



MTConnect[®] Standard

Part 4.1 – Cutting Tools

Version 1.5.0

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Table of Contents

1	Purpose of This Document	2
2	Terminology and Conventions	3
2.1	Glossary	3
2.2	Acronyms	4
2.3	MTConnect References	4
3	Assets Model	5
3.1	AssetModel	5
3.1.1	Asset	5
3.1.1.1	assetId	5
3.1.1.2	deviceUuid	5
3.1.1.3	removed	5
3.1.1.4	timestamp	5
3.1.1.5	Description	6
3.2	CuttingToolModel	6
3.2.1	CuttingTool	6
3.2.1.1	manufacturers	6
3.2.1.2	serialNumber	6
3.2.1.3	toolId	6
3.2.1.4	CuttingToolLifeCycle	7
3.2.1.5	CuttingToolArchetypeReference	7
3.2.1.6	CuttingToolDefinition	7
3.2.2	CuttingToolArchetype	7
3.2.2.1	manufacturers	7
3.2.2.2	serialNumber	7
3.2.2.3	toolId	8
3.2.2.4	CuttingToolDefinition	8
3.2.2.5	CuttingToolLifeCycle	8
3.2.3	CuttingToolArchetypeReference	8
3.2.3.1	source	8
3.2.3.2	value	8
3.2.4	CuttingToolDefinition	8
3.2.4.1	format	9
3.2.4.2	value	9
3.2.5	CuttingToolLifeCycle	9
3.2.5.1	ConnectionCodeMachineSide	10
3.2.5.2	ProgramToolGroup	10
3.2.5.3	ProgramToolNumber	10
3.2.5.4	ProcessFeedRate	10
3.2.5.5	ToolLife	10

3.2.5.6	ToolLife	11
3.2.5.7	ProcessSpindleSpeed	11
3.2.5.8	ToolLife	11
3.2.5.9	CutterStatus	11
3.2.5.10	CuttingItems	11
3.2.5.11	Measurements	11
3.2.5.12	ReconditionCount	11
3.2.5.13	Location	11
3.2.6	Location	12
3.2.6.1	negativeOverlap	12
3.2.6.2	positiveOverlap	12
3.2.6.3	type	12
3.2.7	Measurement	13
3.2.7.1	code	13
3.2.7.2	maximum	15
3.2.7.3	minimum	15
3.2.7.4	nativeUnits	15
3.2.7.5	nominal	17
3.2.7.6	significantDigits	17
3.2.7.7	units	17
3.2.8	ProcessFeedRate	19
3.2.8.1	maximum	19
3.2.8.2	minimum	19
3.2.8.3	nominal	19
3.2.9	ProcessSpindleSpeed	19
3.2.9.1	maximum	20
3.2.9.2	minimum	20
3.2.9.3	nominal	20
3.2.10	ReconditionCount	20
3.2.10.1	maximumCount	20
3.2.11	Status	20
3.2.11.1	value	21
3.2.12	ToolLife	21
3.2.12.1	countDirection	22
3.2.12.2	initial	22
3.2.12.3	limit	22
3.2.12.4	warning	22
3.3	CuttingItemModel	22
3.3.1	CuttingItem	23
3.3.1.1	Description	23
3.3.1.2	grade	23
3.3.1.3	indices	23

3.3.1.4	itemId	23
3.3.1.5	Locus	24
3.3.1.6	manufacturers	24
3.3.1.7	ProgramToolGroup	24
3.3.1.8	CutterStatus	24
3.3.1.9	ItemLife	24
3.3.1.10	ItemLife	24
3.3.1.11	ItemLife	24
3.3.1.12	Measurements	24
3.3.2	ItemLife	25
3.3.2.1	countDirection	25
3.3.2.2	initial	25
3.3.2.3	limit	25
3.3.2.4	warning	25
Appendices		26
A	Bibliography	26
B	Additional Illustrations	28
C	Cutting Tool Example	32
C.1	Shell Mill	32
C.2	Step Drill	35
C.3	Shell Mill with Individual Loci	37
C.4	Drill with Individual Loci	39
C.5	Shell Mill with Different Inserts on First Row	41

Table of Figures

Figure 1: Cutting Tool Measurement Diagram 1 (Cutting Tool, Cutting Item, and Assembly Item – ISO 13399)	28
Figure 2: Cutting Tool Measurement Diagram 2 (Cutting Tool, Cutting Item, and Assembly Item – ISO 13399)	29
Figure 3: Cutting Tool Measurement Diagram 3 (Cutting Item – ISO 13399)	29
Figure 4: Cutting Tool Measurement Diagram 4 (Cutting Item – ISO 13399)	30
Figure 5: Cutting Tool Measurement Diagram 5 (Cutting Item – ISO 13399)	30
Figure 6: Cutting Tool Measurement Diagram 6 (Cutting Item – ISO 13399)	31
Figure 7: Shell Mill Side View	32
Figure 8: Indexable Insert Measurements	32
Figure 9: Step Mill Side View	35
Figure 10: Shell Mill with Explicate Loci	37
Figure 11: Step Drill with Explicate Loci	39
Figure 12: Shell Mill with Different Inserts on First Row	41

List of Tables

Table 1: Properties of Asset	5
Table 2: Properties of CuttingTool	6
Table 3: Properties of CuttingToolArchetype	7
Table 4: Properties of CuttingToolArchetypeReference	8
Table 5: Properties of CuttingToolDefinition	9
Table 6: FormatType Enumeration	9
Table 7: Properties of CuttingToolLifeCycle	10
Table 8: Properties of Location	12
Table 9: LocationType Enumeration	12
Table 10: Properties of Measurement	13
Table 11: CodeEnum Enumeration	14
Table 12: NativeUnitEnum Enumeration	16
Table 13: UnitEnum Enumeration	18
Table 14: Properties of ProcessFeedRate	19
Table 15: Properties of ProcessSpindleSpeed	19
Table 16: Properties of ReconditionCount	20
Table 17: Properties of Status	20
Table 18: CutterStatusType Enumeration	21
Table 19: Properties of ToolLife	22
Table 20: CountDirectionType Enumeration	22
Table 21: Properties of CuttingItem	23
Table 22: Properties of ItemLife	25
Table 23: CountDirectionType Enumeration	25

1 1 Purpose of This Document

2 This document, *MTConnect Standard: Part 4.1 - Cutting Tools* of the MTConnect Stan-
3 dard, establishes the rules and terminology to be used by designers to describe the function
4 and operation of cutting tools used within manufacturing and to define the data that is pro-
5 vided by an *Agent* from a piece of equipment. This part of the Standard also defines the
6 structure for the XML document that is returned from an *Agent* in response to a probe
7 request.

8 The data associated with these cutting tools will be retrieved from multiple sources that
9 are responsible for providing their knowledge of an *MTConnect Asset*.

10 2 Terminology and Conventions

11 Refer to Section 2 of *MTConnect Standard Part 1.0 - Overview and Fundamentals* for a
 12 dictionary of terms, reserved language, and document conventions used in the MTConnect
 13 Standard.

14 2.1 Glossary

15 ***Agent***

16 Refers to an MTConnect Agent.

17 Software that collects data published from one or more piece(s) of equipment, orga-
 18 nizes that data in a structured manner, and responds to requests for data from client
 19 software systems by providing a structured response in the form of a *Response Doc-*
 20 *ument* that is constructed using the *semantic data models* defined in the Standard.

21 Appears in the documents in the following form: *Agent*.

22 ***Asset Document***

23 An electronic document published by an *Agent* in response to a *Request* for infor-
 24 mation from a client software application relating to Assets.

