70	}	*	Unassigned
to G79			
G80	e		Fixed Cycle Cancel
G81	}		Fixed Cycle
to G89			
G90	j		Absolute Dimension
G91	j		Incremental Dimension
G92		X	Preload Registers
G93	k		Inverse Time, Feed Rate
G94	k		Feed per Minute
G95	k		Feed per Spindle Revolution
G96	l		Constant Surface Speed
G97	l		Revolutions per Minute (Spindle)
G98	}	*	Unassigned
to G99			

1) If cutter compensation for straight-cut controls is not provided, G43 to G52 are unassigned and are available for other uses.

2) Letter (d) between brackets in the left-hand column means that if the option used is the one of the left-hand column, the cancel or replacement function shall be one of those designated by the letter d without brackets. The cancel or replacement function may also be one of those designated by the letter (d) between brackets, if the option used for that replacement function is the one of the left-hand column.

3) Functions G45 to G52 may apply to any two different predetermined axes of the machine.

4) If these functions are not provided in the control, they are unassigned and available for other uses.

5) Previously "Change of rate".

6) Previously "Reserved for positioning only".

* The choice of a particular case must be designated in the Format Specification.

2.2 Definitions

Permanently unassigned codes are for individual use and are not intended to be assigned in future revisions of this International Standard.

Unassigned codes are for individual use. However, in future International Standards or future revisions of this International Standard, particular meanings may be allocated to these unassigned preparatory function code numbers.

G00	Point-to Point Positioning	A mode of control in which movement to the programmed point occurs with maximum, e.g. Rapid, feedrate; a feedrate previously programmed is ignored but not cancelled, and the movements in different axes may be unco-ordinated.
G01	Linear Interpolation	A mode of control, used for a uniform slope or straight line motion, that uses the information contained in a block to produce velocities proportional to the distances to be moved in two or more axes simultaneously.
	Circular Interpolation	A mode of contouring control that uses the information contained in one or two blocks to produce an arc of a circle, the velocities of the axes used to generate the arc being varied by the control.
G02	Circular Interpolation Arc CW	Circular interpolation in which the curvature of the path of the tool with respect to the work-piece is clockwise when the plane of motion is viewed in the negative direction of the axis perpendicular to it.
G03	Circular Interpolation Arc CCW	Circular interpolation in which the curvature of the path of the tool with respect to the work-piece is counter-clockwise when the plane of motion is viewed in the negative direction of the axis perpendicular to it.
G04	Dwell	A timed delay of programmed or established duration, not cyclic or sequential; i.e. not an interlock or hold.
G06	Parabolic Interpolation	A move of contouring control which uses the information contained in one or more blocks to produce an arc of a parabola. The velocities of the axes used to generate this arc are varied by the control.
G08	Acceleration	An automatic velocity increase to programmed rate starting at beginning of movement.
G09	Deceleration	An automatic velocity decrease from programmed rate starting on approach to the programmed point.
G17 to G19	Plane Selection	Used to identify the plane for such functions as Circular Interpolation, Cutter Compensation, and others as required.
G33	Thread Cutting, Constant Lead	Mode selection for machines equipped for thread cutting.

G34	Thread Cutting, Increasing Lead	Mode selection for machines equipped for thread cutting where a constantly increasing lead is desired.
G35	Thread Cutting, Decreasing Lead	Mode selection for machines equipped for thread cutting where a constantly decreasing lead is desired.
G40	Cutter Compensation/Tool Offset Cancel	Command which will discontinue any cutter compensation (diameter or radius), or tool offset.
G41	Cutter Compensation — Left	Cutter on left side of work surface looking from cutter in the direction of relative cutter motion.
G42	Cutter Compensation — Right	Cutter on right side of work surface looking from cutter in the direction of relative cutter motion.
G43	Tool Offset Positive	Used to indicate that the value of the Tool Offset (pre-set on the control) has to be added to the co-ordinate dimension of the relevant block, or blocks.
G44	Tool Offset Negative	Used to indicate that the value of the Tool Offset (pre-set on the control) has to be subtracted from the co-ordinate dimension of the relevant block, or blocks.
G45 to G52	Tool Offset	Used to indicate whether the value of the Tool Offset (pre-set on the control) has to be added to or subtracted from the co-ordinate dimension(s) of the relevant block or blocks, or is zero.
G54 to G59	Linear Shift	Used to demand Datum Shift by values pre-set on the controls.
G60 G61	Positioning Exact 1 (Fine) Positioning Exact 2 (Medium)	Used for positioning within one or two defined tolerance zones. If necessary, a uni-directional approach can be selected.
G62	Positioning Fast (Coarse)	Used to position to an enlarged tolerance zone with the aim of saving time.
G63	Tapping	Positioning with stop of spindle, after reaching the position.
G68	Tool Offset, Inside Corner	Used to indicate that the value of the tool offset (pre-set on the control) will be added or subtracted to the co-ordinate dimension of the relevant block or blocks according to the shape of the workpiece (inside corner).
G69	Tool Offset, Outside Corner	Used to indicate that the value of the tool offset (pre-set on the control) will be added or subtracted to the co-ordinate dimension of the relevant block or blocks according to the shape of the workpiece (outside corner).
G80	Fixed Cycle Cancel	Command which will discontinue any fixed cycle.

