

Working Draft: ISO 14649 Part 12 & 121

Turning Data Model for STEP-NC

ISO SC4 Fukuoka Meeting, October 2001

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Contents

I. Introduction

- Background
- Foreword

II. Part 12: turning features

- Relationship between Part 10 and Part 12
- Turning feature schema

III. Part 12: process data for turning

- Relationship between Part 10 and Part 12
- Turning process schema

IV. Part 121: tools for turning

- Relationship between Part 10 and Part 121
- Turning tool schema

1.1 Background

1. Co-worked by two institutions:
 - NRL-SNT of POSTECH, Korea
 - ISW of University of Stuttgart, Germany
2. Preliminary work – User requirements for turning data model (Feb 2001)
3. 1st Version of the turning data model (April 2001)
4. Presentation at SC1 Frankfurt Meeting (May 10, 2001)
5. 2nd Version of the turning data model (May E 2001)
6. Presentation at SC4 San Francisco Meeting (June 12, 2001)
7. 3rd Version of the turning data model (August E 2001)
8. 4th and Harmonized version (September 10, 2001) to be presented at Fukuoka Meeting (Oct 2001)
9. To be submitted for ISO CD-ballot in the very near future
10. Both institutions will update and follow up henceforth for the deliverables of Task 5.2 of the IMS STEP-NC Project

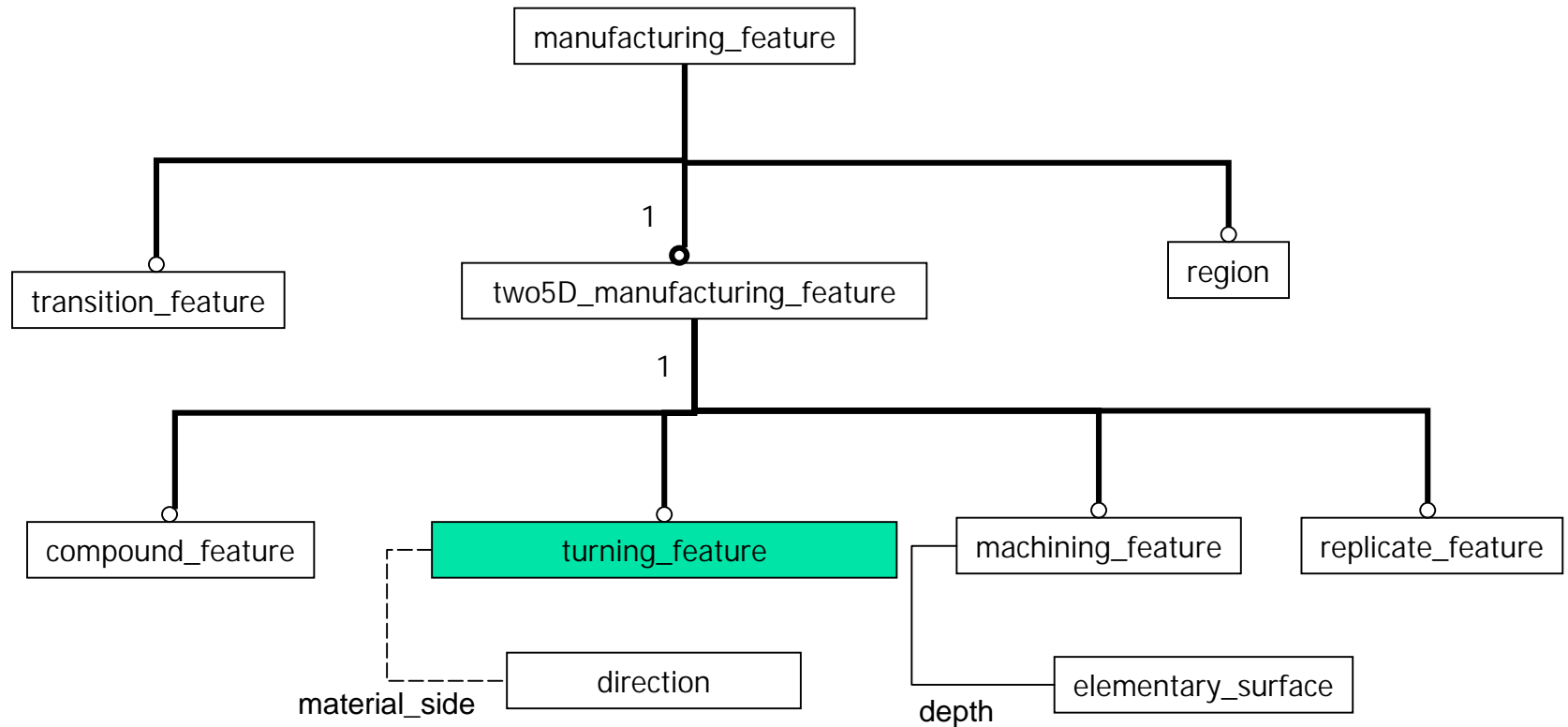
1.2 Foreword

1. **Part 12: Turning features**
 - **Maximum compliance with AP224 (2nd Ed.)**
 - **Consistency with Part 10 of the ISO 14649 FDIS version of August 2001**
2. **Part 12: Turning process**
 - **Consistency with the paradigm of Part 10 and 11 of ISO 14649 FDIS**
3. **Part 121:**
 - **Maximum compliance with ISO 13399**
 - **Consistency with the paradigm of Part 10 and 111 of ISO 14649 FDIS**
 - **Inclusion of figures for clarity and completeness of definition**
4. **Commercial softwares (SFP and CAD/CAM system) and catalogues practically used for turning are referenced**
5. **Verification by pre-implementation**
 - **Usage test for the defined turning features are made**
 - **Open issues are remaining !**

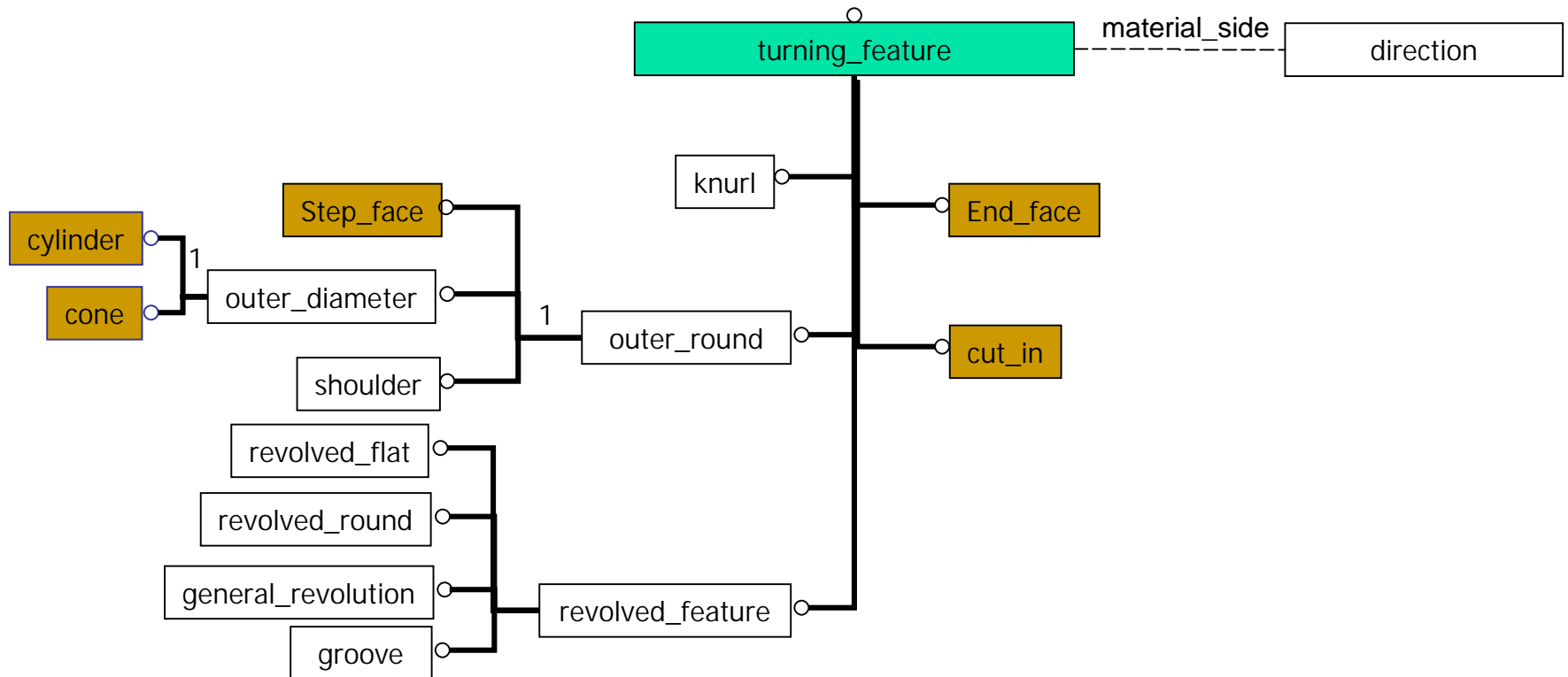
II. Part 12 : turning_feature

1. Location of turning_feature related with Part 10
2. Overall schema of turning_feature
3. Subclasses of turning_feature:
 - 1) knurl
 - 2) cut_in
 - 3) end_face
 - 4) outer_round
 - 5) revolved_feature