25 ***Document***

26 General meaning:

27 A piece of written, printed, or electronic matter that provides information.

28 Used to represent an *MTConnect Document*:

29 Refers to printed or electronic document(s) that represent a *Part(s)* of the MTCon-
 30 nect Standard.

31 Appears in the documents in the following form: *MTConnect Document*.

32 Used to represent a specific representation of an *MTConnect Document*:

33 Refers to electronic document(s) associated with an *Agent* that are encoded using
 34 XML; *Response Documents* or *Asset Documents*.

35 Appears in the documents in the following form: *MTConnect XML Document*.

36 Used to describe types of information stored in an *Agent*:

37 In an implementation, the electronic documents that are published from a data source
 38 and stored by an *Agent*.

39 Appears in the documents in the following form: *Asset Document*.

40 Used to describe information published by an Agent:

41 A document published by an *Agent* based upon one of the *semantic data models*
42 defined in the MTConnect Standard in response to a request from a client.

43 Appears in the documents in the following form: *Response Document*.

44 ***MTConnect Document***

45 See *Document*.

46 ***MTConnect XML Document***

47 See *Document*.

48 ***Response Document***

49 See *Document*.

50 ***semantic data model***

51 A methodology for defining the structure and meaning for data in a specific logical
52 way.

53 It provides the rules for encoding electronic information such that it can be inter-
54 preted by a software system.

55 Appears in the documents in the following form: *semantic data model*.

56 2.2 Acronyms

57 ***AMT***

58 The Association for Manufacturing Technology

59 2.3 MTConnect References

60 [MTConnect Part 1.0] *MTConnect Standard Part 1.0 - Overview and Fundamentals*. Ver-
61 sion 1.5.0.

62 [MTConnect Part 4.1] *MTConnect Standard: Part 4.1 - Cutting Tools*. Version 1.5.0.

63 3 Assets Model

64 3.1 AssetModel

65 3.1.1 Asset

66 An Asset is something that is used in the manufacturing process, but is not permanently
 67 associated with a single piece of equipment, can be removed from the piece of equipment
 68 without compromising its function, and can be associated with other pieces of equipment
 69 during its lifecycle.

Table 1: Properties of Asset

Property	Type	Multiplicity
assetId	ID	1
deviceUuid	NMTOKEN	1
removed	boolean	0..1
timestamp	dateTime	1
Description	Description	0..1

70 3.1.1.1 assetId

71 The unique identifier for an Asset.

72 3.1.1.2 deviceUuid

73 The piece of equipment's uuid that supplied the Asset's data.

74 3.1.1.3 removed

75 An indicator that the Asset has been removed from the piece of equipment.

76 3.1.1.4 timestamp

77 The point in time the Asset data was last modified.

78 3.1.1.5 Description

79 Placeholder for documentation!

80 3.2 CuttingToolModel

81 3.2.1 CuttingTool

82 Subtype of Asset

83 A CuttingTool physically removes the material from the workpiece by shear deformation.

Table 2: Properties of CuttingTool

Property	Type	Multipl
manufacturers	string	0..1
serialNumber	string	1
toolId	string	1
CuttingToolLifeCycle	CuttingToolLifeCycle	0..1
CuttingToolArchetypeReference	CuttingToolArchetypeReference	0..1
«deprecated» CuttingToolDefinition	CuttingToolDefinition	0..1

84 3.2.1.1 manufacturers

85 The manufacturers of the Cutting Item or Tool.

86 3.2.1.2 serialNumber

87 The unique identifier for this assembly.

88 3.2.1.3 toolId

89 The identifier for a class of cutting tools.

90 **3.2.1.4 CuttingToolLifeCycle**

91 Placeholder for documentation!

92 **3.2.1.5 CuttingToolArchetypeReference**

93 Placeholder for documentation!

94 **3.2.1.6 CuttingToolDefinition**

95 Placeholder for documentation!

96 **3.2.2 CuttingToolArchetype**

97 Subtype of Asset

98 The CuttingToolArchetype represents the static cutting tool geometries and nominal values
99 as one would expect from a tool catalog.

Table 3: Properties of CuttingToolArchetype

Property	Type	Multiplicity
manufacturers	string	0..1
serialNumber	string	1
toolId	string	1
CuttingToolDefinition	CuttingToolDefinition	0..1
CuttingToolLifeCycle	CuttingToolLifeCycle	0..1

100 **3.2.2.1 manufacturers**

101 Placeholder for documentation!

102 **3.2.2.2 serialNumber**

103 The unique identifier for this assembly.

104 3.2.2.3 toolId

105 The identifier for a class of cutting tools.

106 3.2.2.4 CuttingToolDefinition

107 Placeholder for documentation!

108 3.2.2.5 CuttingToolLifeCycle

109 Placeholder for documentation!

110 3.2.3 CuttingToolArchetypeReference

111 CuttingToolArchetypeReference has reference information about the assetId and/or the
112 URL of the data source of CuttingToolArchetype.

Table 4: Properties of CuttingToolArchetypeReference

Property	Type	Multiplicity
source	string	0..1
value	CuttingToolArchetype	0..1

113 3.2.3.1 source

114 The URL of the CuttingToolArchetype Information Model.

115 3.2.3.2 value

116 Placeholder for documentation!

117 3.2.4 CuttingToolDefinition

118 Reference to an ISO 13399.

Table 5: Properties of CuttingToolDefinition

Property	Type	Multiplicity
format	FormatType	0..1
value	string	0..*

119 3.2.4.1 format

120 Identifies the expected representation of the enclosed data.

121 Enumeration for CuttingToolDefinition format values.

Table 6: FormatType Enumeration

Name	Description
EXPRESS	The document will confirm to the ISO 10303 Part 21 standard.
TEXT	The document will be a text representation of the tool data.
UNDEFINED	The document will be provided in an undefined format.
XML	The default value for the definition. The content will be an XML document.

122 3.2.4.2 value

123 Placeholder for documentation!

124 3.2.5 CuttingToolLifeCycle

125 Data regarding the use of the cutting tool.

Table 7: Properties of CuttingToolLifeCycle

Property	Type	Multiplicity
ConnectionCodeMachineSide	string	0..1
ProgramToolGroup	string	0..1
ProgramToolNumber	integer	0..1
ProcessFeedRate	ProcessFeedRate	0..1
ToolLife	ToolLife	0..1
ToolLife	ToolLife	0..1
ProcessSpindleSpeed	ProcessSpindleSpeed	0..1
ToolLife	ToolLife	0..1
CutterStatus	Status	1..*
CuttingItems	CuttingItem	0..*
Measurements	Measurement	0..*
ReconditionCount	ReconditionCount	0..1
Location	Location	0..1

126 **3.2.5.1 ConnectionCodeMachineSide**

127 Identifier for the capability to connect any Component of the cutting tool together,
 128 except Assembly Items, on the machine side. Code: CCMS

129 **3.2.5.2 ProgramToolGroup**

130 The tool group this tool is assigned in the part program.

131 **3.2.5.3 ProgramToolNumber**

132 The number of the tool as referenced in the part program.

133 **3.2.5.4 ProcessFeedRate**

134 Placeholder for documentation!

135 **3.2.5.5 ToolLife**

136 Placeholder for documentation!

137 **3.2.5.6 ToolLife**

138 Placeholder for documentation!

139 **3.2.5.7 ProcessSpindleSpeed**

140 Placeholder for documentation!

141 **3.2.5.8 ToolLife**

142 Placeholder for documentation!

143 **3.2.5.9 CutterStatus**

144 Placeholder for documentation!

145 **3.2.5.10 CuttingItems**

146 Placeholder for documentation!

147 **3.2.5.11 Measurements**

148 Placeholder for documentation!

149 **3.2.5.12 ReconditionCount**

150 Placeholder for documentation!

151 **3.2.5.13 Location**

Placeholder for documentation!

3.2.6 Location

The Pot or Spindle the cutting tool currently resides in.