G81
to
G89

}

Fixed Cycle*

A pre-set series of operations which direct machine axis movement and/or cause spindle operation to complete such action as boring, drilling, tapping or combinations thereof.

Fixed Cycle Code	Movement In	At Bottom		Movement Out to Feed Start	Typical Usage
		Dwell	Spindle		
G81	Feed	—	—	Rapid	Drill Spot Drill
G82	Feed	Yes	—	Rapid	Drill Counterbore
G83	Intermittent	—	—	Rapid	Deep Hole
G84	Forward Spindle Feed	—	Rev.	Feed	Tap
G85	Feed	—	—	Feed	Bore
G86	Start Spindle Feed	—	Stop	Rapid	Bore
G87	Start Spindle Feed	—	Stop	Manual	Bore
G88	Start Spindle Feed	Yes	Stop	Manual	Bore
G89	Feed	Yes	—	Feed	Bore

G92

Preload Registers

Used to modify or set axis position registers by the programmed dimension words. No motion occurs.

G93

Inverse Time Feed Rate

The data following the feed rate address is equal to the reciprocal of the time in minutes to execute the blocks.

G94

Feed per Minute

The Feed rate units are millimetres per minute or inches per minute.

G95

Feed per Revolution

The Feed rate units are millimetres (inches) per revolution of the spindle.

G96

Constant Surface Speed

The spindle speed codes specify the constant surface speed in metres (feet) per minute. The spindle speed is automatically controlled to maintain the programmed value.

G97

Revolutions per Minute

Cancels G96.

* This command initiates a sequence of events which will be repeated at the appropriate times until cancelled or changed.

3 CODING OF MISCELLANEOUS FUNCTIONS M

3.1 Table

Code	Function starts		Function retained until cancelled or superseded by an appropriate subsequent command	Function affects only the block within which it appears	Function
	with commanded motion in its block	after completion of commanded motion in its block			
M00		X		X	Program Stop
M01		X		X	Optional (Planned) Stop
M02		X		X	End of Program
M03	X		X		Spindle CW
M04	X		X		Spindle CCW
M05		X	X		Spindle OFF
M06	*	*		X	Tool Change
M07	X		X		Coolant No. 2 ON
M08	X		X		Coolant No. 1 ON
M09		X	X		Coolant OFF
M10	*	*	X		Clamp
M11	*	*	X		Unclamp
M12	*	*	*	*	Unassigned
M13	X		X		Spindle CW and Coolant ON
M14	X		X		Spindle CCW and Coolant ON
M15	X			X	Motion +
M16	X			X	Motion -
M17 to M18	} *	* }	* }	*	Unassigned
M19		X	X		Oriented Spindle Stop
M20 to M29	} *	* }	* }	*	Permanently Unassigned
M30		X		X	End of Tape
M31	*	*		X	Interlock Bypass
M32 to M35	} *	* }	* }	*	Unassigned ¹⁾
M36	X		X		Feed Range 1
M37	X		X		Feed Range 2
M38	X		X		Spindle Speed Range 1
M39	X		X		Spindle Speed Range 2
M40 to M45	} *	* }	* }	*	Gear Changes if used; otherwise unassigned
M46 and M47	} *	* }	* }	*	Unassigned

1) Previously "Constant Cutting Speed".

- The choice of a particular case must be designated in the Format Specification.