2.1 Location of turning_feature



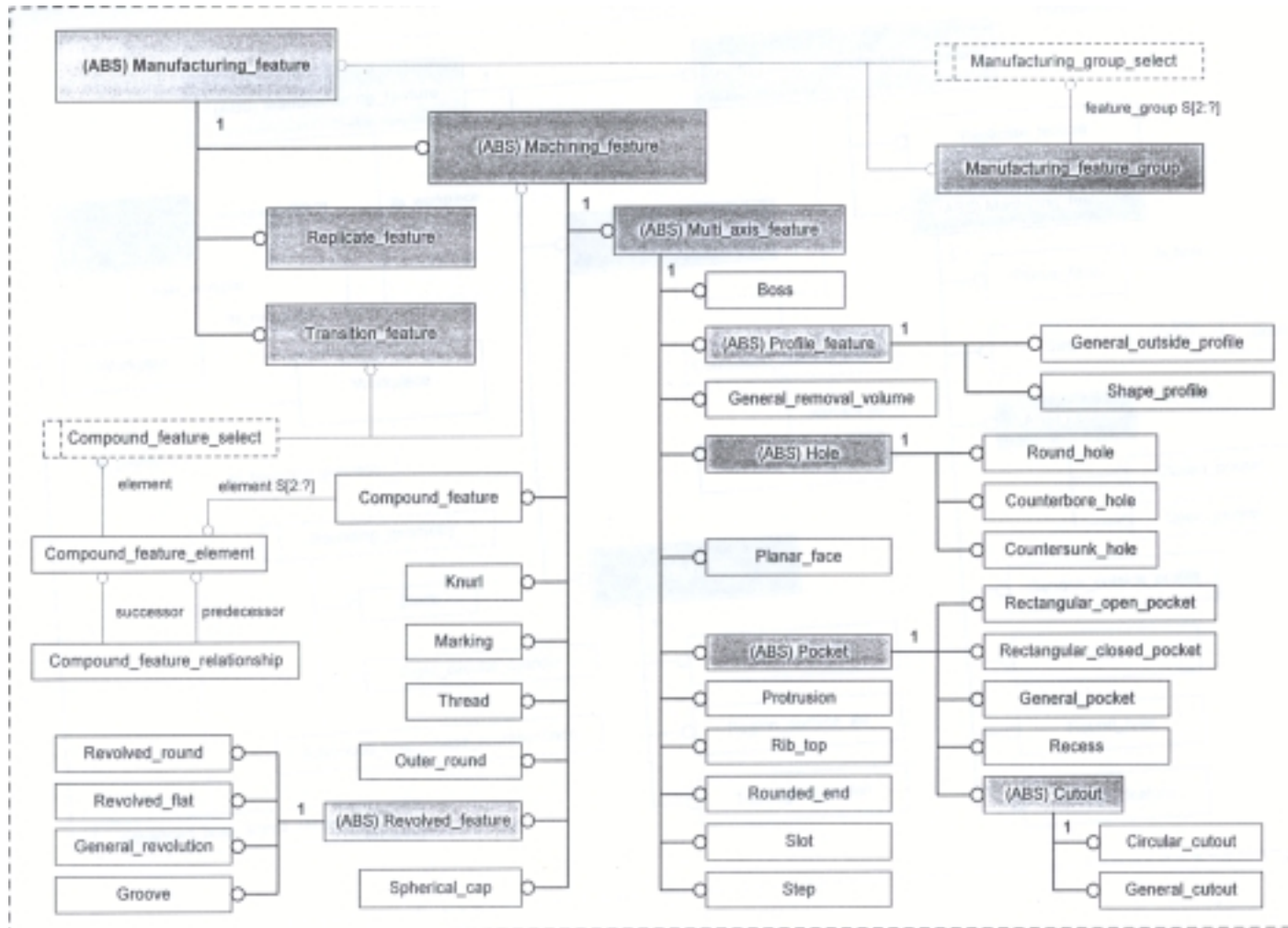
2.2 Overall schema of turning_feature



Remarks on turning_feature

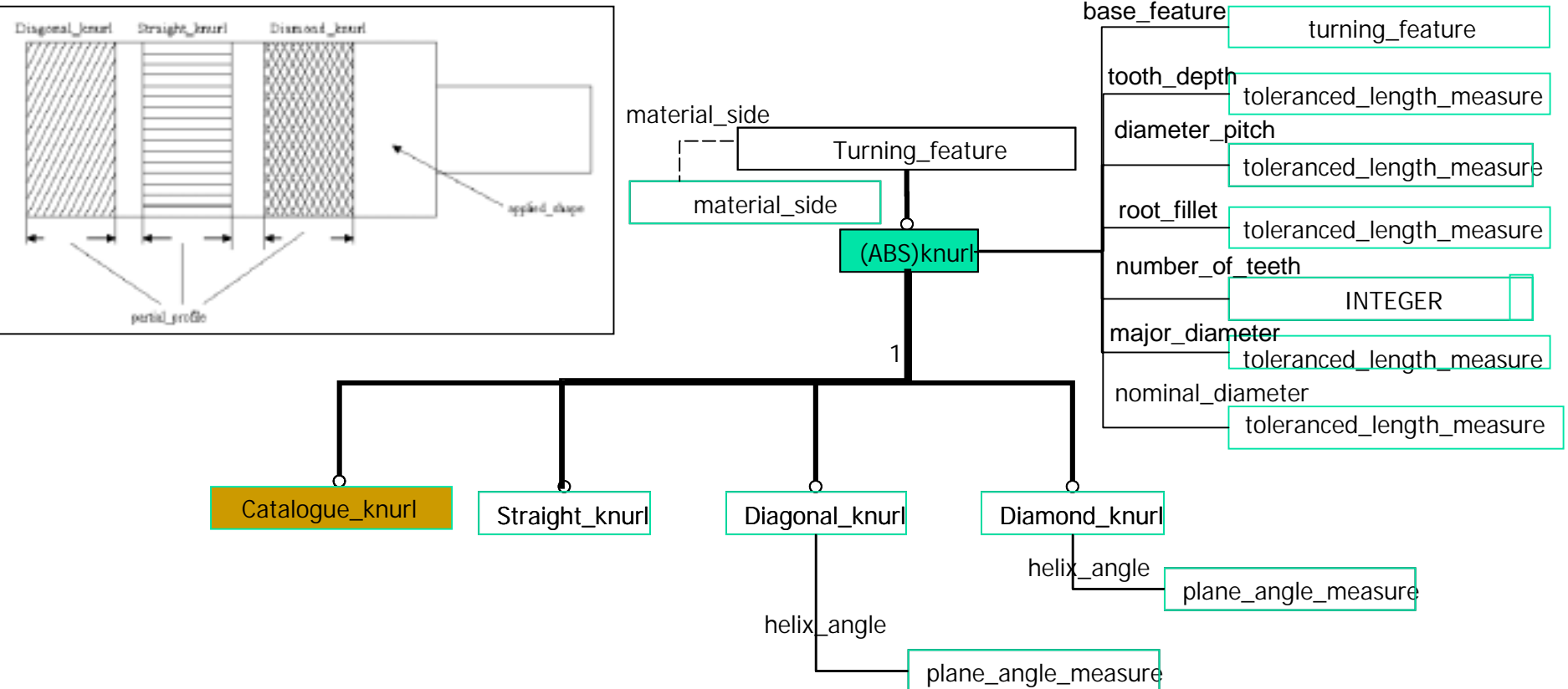
1. Fitting the *turning feature* in the current Part 10, which is now as a subtype of *two5D_manufacturing_feature*
2. *turning feature* has *material_side* as a optional attribute
3. Five subtypes for turning feature: 1) *knurl*, 2) *outer_round*, 3) *revolved_feature* 4) *cut_in*, 5) *end_face*
4. The first 3 are based on AP224 (2nd Ed.), and the latter 2 are newly added for practical use in turning operation.
5. *outer_round* has 3 subtypes:
 - 1) *outer_diameter* (has 2 subtypes: cone & cylinder – for practical use)
 - 2) *shoulder* (same as that of AP 224)
 - 3) *step_face* (newly added for practical use)

Informative: Schema of AP224 (2nd Ed.)



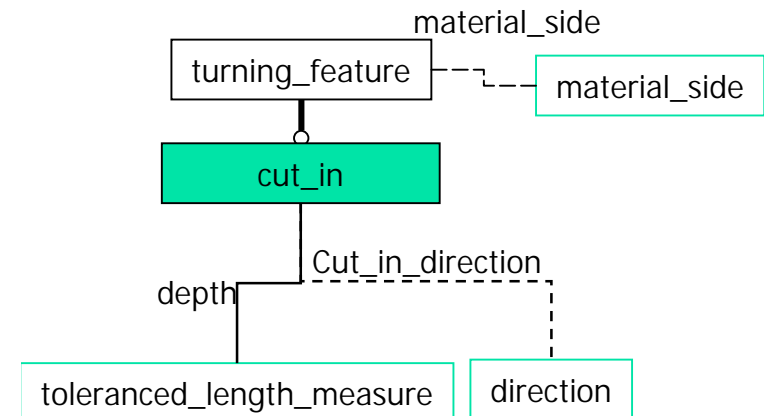
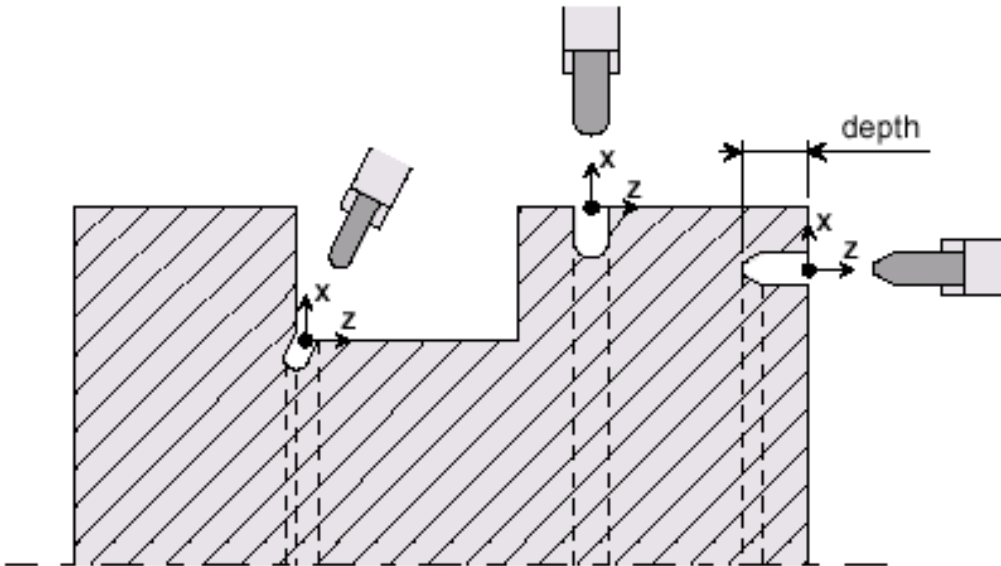
2.3.1 Knurl feature

* Compared with AP224, a new subtype *catalogue_knurl* is included



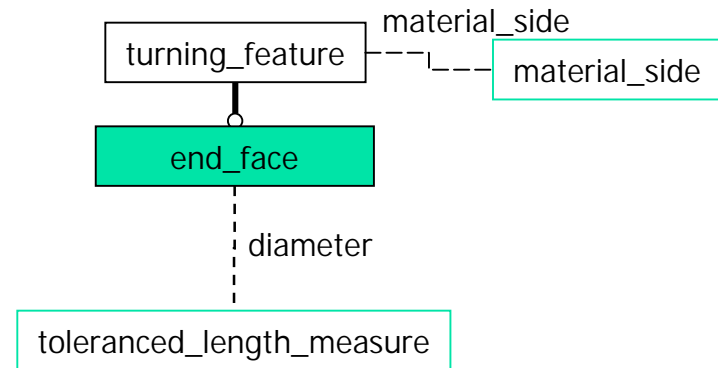
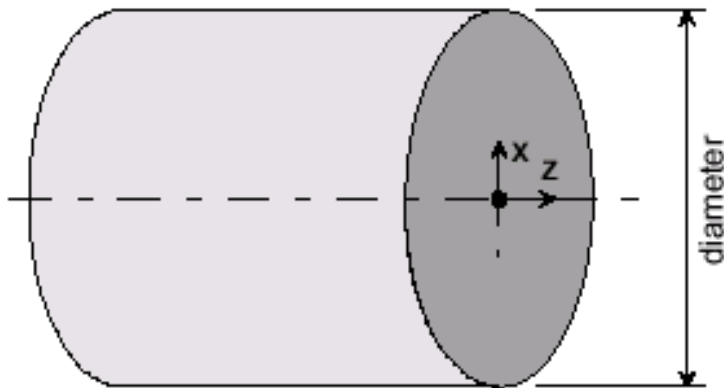
2.3.2 Cut_in feature