Table 8: Properties of Location

Property	Type	Multiplicity
negativeOverlap	integer	0..1
positiveOverlap	integer	0..1
type	LocationType	1

3.2.6.1 negativeOverlap

The number of location at lower index values from this location.

3.2.6.2 positiveOverlap

The number of locations at higher index value from this location.

3.2.6.3 type

The type of location being identified.

Enumeration for Location types

Table 9: LocationType Enumeration

Name	Description
POT	The number of the pot in the tool handling system.
STATION	The tool location in a horizontal turning machine.
CRIB	The location with regard to a tool crib.

162 3.2.7 Measurement

163 A constrained scalar value associated with this cutting tool.

Table 10: Properties of Measurement

Property	Type	Multiplicity
code	CodeEnum	1
maximum	float	0..1
minimum	float	0..1
nativeUnits	NativeUnitEnum	0..1
nominal	float	0..1
significantDigits	integer	0..1
units	UnitEnum	0..1

164 3.2.7.1 code

165 A shop specific code for this measurement. ISO 13399 codes MAY be used for these
166 codes as well.

167 Placeholder for documentation!

Table 11: CodeEnum Enumeration

Name	Description
BDX	The largest diameter of the body of a Tool Item.
LBX	The distance measured along the X axis from that point of the item closest to the workpiece, including the Cutting Item for a Tool Item but excluding a protruding locking mechanism for an Adaptive Item, to either the front of the flange on a flanged body or the beginning of the connection interface feature on the machine side for cylindrical or prismatic shanks.
APMX	The maximum engagement of the cutting edge or edges with the workpiece measured perpendicular to the feed motion.
DC	The maximum diameter of a circle on which the defined point Pk of each of the master inserts is located on a Tool Item. The normal of the machined peripheral surface points towards the axis of the Cutting Tool.
DF	The dimension between two parallel tangents on the outside edge of a flange.
OAL	The largest length dimension of the Cutting Tool including the master insert where applicable.
DMM	The dimension of the diameter of a cylindrical portion of a Tool Item or an Adaptive Item that can participate in a connection.
H	The dimension of the height of the shank.
LS	The dimension of the length of the shank.
LUX	Maximum length of a Cutting Tool that can be used in a particular cutting operation including the non-cutting portions of the tool.
LPR	The dimension from the yz-plane to the furthest point of the Tool Item or Adaptive Item measured in the -X direction.
WT	The total weight of the Cutting Tool in grams. The force exerted by the mass of the Cutting Tool.
LF	The distance from the gauge plane or from the end of the shank to the furthest point on the tool, if a gauge plane does not exist, to the cutting reference point determined by the main function of the tool. The model:CuttingTool functional length will be the length of the entire tool, not a single Cutting Item. Each model:CuttingItem can have an independent model:FunctionalLength represented in its measurements.
CRP	The theoretical sharp point of the Cutting Tool from which the major functional dimensions are taken.
L	The theoretical length of the cutting edge of a Cutting Item over sharp corners.
DRVA	Angle between the driving mechanism locator on a Tool Item and the main cutting edge.
WF	The distance between the cutting reference point and the rear backing surface of a turning tool or the axis of a boring bar.
IC	The diameter of a circle to which all edges of a equilateral and round regular insert are tangential.
SIG	The angle between the major cutting edge and the same cutting edge rotated by 180 degrees about the tool axis.
KAPR	The angle between the tool cutting edge plane and the tool feed plane measured in a plane parallel the xy plane.

168 **3.2.7.2 maximum**

169 The maximum value for this measurement.

170 **3.2.7.3 minimum**

171 The minimum value for this measurement.

172 **3.2.7.4 nativeUnits**

173 The units the measurement was originally recorded in.

174 Placeholder for documentation!

Table 12: NativeUnitEnum Enumeration

Name	Description
CENTIPOISE	Placeholder for documentation!
DEGREE/MINUTE	Placeholder for documentation!
FAHRENHEIT	Placeholder for documentation!
FOOT	Placeholder for documentation!
FOOT/MINUTE	Placeholder for documentation!
FOOT/SECOND	Placeholder for documentation!
FOOT/SECOND ²	Placeholder for documentation!
FOOT_3D	Placeholder for documentation!
GALLON/MINUTE	Placeholder for documentation!
HOURL	Placeholder for documentation!
INCH	Placeholder for documentation!
INCH/MINUTE	Placeholder for documentation!
INCH/SECOND	Placeholder for documentation!
INCH/SECOND ²	Placeholder for documentation!
INCH_POUND	Placeholder for documentation!
INCH_3D	Placeholder for documentation!
KELVIN	Placeholder for documentation!
KILOWATT	Placeholder for documentation!
KILOWATT_HOURL	Placeholder for documentation!
LITER	Placeholder for documentation!
LITER/MINUTE	Placeholder for documentation!
MILLIMETER/MINUTE	Placeholder for documentation!
MINUTE	Placeholder for documentation!
OTHER	Placeholder for documentation!
POUND	Placeholder for documentation!
POUND/INCH ²	Placeholder for documentation!
RADIAN	Placeholder for documentation!
RADIAN/MINUTE	Placeholder for documentation!
RADIAN/SECOND	Placeholder for documentation!
RADIAN/SECOND ²	Placeholder for documentation!
REVOLUTION/SECOND	Placeholder for documentation!

175 **3.2.7.5 nominal**

176 The as advertised value for this measurement.

177 **3.2.7.6 significantDigits**

178 The number of significant digits in the reported value.

179 **3.2.7.7 units**

180 The units for the measurements.

181 Placeholder for documentation!

Table 13: UnitEnum Enumeration

Name	Description
AMPERE	Amps
CELSIUS	Degrees Celsius
COUNT	A count of something.
DECIBEL	Sound Level
DEGREE	Angle in degrees
DEGREE/SECOND	Angular degrees per second
DEGREE/SECOND ²	Angular acceleration in degrees per second squared
HERTZ	Frequency measured in cycles per second
JOULE	A measurement of energy.
KILOGRAM	Kilograms
LITER	Measurement of volume of a fluid
LITER/SECOND	Liters per second
MICRO_RADIAN	Measurement of Tilt
MILLIMETER	Millimeters
MILLIMETER_3D	A point in space identified by X, Y, and Z positions and represented by a space-delimited set of numbers each expressed in millimeters.
MILLIMETER/REVOLUTION	Millimeters per revolution.
MILLIMETER/SECOND	Millimeters per second
MILLIMETER/SECOND ²	Acceleration in millimeters per second squared
NEWTON	Force in Newtons
NEWTON_METER	Torque, a unit for force times distance.
OHM	Measure of Electrical Resistance
PASCAL	Pressure in Newtons per square meter
PASCAL_SECOND	Measurement of Viscosity
PERCENT	Percentage
PH	A measure of the acidity or alkalinity of a solution.
REVOLUTION/MINUTE	Revolutions per minute
SECOND	A measurement of time.
SIEMENS/METER	A measurement of Electrical Conductivity
VOLT	Volts
VOLT_AMPERE	The measurement of the apparent power in an electrical circuit, equal to the product of root-mean-square (RMS) voltage and RMS current (commonly referred to as VA).
VOLT_AMPERE_REACTIVE	The measurement of reactive power in an AC electrical circuit, equal to the product of root-mean-square (RMS) voltage and RMS current (commonly referred to as VAR).
WATT	Watts
WATT_SECOND	Measurement of electrical energy, equal to one Joule

182 3.2.8 ProcessFeedRate

183 The constrained process feed rate for this tool in mm/s.

Table 14: Properties of ProcessFeedRate

Property	Type	Multiplicity
maximum	float	0..1
minimum	float	0..1
nominal	float	0..1