1. Newly added for practical use in turning operation
2. It is identical to the shape of the used tool.



2.3.3 End_face feature

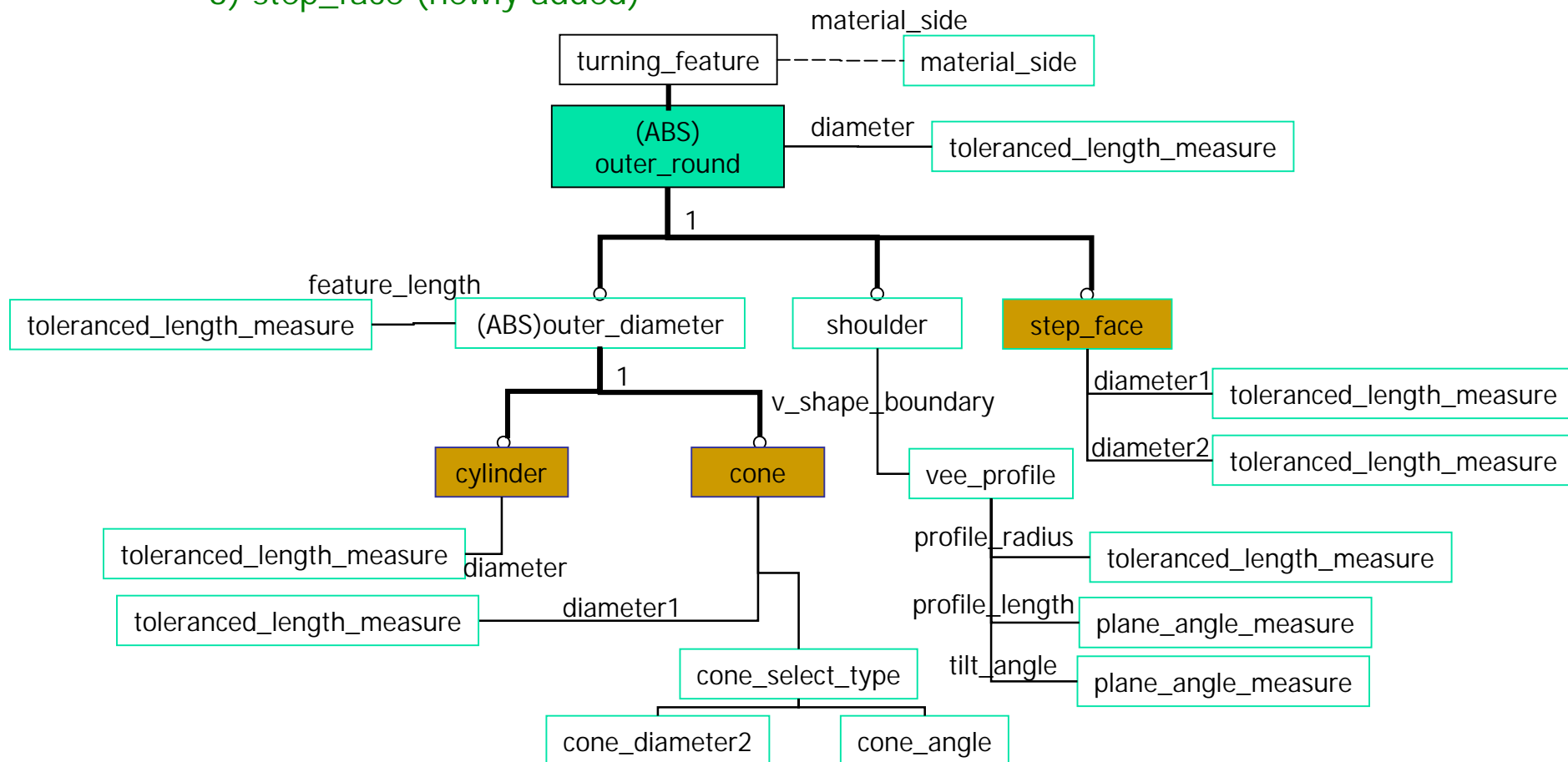
1. Newly added for practical use in turning operation
2. Used for machining of a plane surface on the end wall of a workpiece



2.3.4 Outer_round: overall schema

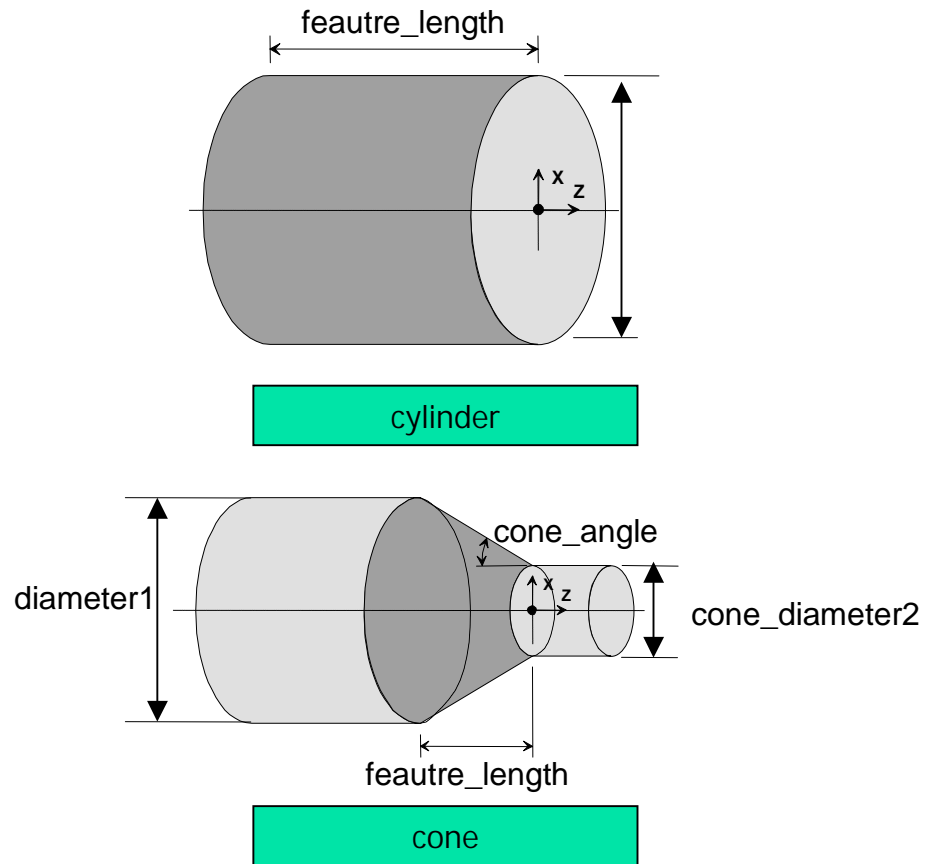
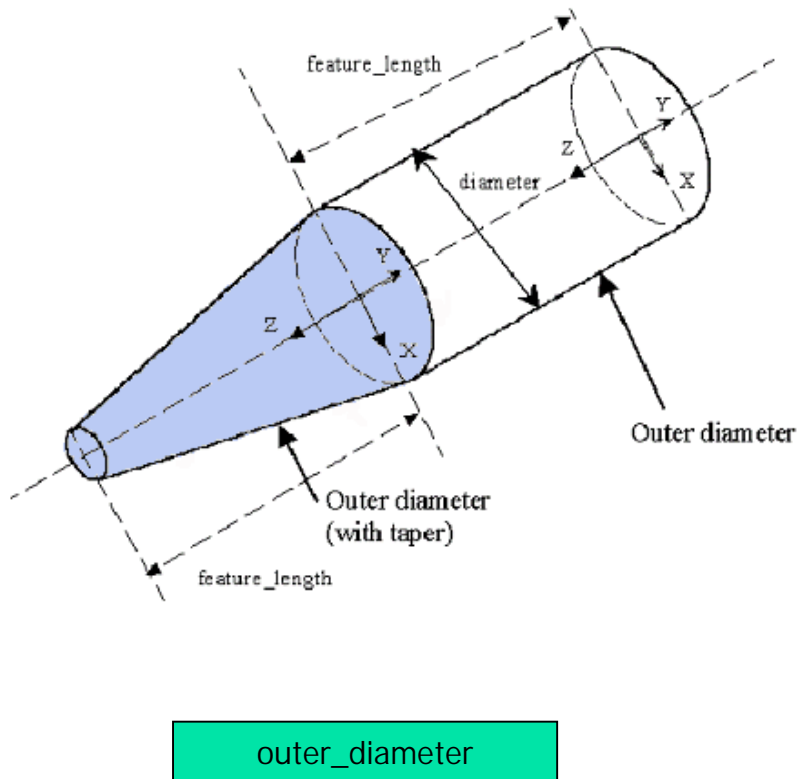
* *outer_round* has 3 subtypes :

- 1) *outer_diameter* (modified from AP224)
- 2) *shoulder* (based on AP224)
- 3) *step_face* (newly added)



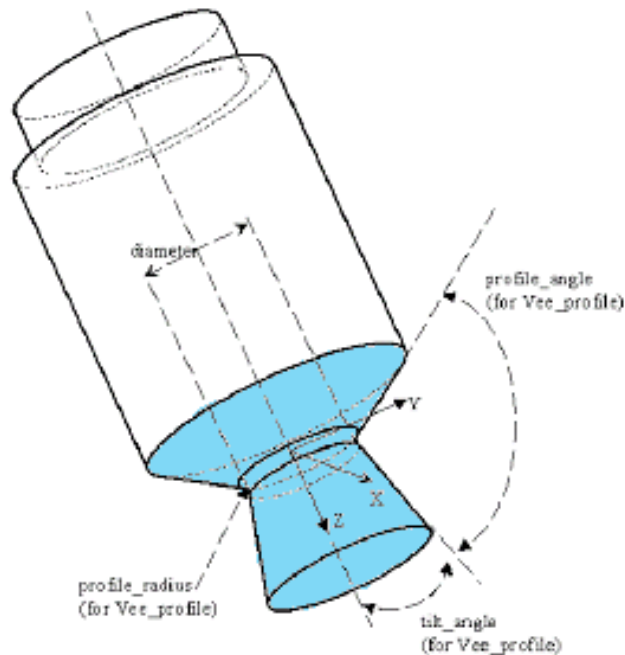
2.3.4.1 Outer_round: outer_diameter, cone, cylinder

* *outer_diameter* has 2 subtypes for practical use : 1) cone 2) cylinder

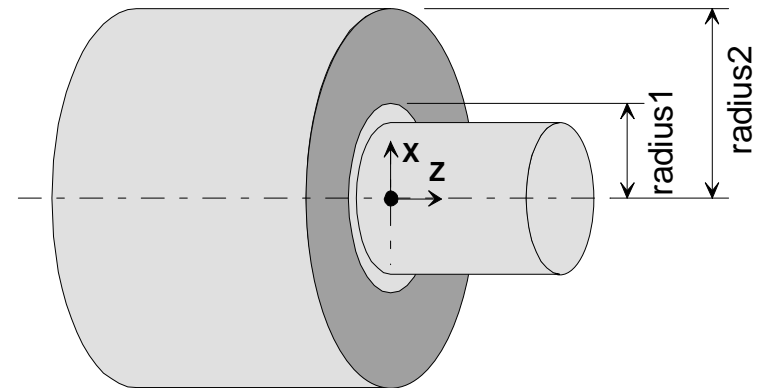


2.3.4.2 Outer_round: shoulder & step_face

* *Step_face* is newly added for practical use



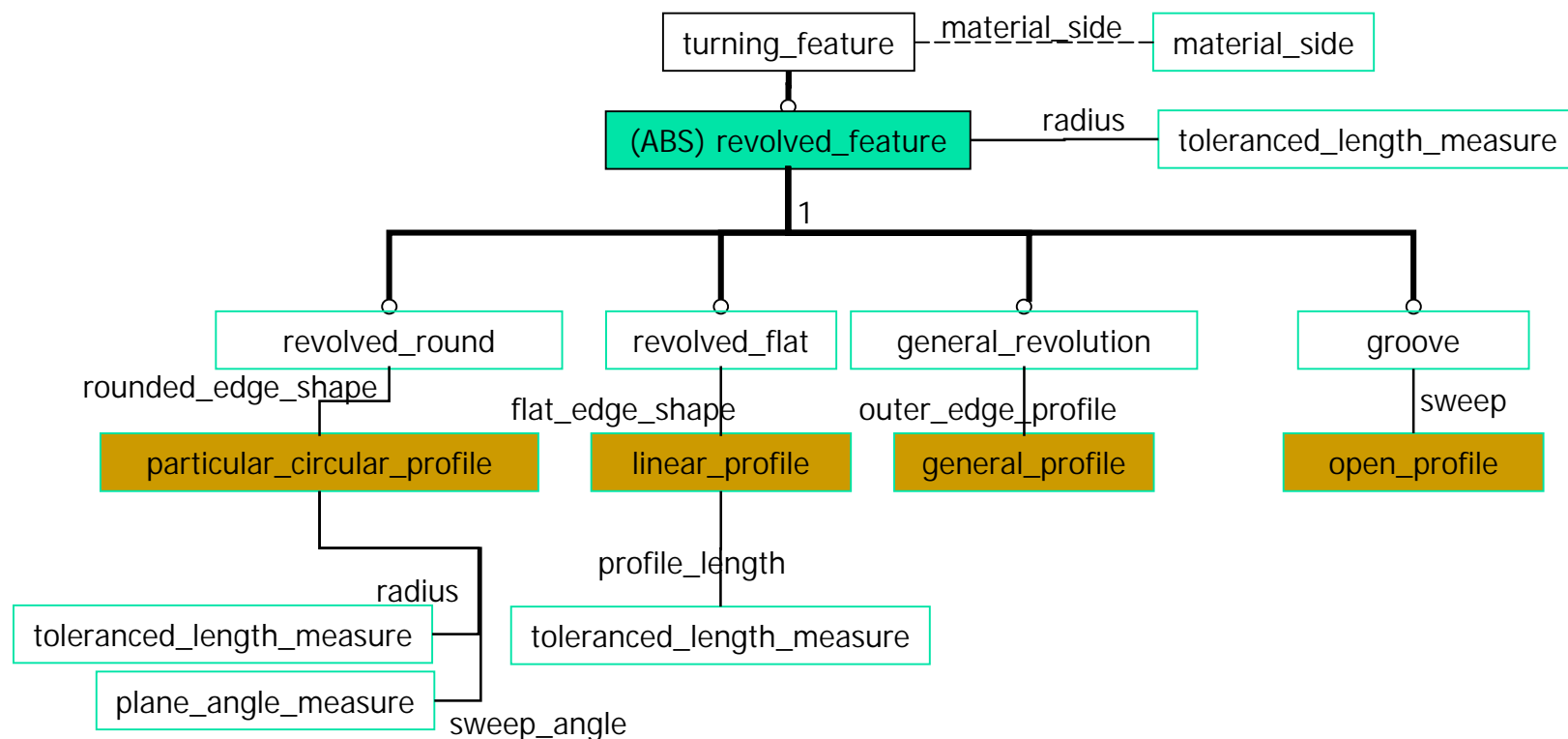
shoulder



Step_face

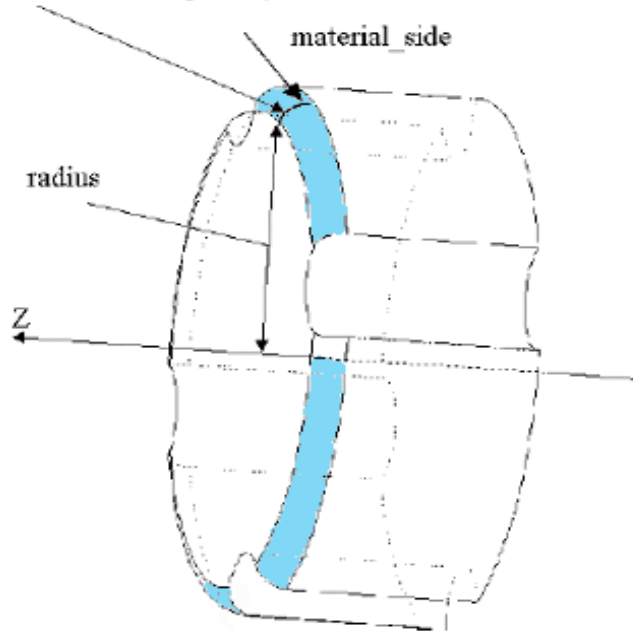
2.3.5 Revolved_feature: overall schema

- Compared with AP224, *material_side* is moved to as an attribute of *turning_feature*
- Based on FDIS, *profile* defined in Part 10 is used instead of *bounded_curve*



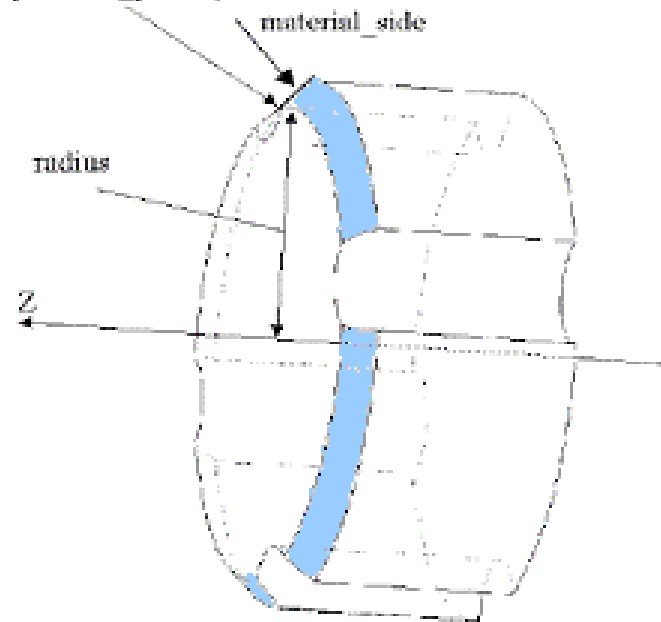
2.3.5.1 Revolved_feature: revolved_round & revolved_flat

rounded_edge_shape
(defined by Partial circular profile)



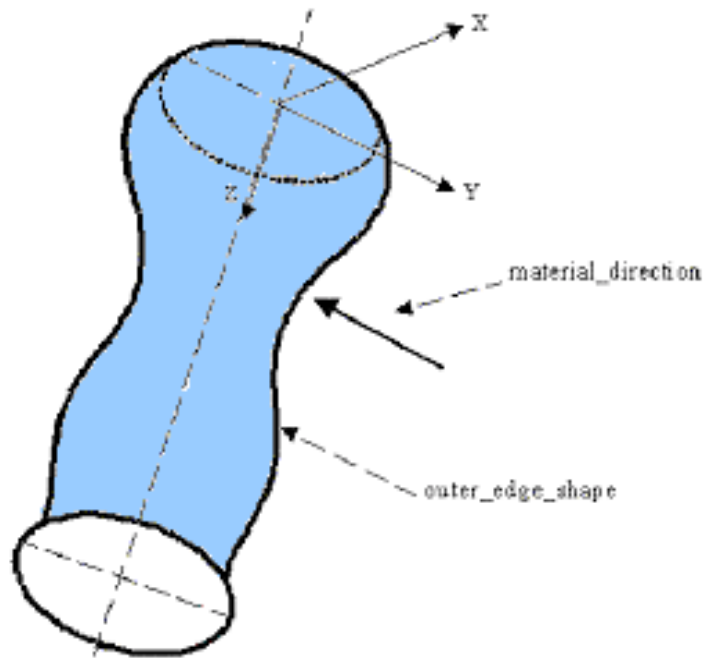
Revolved_round

flat_edge_shape
(defined by Linear_profile)

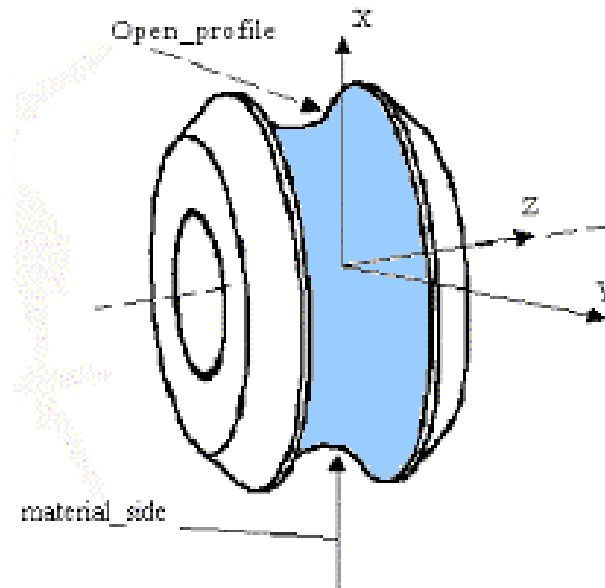


Revolved_flat

2.3.5.2 Revolved_feature: general_revolution & groove



General_revolution



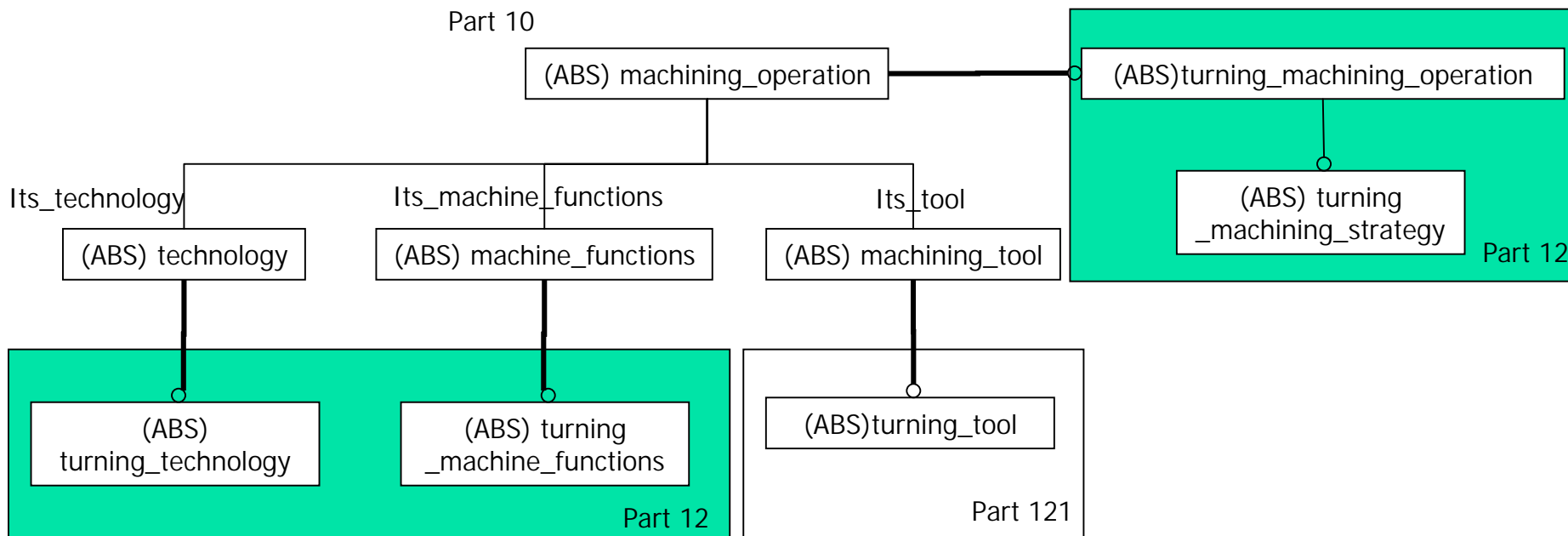
groove

III. Part 12 : Process data for turning

1. Relationship / update of machining_operation of Part 10
2. Turning_machining_operation
 - Turning_machining_strategy
 - Details of subclasses
3. Turning_technology
4. Turning_machine_functions

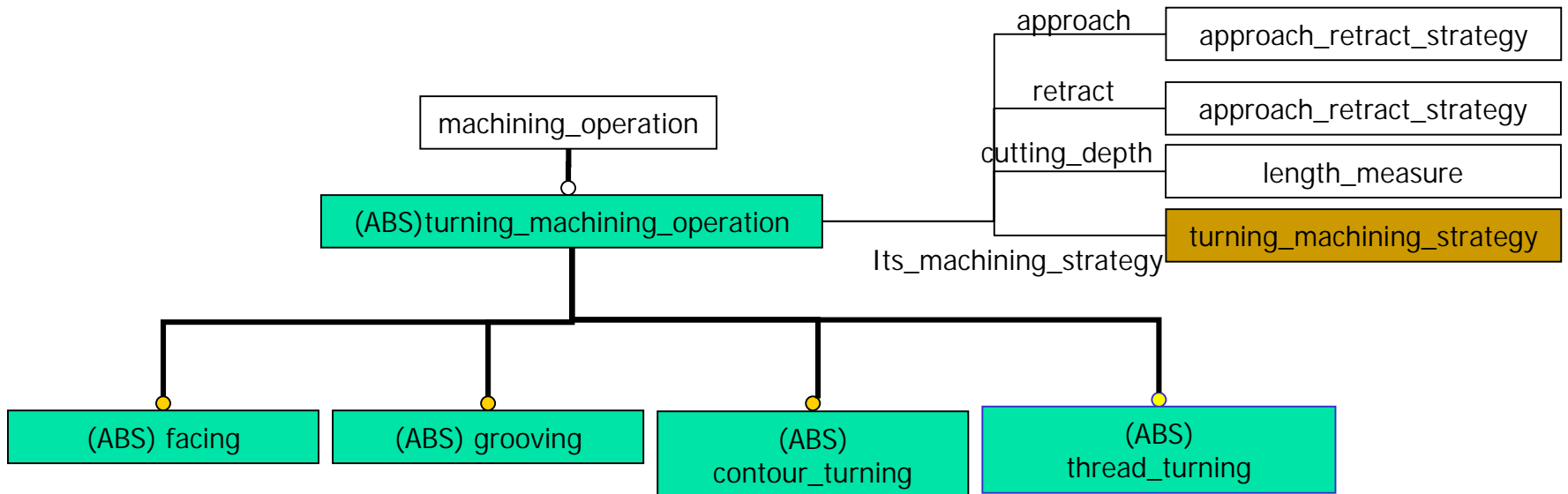
3.1 Relationship / update for machining_operation of Part 10