184 3.2.8.1 maximum

185 The upper bound for the tool's process target feedrate.

186 3.2.8.2 minimum

187 The lower bound for the tools feedrate.

188 3.2.8.3 nominal

189 The nominal feedrate the tool is designed to operate at.

190 3.2.9 ProcessSpindleSpeed

191 The constrained process spindle speed for this tool.

Table 15: Properties of ProcessSpindleSpeed

Property	Type	Multiplicity
maximum	float	0..1
minimum	float	0..1
nominal	float	0..1

192 **3.2.9.1 maximum**

193 The upper bound for the tool's target spindle speed.

194 **3.2.9.2 minimum**

195 The lower bound for the tools spindle speed.

196 **3.2.9.3 nominal**

197 The nominal speed the tool is designed to operate at.

198 **3.2.10 ReconditionCount**

199 The number of times this cutter has been reconditioned.

Table 16: Properties of ReconditionCount

Property	Type	Multiplicity
maximumCount	integer	0..1

200 **3.2.10.1 maximumCount**

201 The maximum number of times this tool may be reconditioned.

202 **3.2.11 Status**

203 The status of the cutting tool.

Table 17: Properties of Status

Property	Type	Multiplicity
value	CutterStatusType	1

204 3.2.11.1 value

205 The status value of the cutting tool.

206 Enumeration for CutterStatus values.

Table 18: CutterStatusType Enumeration

Name	Description
NEW	A new tool that has not been used or first use. Marks the start of the tool history.
AVAILABLE	Indicates the tool is available for use. If this is not present, the tool is currently not ready to be used.
UNAVAILABLE	Indicates the tool is unavailable for use in metal removal. If this is not present, the tool is currently not ready to be used.
ALLOCATED	Indicates if this tool is has been committed to a piece of equipment for use and is not available for use in any other piece of equipment.
UNALLOCATED	Indicates this cutting tool has not been committed to a process and can be allocated.
MEASURED	The tool has been measured.
RECONDITIONED	The Cutting Tool has been reconditioned.
USED	The cutting tool is in process and has remaining tool life.
EXPIRED	The cutting tool has reached the end of its useful life.
BROKEN	Premature tool failure.
NOT_REGISTERED	This cutting tool cannot be used until it is entered into the system.
UNKNOWN	The cutting tool is an indeterminate state. This is the default value.

207 3.2.12 ToolLife

208 The cutting tool life as related to this assembly.

Table 19: Properties of ToolLife

Property	Type	Multiplicity
countDirection	CountDirectionType	1
initial	float	0..1
limit	float	0..1
warning	float	0..1

209 3.2.12.1 countDirection

210 Indicates if the tool life counts from zero to maximum or maximum to zero.

211 Enumeration for countDirection types.

Table 20: CountDirectionType Enumeration

Name	Description
UP	The tool life counts up from zero to the maximum.
DOWN	The tool life counts down from the maximum to zero.

212 3.2.12.2 initial

213 The initial life of the tool when it is new.

214 3.2.12.3 limit

215 The end of life limit for this tool.

216 3.2.12.4 warning

217 The point at which a tool life warning will be raised.

218 3.3 CuttingItemModel

219 3.3.1 CuttingItem

220 A CuttingItem is the portion of the tool that physically removes the material from the
221 workpiece by shear deformation.

Table 21: Properties of CuttingItem

Property	Type	Multiplicity
Description	string	0..1
grade	string	0..1
indices	string	1
itemId	ID	0..1
Locus	string	0..1
manufacturers	string	0..1
ProgramToolGroup	string	0..1
CutterStatus	Status	1..*
ItemLife	ItemLife	0..1
ItemLife	ItemLife	0..1
ItemLife	ItemLife	0..1
Measurements	Measurement	0..*

222 3.3.1.1 Description

223 A free-form description of the Cutting Item.

224 3.3.1.2 grade

225 The material composition for this Cutting Item.

226 3.3.1.3 indices

227 The number or numbers representing the individual Cutting Item or items on the tool.

228 3.3.1.4 itemId

229 The manufacturer identifier of this Cutting Item.

230 **3.3.1.5 Locus**

231 A free form description of the location on the Cutting Tool.

232 **3.3.1.6 manufacturers**

233 The manufacturers of the Cutting Item or Tool.

234 **3.3.1.7 ProgramToolGroup**

235 The tool group this item is assigned in the part program.

236 **3.3.1.8 CutterStatus**

237 Placeholder for documentation!

238 **3.3.1.9 ItemLife**

239 Placeholder for documentation!

240 **3.3.1.10 ItemLife**

241 Placeholder for documentation!

242 **3.3.1.11 ItemLife**

243 Placeholder for documentation!

244 **3.3.1.12 Measurements**

245 Placeholder for documentation!

246 3.3.2 ItemLife

247 The life of this Cutting Item.

Table 22: Properties of ItemLife

Property	Type	Multiplicity
countDirection	CountDirectionType	1
initial	float	0..1
limit	string	0..1
warning	float	0..1

248 3.3.2.1 countDirection

249 Indicates if the item life counts from zero to maximum or maximum to zero.

250 Enumeration for countDirection types.

Table 23: CountDirectionType Enumeration

Name	Description
UP	The tool life counts up from zero to the maximum.
DOWN	The tool life counts down from the maximum to zero.

251 3.3.2.2 initial

252 The initial life of the item when it is new

253 3.3.2.3 limit

254 The end of life limit for this item.

255 3.3.2.4 warning

256 The point at which a item life warning will be raised.

257 Appendices

258 A Bibliography

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 260 Block Data Format for Positioning, Contouring, and Contouring/Positioning Numerically
 261 Controlled Machines. Washington, D.C. 1979.
- 262 ISO TC 184/SC4/WG3 N1089. *ISO/DIS 10303-238*: Industrial automation systems and
 263 integration Product data representation and exchange Part 238: Application Protocols: Ap-
 264 plication interpreted model for computerized numerical controllers. Geneva, Switzerland,
 265 2004.
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 267 tems and integration – Physical device control – Data model for computerized numerical
 268 controllers – Part 10: General process data. Geneva, Switzerland, 2004.
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 270 tems and integration – Physical device control – Data model for computerized numerical
 271 controllers – Part 11: Process data for milling. Geneva, Switzerland, 2000.
- 272 International Organization for Standardization. *ISO 6983/1* – Numerical Control of ma-
 273 chines – Program format and definition of address words – Part 1: Data format for posi-
 274 tioning, line and contouring control systems. Geneva, Switzerland, 1982.
- 275 Electronic Industries Association. *ANSI/EIA-494-B-1992*, 32 Bit Binary CL (BCL) and
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 277 Washington, D.C. 1992.
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 279 ment Specifications. Washington, D.C. 1969.
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 281 tion systems and integration Product data representation and exchange Part 11: Descrip-
 282 tion methods: The EXPRESS language reference manual. Geneva, Switzerland, 1994.
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 284 tion systems and integration – Product data representation and exchange – Part 21: Imple-
 285 mentation methods: Clear text encoding of the exchange structure. Geneva, Switzerland,
 286 1996.
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290 *tems and integration - Numerical control of machines - Coordinate systems and motion*
291 *nomenclature*. Geneva, Switzerland, 2001.

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293 *and Turning*. 2005.

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295 *trolled Machining Centers*. 2005.

296 OPC Foundation. *OPC Unified Architecture Specification, Part 1: Concepts Version 1.00*.
297 July 28, 2006.

298 International Organization for Standardization. *ISO 13399: Cutting tool data representa-*
299 *tion and exchange*. Geneva, Switzerland, 2000.