* Based on FDIS of Part 10, turning_machining_operation is now an attribute of turning_machining_operation

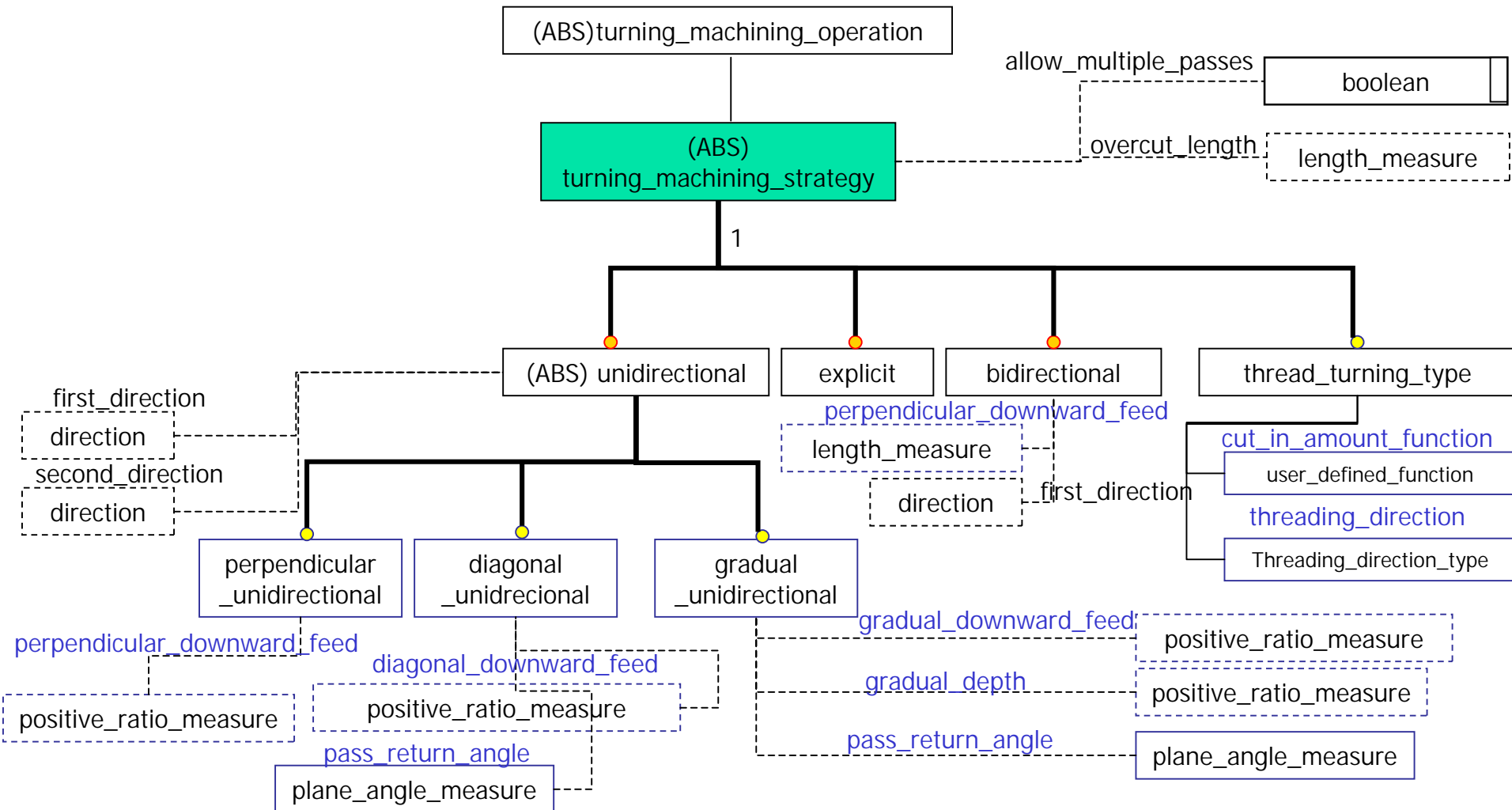


3.2 Turning_machining_operation

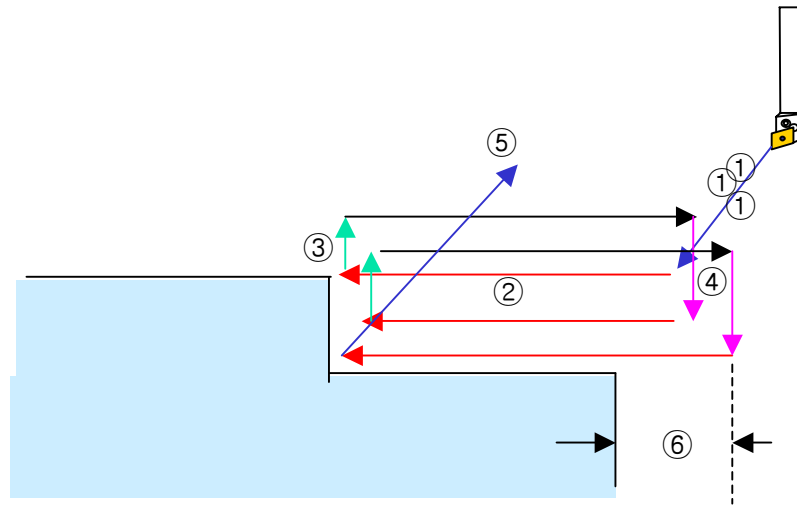
- * Attributes of turning_machining_operation are consistent with FDIS of Part 10:
- * Has 4 subtypes: facing, grooving, contour_turning, and thread_turning



3.2.1 turning_machining_strategy: An attribute of turning_operation



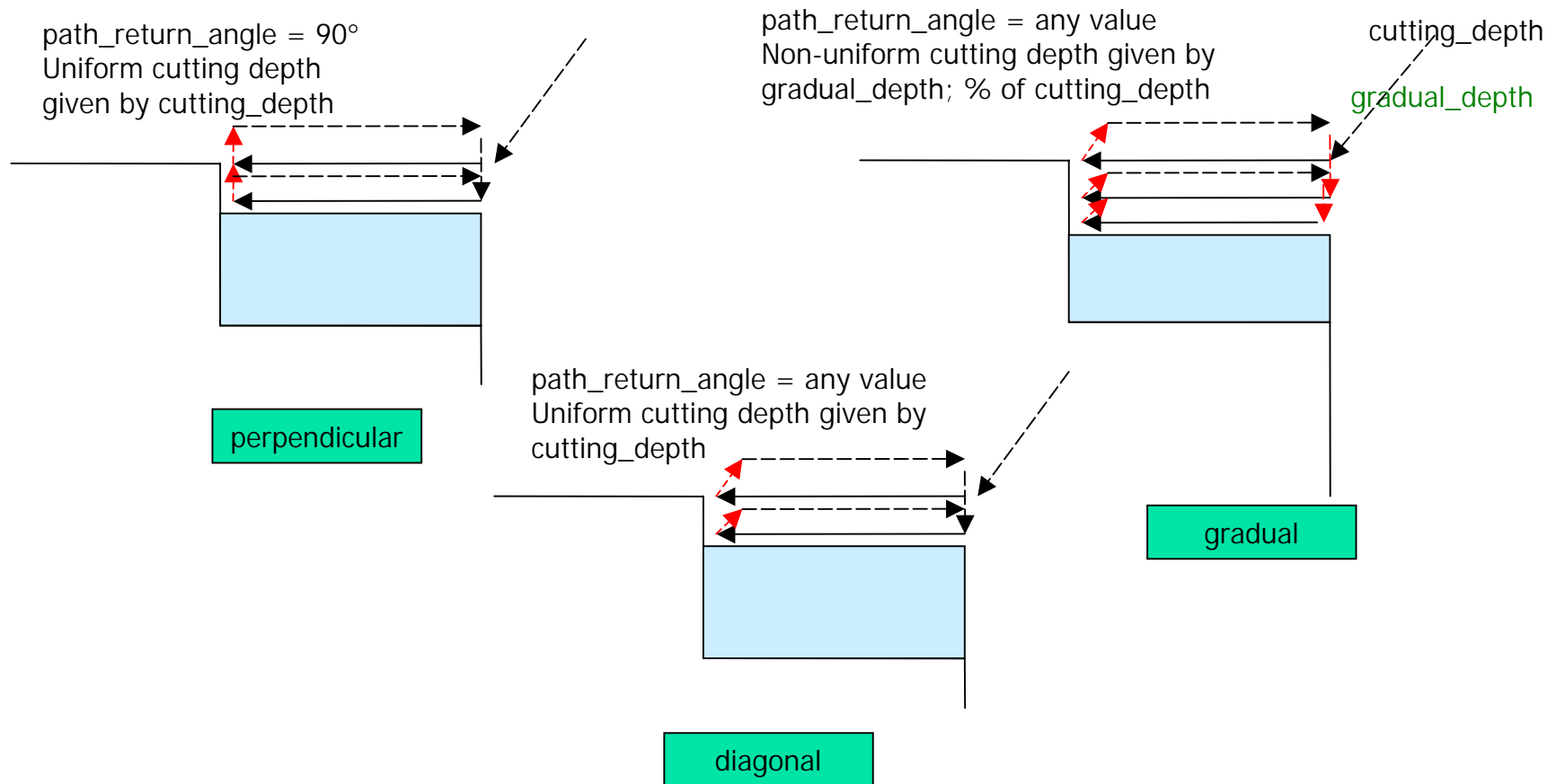
Remarks



- ① approach (turning_machining_operation)
- ② first_direction (turning_machining_strategy)
- ③ return_direction (turning_machining_strategy)
return_amount (turning_machining_operation)
- ④ second_direction (removed from turning_machining_strategy based on FDIS)
amount (cutting_depth : turning_machining_operation)
- ⑤ retract (turning_machining_operation)
- ⑥ overcut_length (turning_machining_strategy)

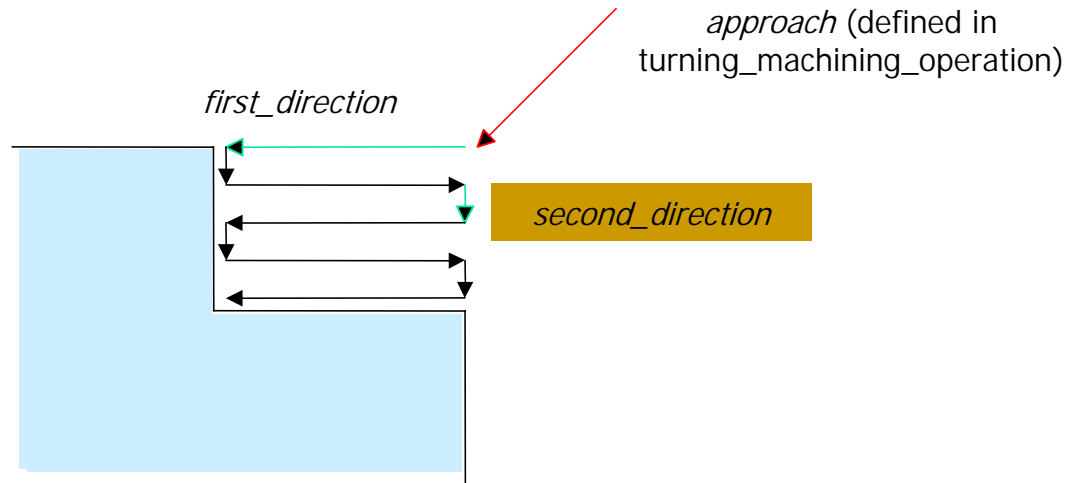
3.2.1.1 unidirectional

- * Depending on return direction and uniformity of cutting depth, 3 subclasses are defined for practical use