300 B Additional Illustrations

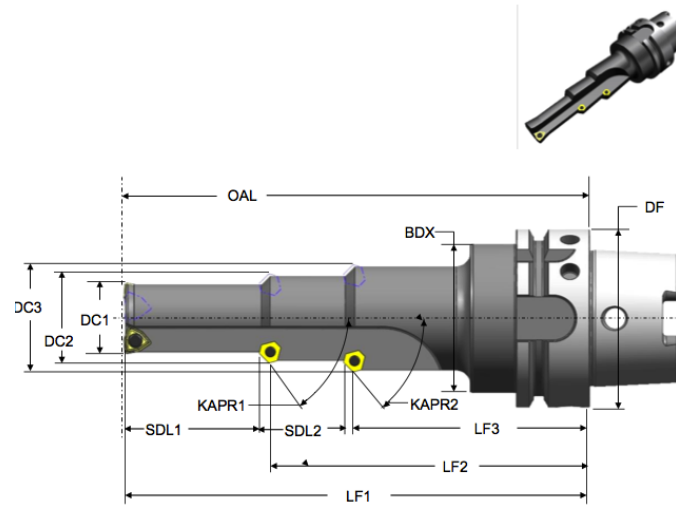


Figure 1: Cutting Tool Measurement Diagram 1
(Cutting Tool, Cutting Item, and Assembly Item – ISO 13399)

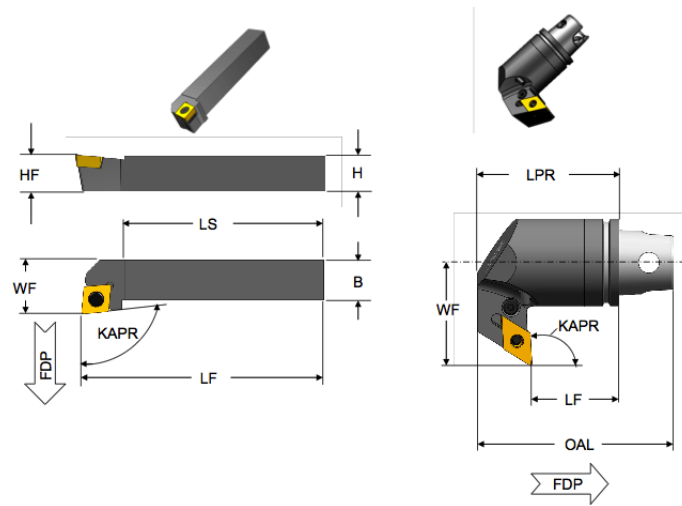


Figure 2: Cutting Tool Measurement Diagram 2
(Cutting Tool, Cutting Item, and Assembly Item – ISO 13399)

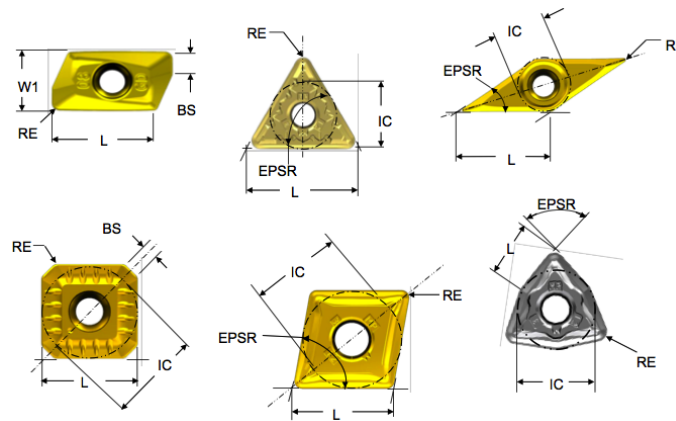


Figure 3: Cutting Tool Measurement Diagram 3
(Cutting Item – ISO 13399)

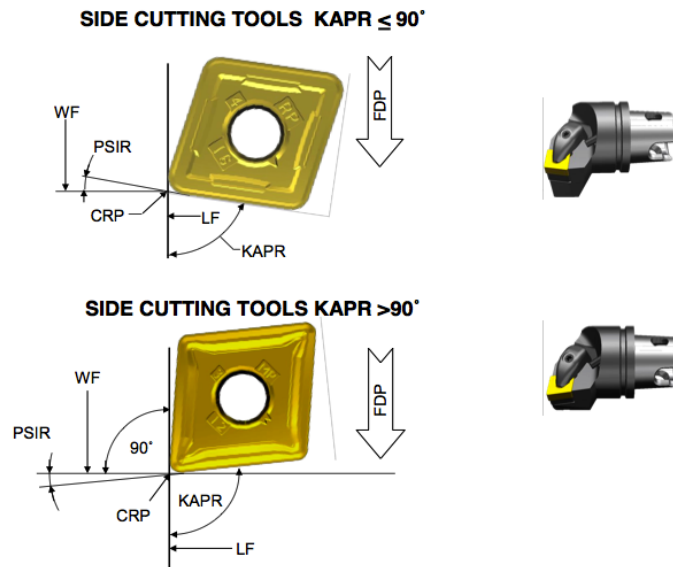


Figure 4: Cutting Tool Measurement Diagram 4
(Cutting Item – ISO 13399)

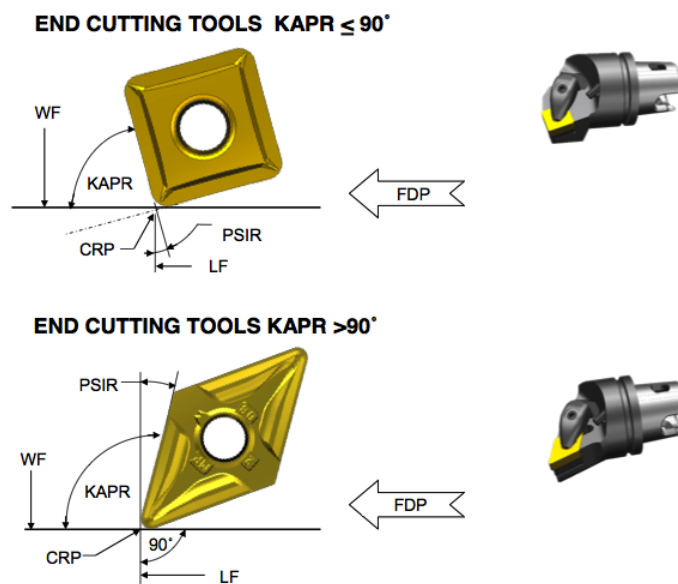


Figure 5: Cutting Tool Measurement Diagram 5
(Cutting Item – ISO 13399)

BCH = CHAMFER FLAT LENGTH

CHW = CHAMFER WIDTH

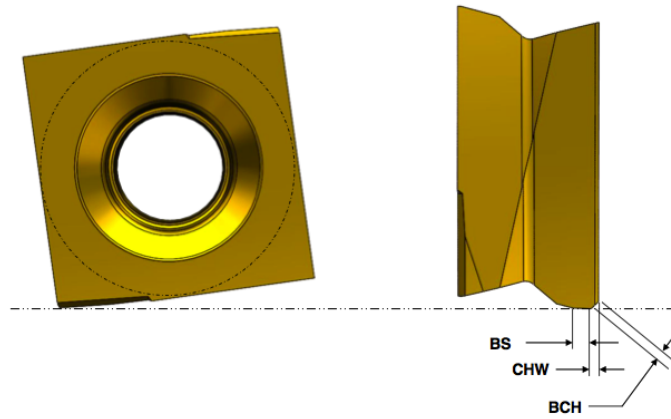


Figure 6: Cutting Tool Measurement Diagram 6
(Cutting Item – ISO 13399)

301 C Cutting Tool Example

302 C.1 Shell Mill

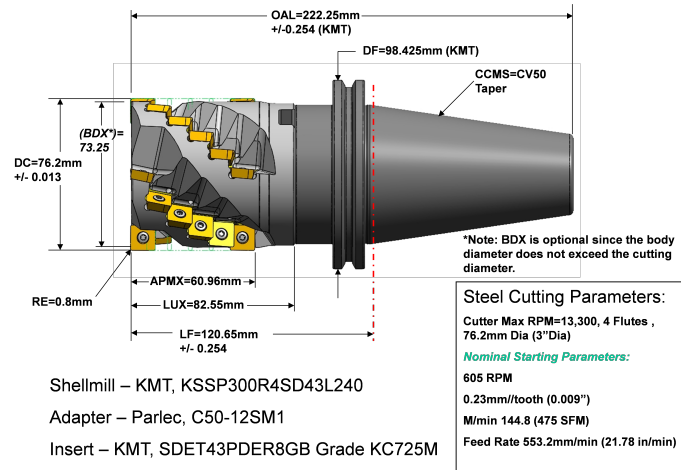


Figure 7: Shell Mill Side View

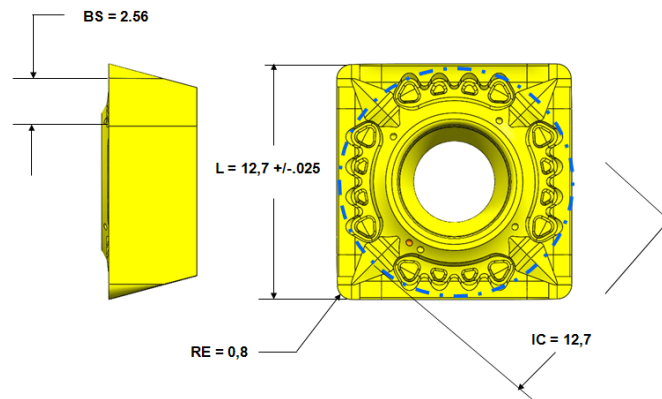


Figure 8: Indexable Insert Measurements

Example 1: Example for Indexable Insert Measurements

```

303 1 <?xml version="1.0" encoding="UTF-8"?>
304 2 <MTConnectAssets
305 3 xmlns:m="urn:mtconnect.org:MTConnectAssets:1.2"
306 4 xmlns="urn:mtconnect.org:MTConnectAssets:1.2"
307 5 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
308 6 xsi:schemaLocation="urn:mtconnect.org:MTConnectAssets:1.2
309 7 http://mtconnect.org/schemas/MTConnectAssets/_1.2.xsd">
310 8   <Header creationTime="2011-05-11T13:55:22"
311 9     assetBufferSize="1024" sender="localhost"

```

```

312 10  assetCount="2" version="1.2" instanceId="1234"/>
313 11  <Assets>
314 12  <CuttingTool serialNumber="1" toolId="KSSP300R4SD43L240"
315 13  timestamp="2011-05-11T13:55:22" assetId="KSSP300R4SD43L240.1"
316 14  manufacturers="KMT,Parlec">
317 15    <CuttingToolLifeCycle>
318 16    <CutterStatus><Status>NEW</Status></CutterStatus>
319 17    <ProcessSpindleSpeed maximum="13300"
320 18    nominal="605">10000</ProcessSpindleSpeed>
321 19    <ProcessFeedRate
322 20    nominal="9.22">9.22</ProcessSpindleSpeed>
323 21    <ConnectionCodeMachineSide>CV50
324 22    </ConnectionCodeMachineSide>
325 23    <Measurements>
326 24      <BodyDiameterMax code="BDX">73.25
327 25      </BodyDiameterMax>
328 26      <OverallToolLength nominal="222.25"
329 27      minimum="221.996" maximum="222.504"
330 28      code="OAL">222.25</OverallToolLength>
331 29      <UsableLengthMax code="LUX" nominal="82.55">82.55
332 30      </UsableLengthMax>
333 31      <CuttingDiameterMax code="DC" nominal="76.2"
334 32      maximum="76.213" minimum="76.187">76.2
335 33      </CuttingDiameterMax>
336 34      <BodyLengthMax code="LF" nominal="120.65"
337 35      maximum="120.904" minimum="120.404">120.65
338 36      </BodyLengthMax>
339 37      <DepthOfCutMax code="APMX"
340 38      nominal="60.96">60.95</DepthOfCutMax>
341 39      <FlangeDiameterMax code="DF"
342 40      nominal="98.425">98.425</FlangeDiameterMax>
343 41    </Measurements>
344 42    <CuttingItems count="24">
345 43      <CuttingItem indices="1-24" itemId="SDET43PDER8GB"
346 44      manufacturers="KMT" grade="KC725M">
347 45        <Measurements>
348 46          <CuttingEdgeLength code="L" nominal="12.7"
349 47          minimum="12.675" maximum="12.725">12.7
350 48          </CuttingEdgeLength>
351 49          <WiperEdgeLength code="BS" nominal="
352 50          "2.56">2.56</WiperEdgeLength>
353 51          <IncribedCircleDiameter code="IC"
354 52          nominal="12.7">12.7
355 53          </IncribedCircleDiameter>
356 54          <CornerRadius code="RE" nominal="0.8">
357 55          0.8</CornerRadius>
358 56        </Measurements>
359 57      </CuttingItem>
360 58    </CuttingItems>
361 59    </CuttingToolLifeCycle>
362 60  </CuttingTool>

```

```
363 61    </Assets>
364 62    </MTConnectAssets>
```


365 C.2 Step Drill

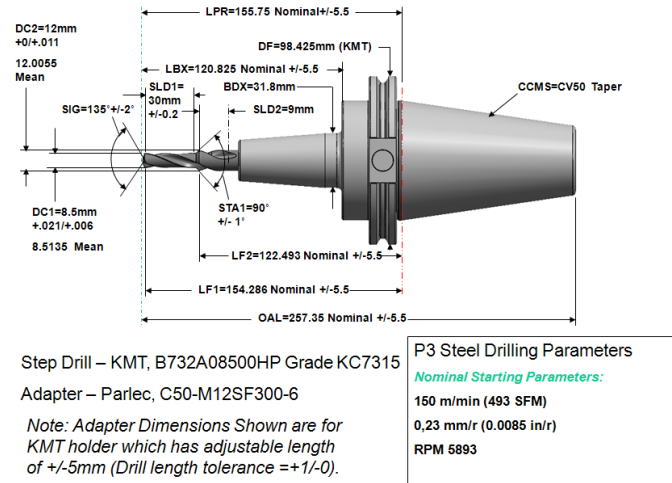


Figure 9: Step Mill Side View

Example 2: Example for Step Mill Side View

```

366 1 <?xml version="1.0" encoding="UTF-8"?>
367 2 <MTConnectAssets xmlns:m="urn:mtconnect.org:MTConnectAssets:1.2"
368 3 xmlns="urn:mtconnect.org:MTConnectAssets:1.2"
369 4 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
370 5 xsi:schemaLocation="urn:mtconnect.org:MTConnectAssets:1.2
371 6 http://mtconnect.org/schemas/MTConnectAssets\_1.2.xsd">
372 7   <Header creationTime="2011-05-
373 8   11T13:55:22" assetBufferSize="1024"
374 9   sender="localhost" assetCount="2" version="1.2" instanceId="1234"/>
375 10  <Assets>
376 11    <CuttingTool serialNumber="1_" toolId="B732A08500HP"
377 12    timestamp="2011-05-11T13:55:22" assetId="B732A08500HP_"
378 13    manufacturers="KMT,Parlec">
379 14      <Description>
380 15        Step Drill - KMT, B732A08500HP Grade KC7315
381 16        Adapter - Parlec, C50-M12SF300-6
382 17      </Description>
383 18      <CuttingToolLifeCycle>
384 19        <CutterStatus><Status>NEW</Status></CutterStatus>
385 20        <ProcessSpindleSpeed nominal="5893">5893</ProcessSpindleSpeed>
386 21        <ProcessFeedRate nominal="2.5">2.5</ProcessFeedRate>
387 22        <ConnectionCodeMachineSide>CV50 Taper</ConnectionCodeMachineSide>
388 23        <Measurements>
389 24          <BodyDiameterMax code="BDX">31.8</BodyDiameterMax>
390 25          <BodyLengthMax code="LBX" nominal="120.825" maximum="126.325"
391 26          minimum="115.325">120.825</BodyLengthMax>
392 27          <ProtrudingLength code="LPR" nominal="155.75" maximum="161.25"
393 28          minimum="150.26">155.75</ProtrudingLength>