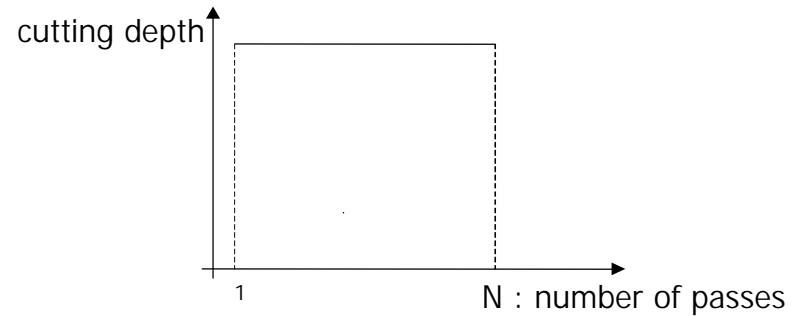
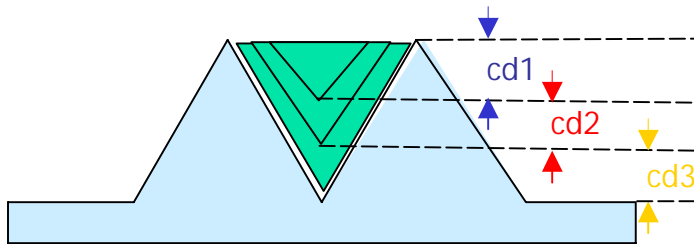
3.2.1.2 bidirectional

* *second_direction* is omitted as Part 11 of ISO 14649 FDIS

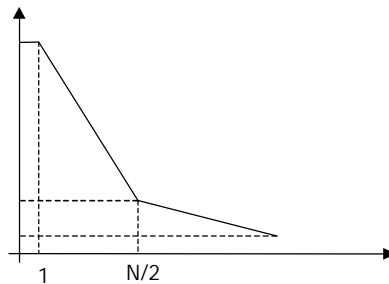


3.2.1.3 thread_turning_type: user_defined_function (examples)

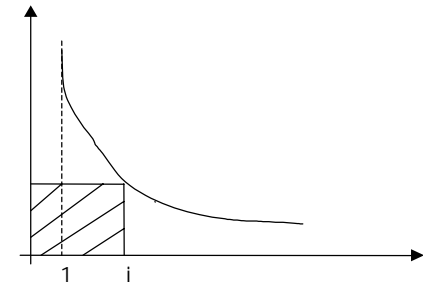
* Incorporates methods used in machine shop



(a)



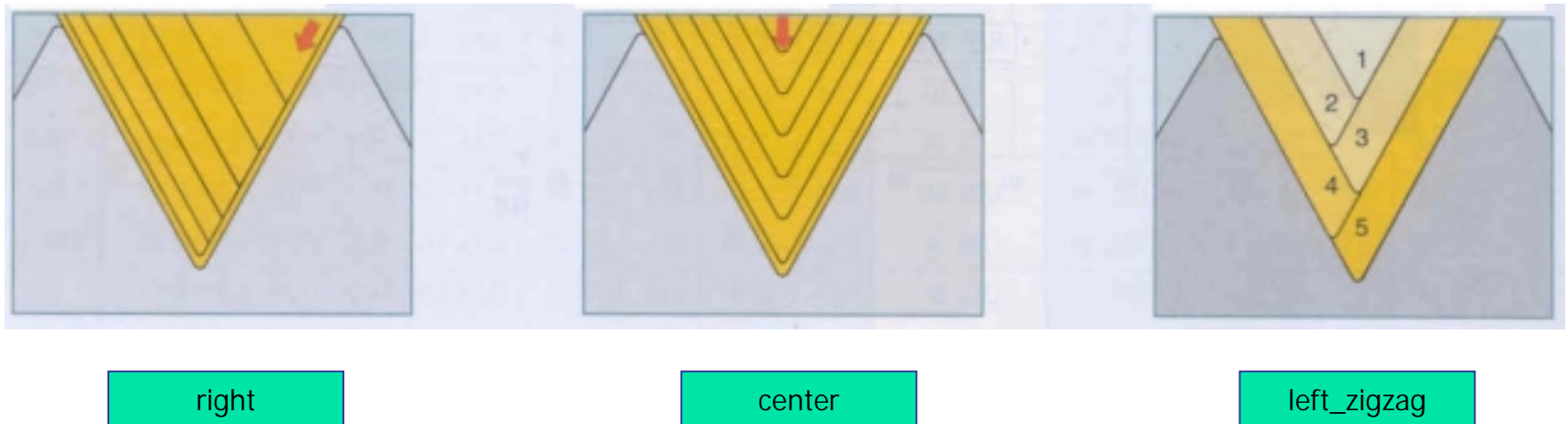
(b)



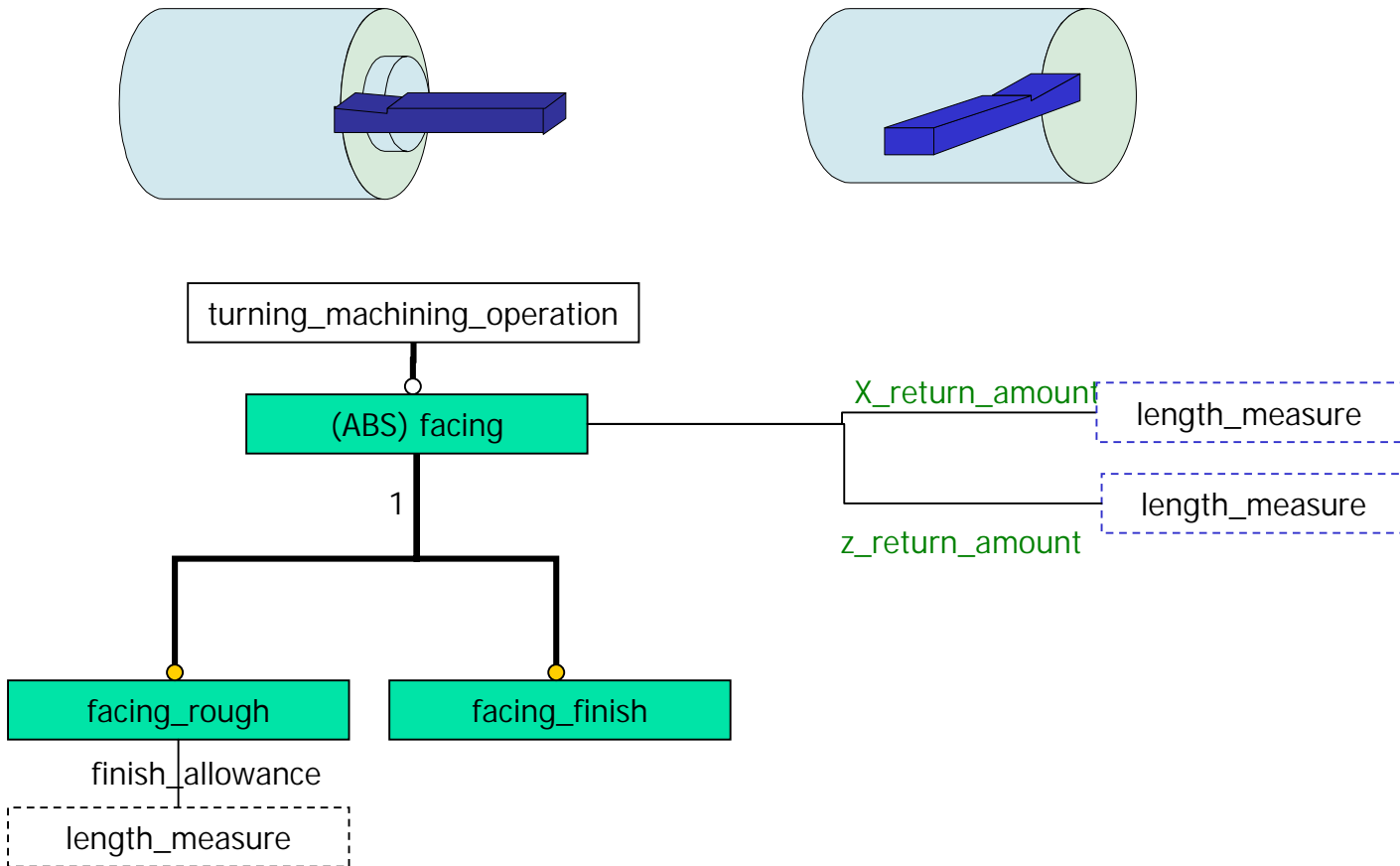
(c)

3.2.1.4: thread_turning_type: threading_direction

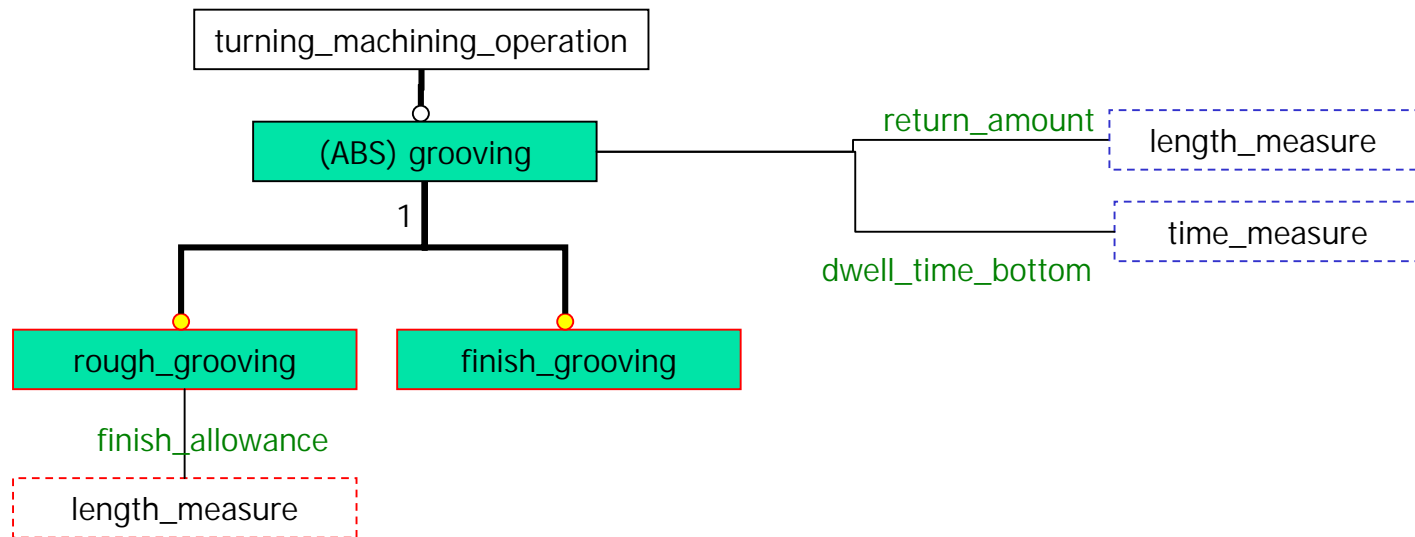
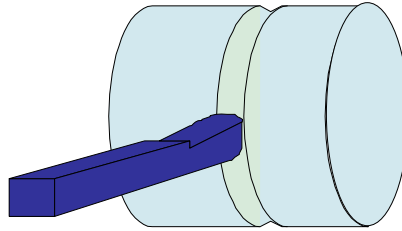
1. Incorporates methods used in machine shop
2. Five directions: left, right, center, left_zigzag, right_zigzag