```

```

394 29      <FlangeDiameterMax code="DF"
395 30      nominal="98.425">98.425</FlangeDiameterMax>
396 31      <OverallToolLength nominal="257.35" minimum="251.85"
397 32      maximum="262.85" code="OAL">257.35</OverallToolLength>
398 33  </Measurements>
399 34  <CuttingItems count="2">
400 35      <CuttingItem indices="1" manufacturers="KMT" grade="KC7315">>
401 36          <Measurements>
402 37              <CuttingDiameter code="DC1" nominal="8.5" maximum="8.521"
403 38              minimum="8.506">8.5135</CuttingDiameter>
404 39              <StepIncludedAngle code="STA1" nominal="90" maximum="91"
405 40              minimum="89">90</StepIncludedAngle>
406 41              <FunctionallLength code="LF1" nominal="154.286"
407 42              minimum="148.786"
408 43              maximum="159.786">154.286</FunctionallLength>
409 44              <StepDiameterLength code="SDL1"
410 45              nominal="9">9</StepDiameterLength>
411 46              <PointAngle code="SIG" nominal="135" minimum="133"
412 47              maximum="137">135</PointAngle>
413 48          </Measurements>
414 49      </CuttingItem>
415 50      <CuttingItem indices="2" manufacturers="KMT" grade="KC7315">>
416 51          <Measurements>
417 52              <CuttingDiameter code="DC2" nominal="12" maximum="12.011"
418 53              minimum="12">12</CuttingDiameter>
419 54              <FunctionallLength code="LF2" nominal="122.493"
420 55              maximum="127.993"
421 56              minimum="116.993">122.493</FunctionallLength>
422 57              <StepDiameterLength code="SDL2"
423 58              nominal="9">9</StepDiameterLength>
424 59          </Measurements>
425 60      </CuttingItem>
426 61  </CuttingItems>
427 62  </CuttingToolLifeCycle>
428 63  </CuttingTool>
429 64  </Assets>
430 65 </MTConnectAssets>

```

431 C.3 Shell Mill with Individual Loci

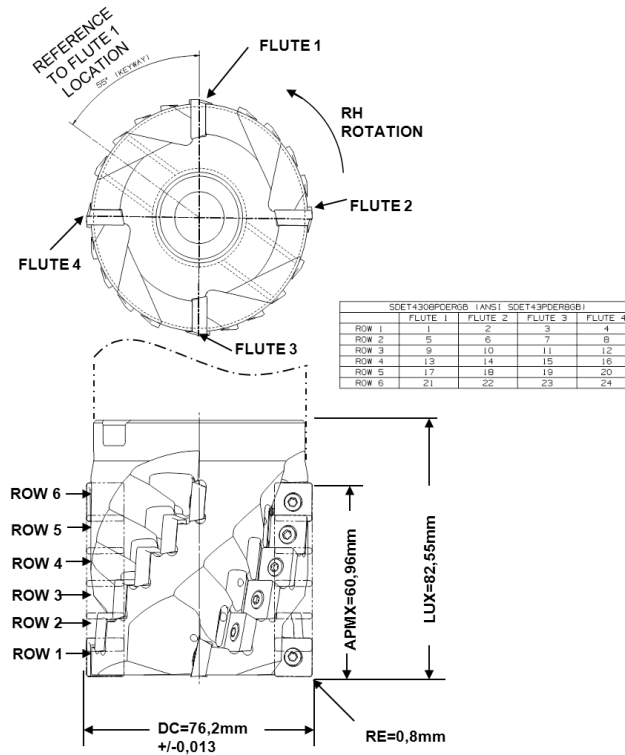


Figure 10: Shell Mill with Explicate Loci

Example 3: Example for Shell Mill with Explicate Loci

```

432 1 <?xml version="1.0" encoding="UTF-8"?>
433 2 <MTConnectAssets xmlns:m="urn:mtconnect.org:MTConnectAssets:1.2"
434 3 xmlns="urn:mtconnect.org:MTConnectAssets:1.2"
435 4 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
436 5 xsi:schemaLocation="urn:mtconnect.org:MTConnectAssets:1.2
437 6 http://mtconnect.org/schemas/MTConnectAssets/_1.2.xsd">
438 7   <Header creationTime="2011-05-11T13:55:22" assetBufferSize="1024"
439 8   sender="localhost" assetCount="2" version="1.2" instanceId="1234"/>
440 9   <Assets>
441 10     <CuttingTool serialNumber="1" toolId="KSSP300R4SD43L240"
442 11     timestamp="2011-05-11T13:55:22" assetId="KSSP300R4SD43L240.1"
443 12     manufacturers="KMT,Parlec">
444 13       <Description>Keyway: 55 degrees</Description>
445 14       <CuttingToolLifeCycle>
446 15         <CutterStatus><Status>NEW</Status></CutterStatus>
447 16         <Measurements>
448 17           <UsableLengthMax code="LUX"
449 18           nominal="82.55">82.55</UsableLengthMax>
450 19           <CuttingDiameterMax code="DC" nominal="76.2" maximum="76.213"

```

```

451 20         minimum="76.187">76.2</CuttingDiameterMax>
452 21         <DepthOfCutMax code="APMX" nominal="60.96">60.95</DepthOfCutMax>
453 22     </Measurements>
454 23     <CuttingItems count="24">
455 24         <CuttingItem indices="1" itemId="SDET43PDER8GB"
456 25             manufacturers="KMT">
457 26             <Locus>FLUTE: 1, ROW: 1</Locus>
458 27             <Measurements>
459 28                 <DriveAngle code="DRVA" nominal="55">55</DriveAngle>
460 29             </Measurements>
461 30         </CuttingItem>
462 31         <CuttingItem indices="2-24" itemId="SDET43PDER8GB"
463 32             manufacturers="KMT">
464 33             <Locus>FLUTE: 2-4, ROW: 1; FLUTE: 1-4, ROW 2-6</Locus>
465 34         </CuttingItem>
466 35     </CuttingItems>
467 36 </CuttingToolLifeCycle>
468 37 </CuttingTool>
469 38 </Assets>
470 39 </MTConnectAssets>