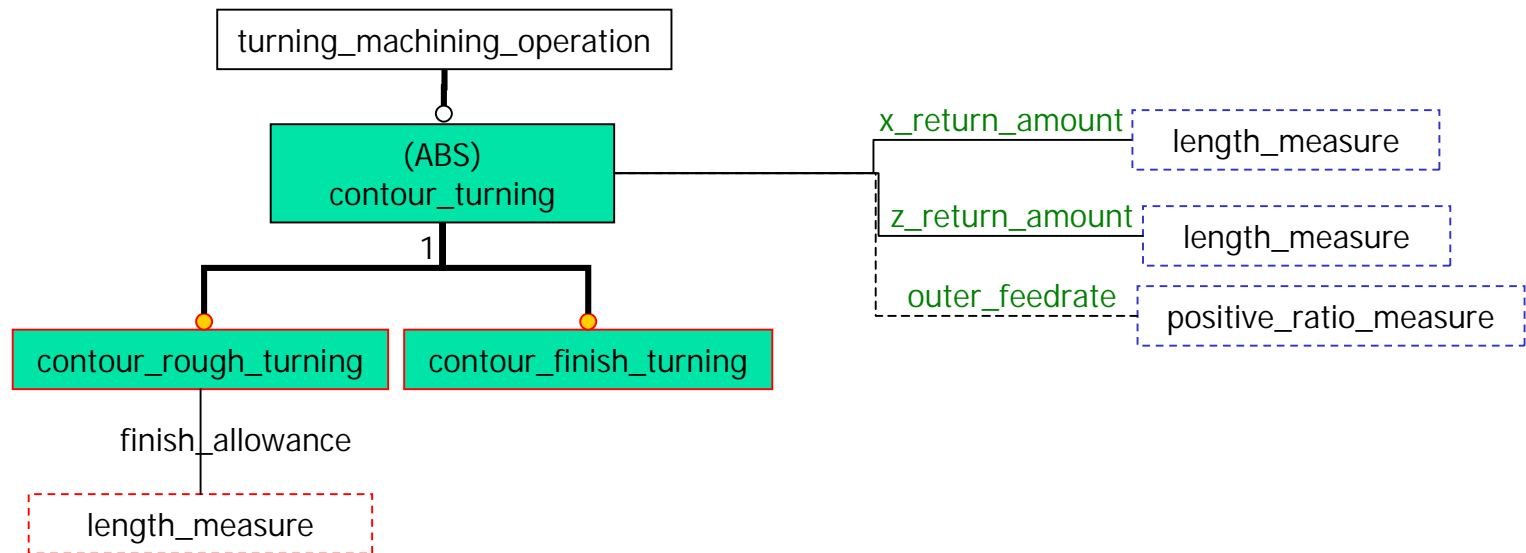
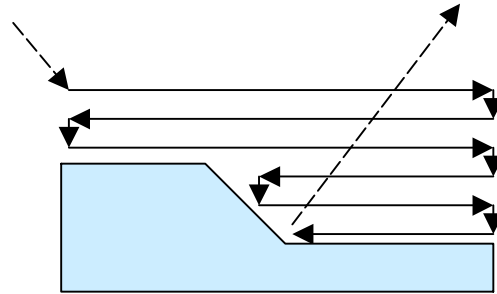
3.2.2 Turning_machining_operation: facing



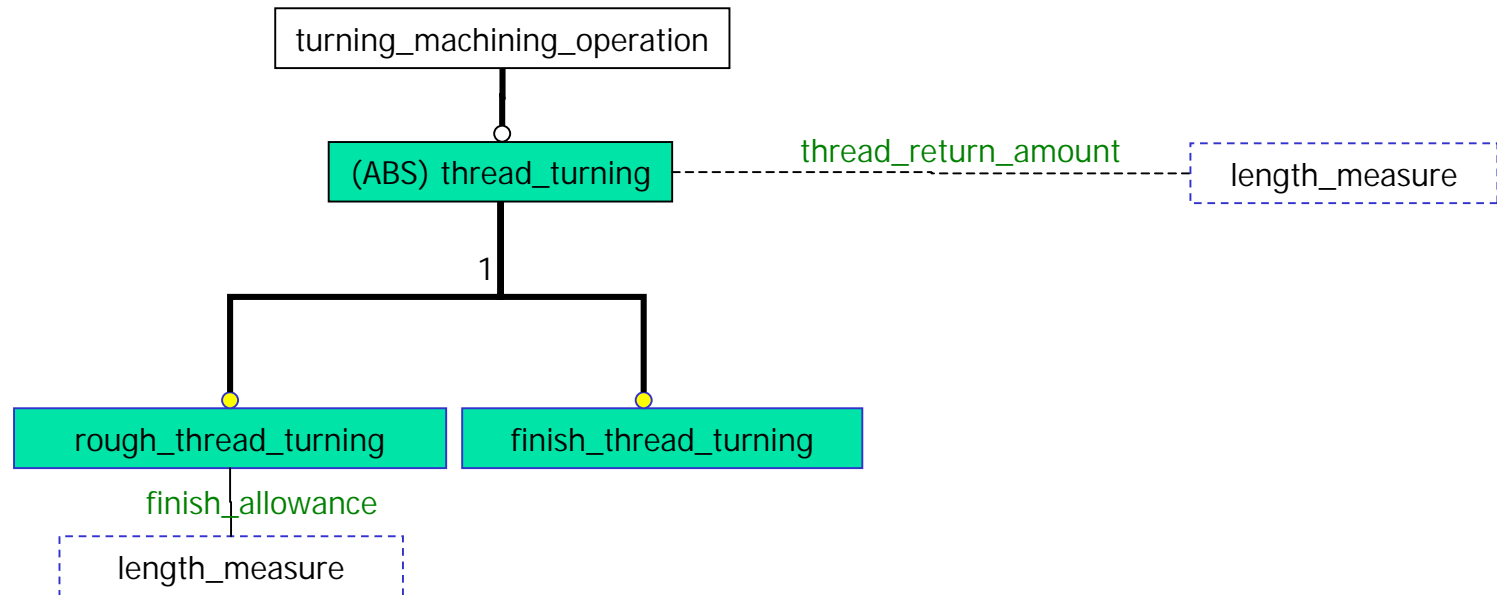
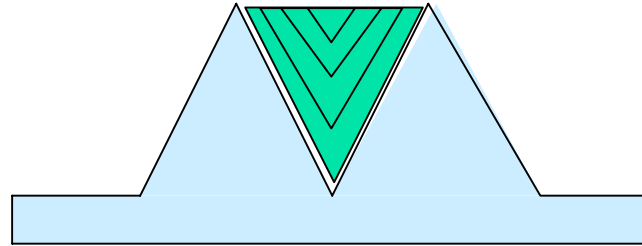
3.2.3 Turning_machining_operation: grooving



3.2.4 Turning_machining_operation: contour_turning

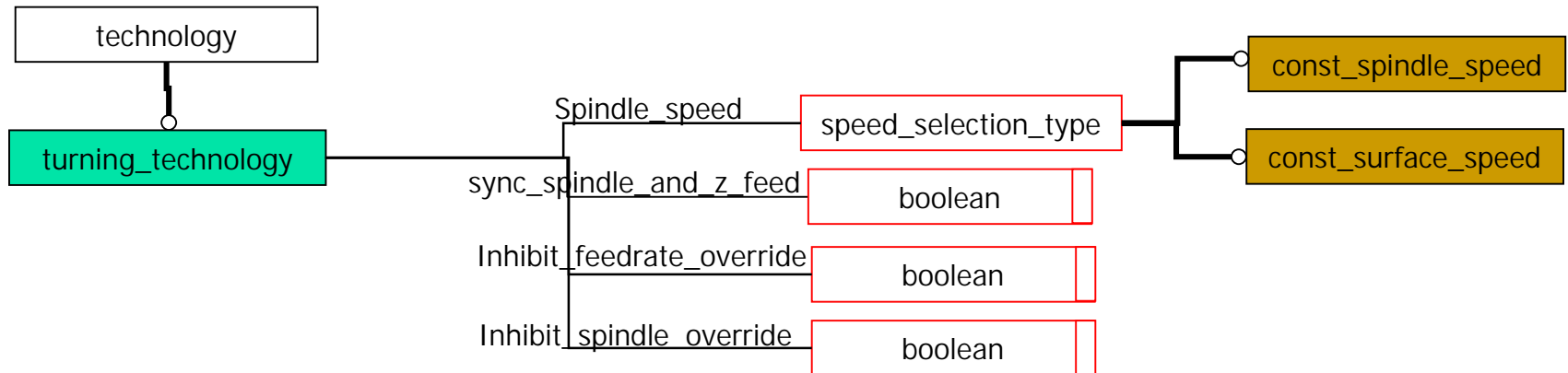


3.2.5 Turning_machining_operation: thread_turning



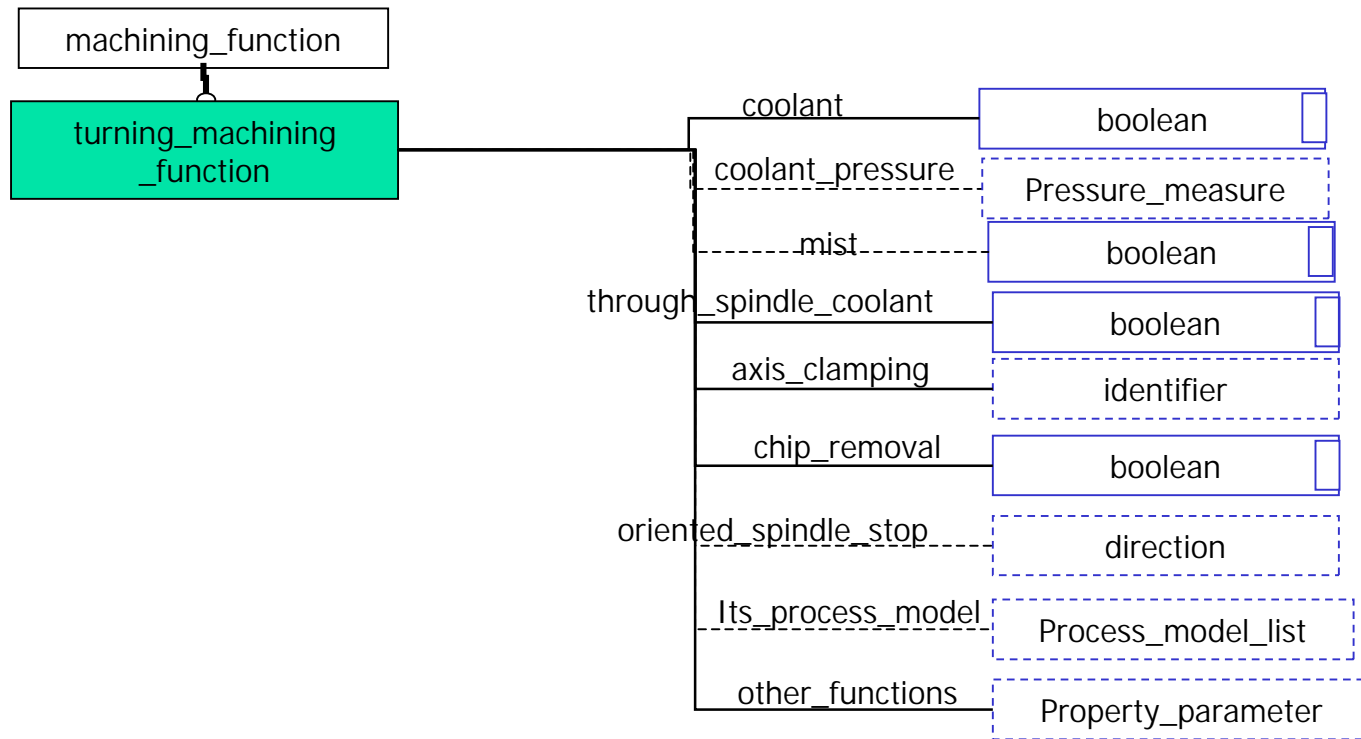
3.3 turning_technology

1. Compared with milling technology, *const_spindle_speed* and *const_surface_speed* are included as type of *speed_selection_type*