```

471 C.4 Drill with Individual Loci

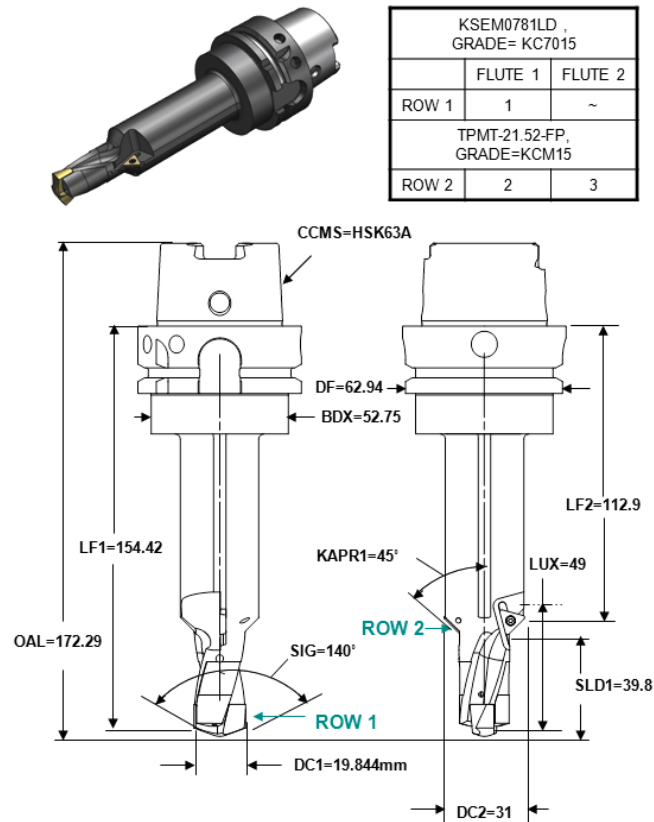


Figure 11: Step Drill with Explicate Loci

Example 4: Example for Step Drill with Explicate Loci

```

472 1 <?xml version="1.0" encoding="UTF-8"?>
473 2 <MTConnectAssets xmlns:m="urn:mtconnect.org:MTConnectAssets:1.2"
474 3 xmlns="urn:mtconnect.org:MTConnectAssets:1.2"
475 4 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
476 5 xsi:schemaLocation="urn:mtconnect.org:MTConnectAssets:1.2
477 6 http://mtconnect.org/schemas/MTConnectAssets/_1.2.xsd">
478 7   <Header creationTime="2011-05-11T13:55:22" assetBufferSize="1024"
479 8   sender="localhost" assetCount="2" version="1.2" instanceId="1234"/>
480 9   <Assets>
481 10     <CuttingTool serialNumber="1" toolId="KSEM0781LD"
482 11     timestamp="2011-05-11T13:55:22" assetId="KSEM0781LD.1" manufacturers="KMT">
483 12       <CuttingToolLifeCycle>
484 13         <CutterStatus><Status>NEW</Status></CutterStatus>
485 14         <ConnectionCodeMachineSide>HSK63A</ConnectionCodeMachineSide>
486 15         <Measurements>
487 16           <BodyDiameterMax code="BDX">52.75</BodyDiameterMax>
488 17           <OverallToolLength nominal="172.29"

```

```

489 18         code="OAL">172.29</OverallToolLength>
490 19         <UsableLengthMax code="LUX" nominal="49">49</UsableLengthMax>
491 20         <FlangeDiameterMax code="DF"
492 21         nominal="62.94">62.94</FlangeDiameterMax>
493 22     </Measurements>
494 23     <CuttingItems count="3">
495 24         <CuttingItem indices="1" itemId="KSEM0781LD" manufacturers="KMT"
496 25         grade="KC7015">
497 26             <Locus>FLUTE: 1, ROW: 1</Locus>
498 27             <Measurements>
499 28                 <FunctionallLength code="LF1" nominal="154.42">154.42</FunctionallLength>
500 29                 <CuttingDiameter code="DC1" nominal="19.844">19.844</CuttingDiameter>
501 30                 <PointAngle code="SIG" nominal="140">140</PointAngle>
502 31                 <ToolCuttingEdgeAngle code="KAPR1" nominal="45">45</ToolCuttingEdgeAngle>
503 32                 <StepDiameterLength code="SLD1" nominal="39.8">39.8</StepDiameterLength>
504 33             </Measurements>
505 34         </CuttingItem>
506 35         <CuttingItem indices="2-3" itemId="TPMT-21.52-FP"
507 36         manufacturers="KMT" grade="KCM15">
508 37             <Locus>FLUTE: 1-2, ROW: 2</Locus>
509 38             <Measurements>
510 39                 <FunctionallLength code="LF2" nominal="112.9">119.2</FunctionallLength>
511 40                 <CuttingDiameter code="DC2" nominal="31">31</CuttingDiameter>
512 41             </Measurements>
513 42         </CuttingItem>
514 43     </CuttingItems>
515 44     </CuttingToolLifeCycle>
516 45 </CuttingTool>
517 46 </Assets>
518 47 </MTConnectAssets>

```

519 C.5 Shell Mill with Different Inserts on First Row

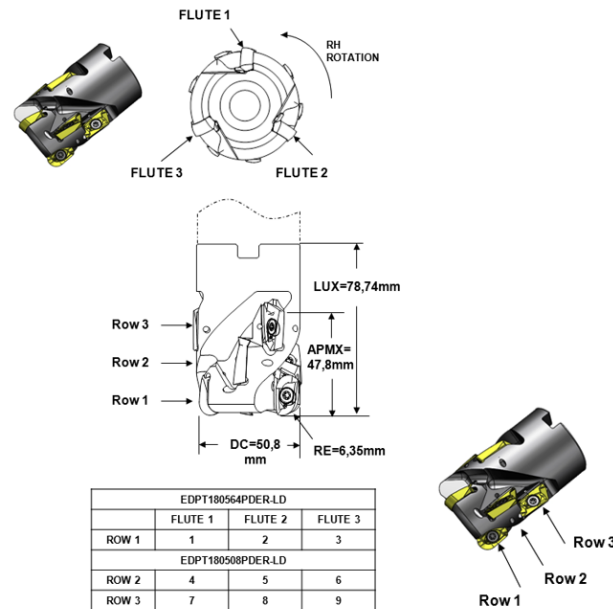


Figure 12: Shell Mill with Different Inserts on First Row

Example 5: Example for Shell Mill with Different Inserts on First Row

```

520 1 <?xml version="1.0" encoding="UTF-8"?>
521 2 <MTConnectAssets xmlns:m="urn:mtconnect.org:MTConnectAssets:1.2"
522 3 xmlns="urn:mtconnect.org:MTConnectAssets:1.2"
523 4 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
524 5 xsi:schemaLocation="urn:mtconnect.org:MTConnectAssets:1.2
525 6 http://mtconnect.org/schemas/MTConnectAssets/_1.2.xsd">
526 7   <Header creationTime="2011-05-11T13:55:22" assetBufferSize="1024"
527 8   sender="localhost" assetCount="2" version="1.2" instanceId="1234"/>
528 9   <Assets>
529 10     <CuttingTool serialNumber="1" toolId="XXX" timestamp="2011-05-11T13:55:22"
530 11     assetId="XXX.1" manufacturers="KMT">
531 12       <CuttingToolLifeCycle>
532 13         <CutterStatus><Status>NEW</Status></CutterStatus>
533 14         <Measurements>
534 15           <DepthOfCutMax code="APMX" nominal="47.8">47.8</DepthOfCutMax>
535 16           <CuttingDiameterMax code="DC"
536 17             nominal="50.8">50.8</CuttingDiameterMax>
537 18           <UsableLengthMax code="LUX"
538 19             nominal="78.74">78.74</UsableLengthMax>
539 20         </Measurements>
540 21         <CuttingItems count="9">
541 22           <CuttingItem indices="1-3" itemId="EDPT180564PDER-LD"
542 23             manufacturers="KMT">
543 24             <Locus>FLUTE: 1-3, ROW: 1</Locus>

```

```
544 25      <Measurements>
545 26      <CornerRadius code="RE" nominal="6.25">6.35</CornerRadius>
546 27      </Measurements>
547 28      </CuttingItem>
548 29      <CuttingItem indices="4-9" itemId="EDPT180508PDER-LD"
549 30      manufacturers="KMT">
550 31      <Locus>FLANGE: 1-4, ROW: 2-3</Locus>
551 32      </CuttingItem>
552 33      </CuttingItems>
553 34      </CuttingToolLifeCycle>
554 35      </CuttingTool>
555 36      </Assets>
556 37 </MTConnectAssets>
```