3.4 turning_machine_function

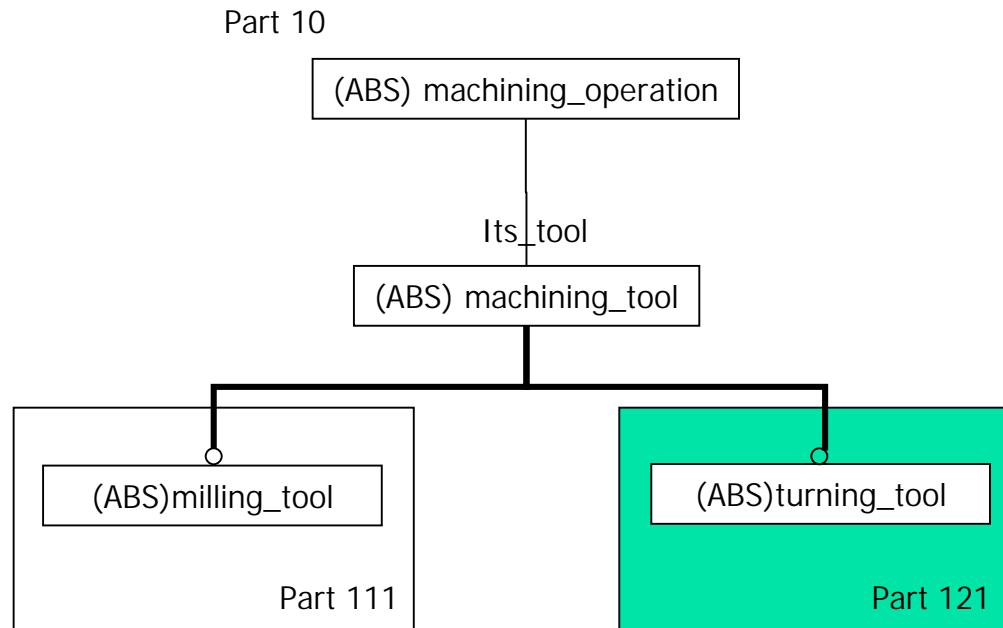
* Same as *milling_machine_function* of Part 11 of ISO 14649 FDIS



IV. Part 121 : Tools for turning

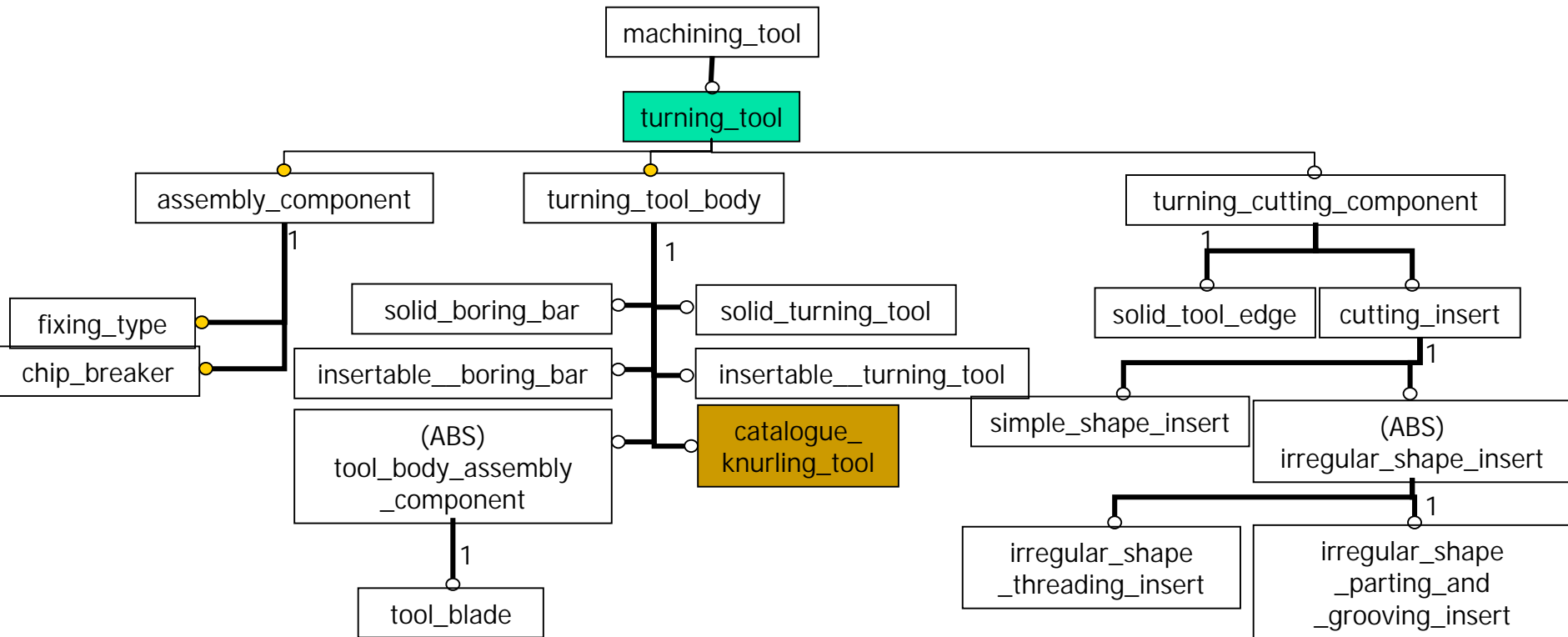
1. Relationship / update of *machining_tool* of Part 10
2. Attributes of turning_tool
3. Turning_tool_body
4. Turning_cutting_component
5. Assembly_component

4.1 Relationship / update for machining_tool of Part 10

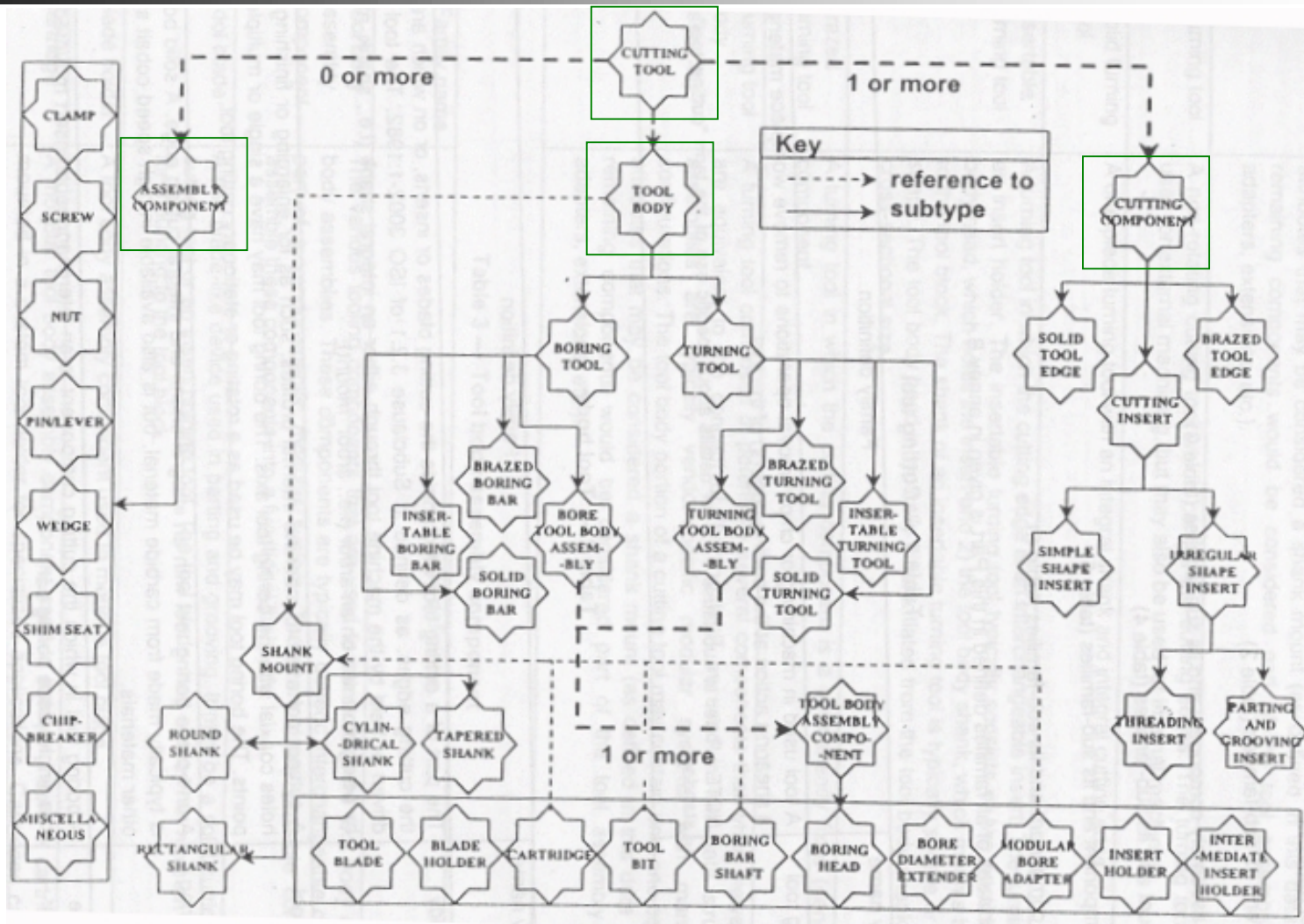


4.2 Turning_tool schema

1. Mostly based on ISO 13399
2. Inclusion of *catalogue_knurling_tool* to cover tools used for knurling operation



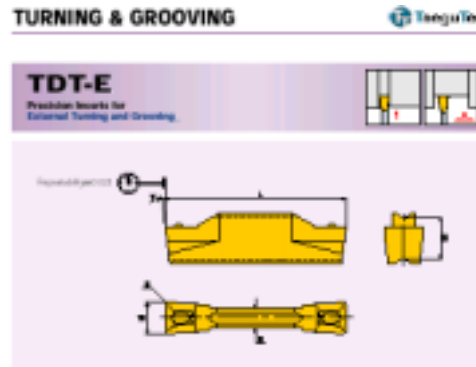
Informative: Schema of 13399



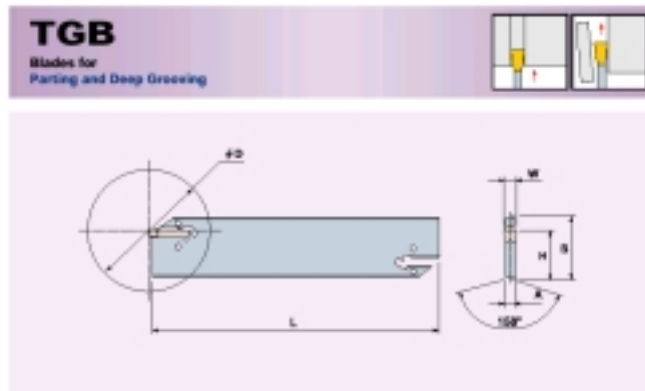
Informative: Some turning tools covered in the schema



Thread insert

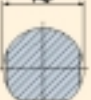
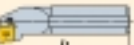




















groove insert



blade

BORING BAR DESIGNATION SYSTEM

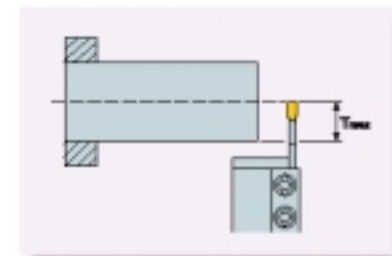
1 Boring Bar	2 Bar Diameter	3 Tool Length	4 Clamping System																														
S : Steel Shank A : Alloy Tough Shank C : Coated Shank		 <table><tr><td>K</td><td>125</td><td>U</td><td>350</td></tr><tr><td>M</td><td>150</td><td>V</td><td>400</td></tr><tr><td>Q</td><td>180</td><td>W</td><td>450</td></tr><tr><td>R</td><td>200</td><td>Y</td><td>500</td></tr><tr><td>S</td><td>250</td><td>X</td><td>Special</td></tr><tr><td>T</td><td>300</td><td></td><td></td></tr></table>	K	125	U	350	M	150	V	400	Q	180	W	450	R	200	Y	500	S	250	X	Special	T	300			<table><tr><td>P / Lever Clamp </td><td>C / Top Clamp </td></tr><tr><td>S / Screw Clamp </td><td>M / Multi Lock </td></tr><tr><td>B / Double Clamp </td><td>W / Wedge Clamp </td></tr></table>	P / Lever Clamp 	C / Top Clamp 	S / Screw Clamp 	M / Multi Lock 	B / Double Clamp 	W / Wedge Clamp 
K	125	U	350																														
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S	250	X	Special																														
T	300																																
P / Lever Clamp 	C / Top Clamp 																																
S / Screw Clamp 	M / Multi Lock 																																
B / Double Clamp 	W / Wedge Clamp 																																

Boring bar

Blade or Holder Size

To minimize risk of vibration and deflection always choose :

- Blade or toolholder with smallest possible overhang
- Toolholder with maximum shank dimension
- Recommendation of T_{max} is smaller than Blade height(B)

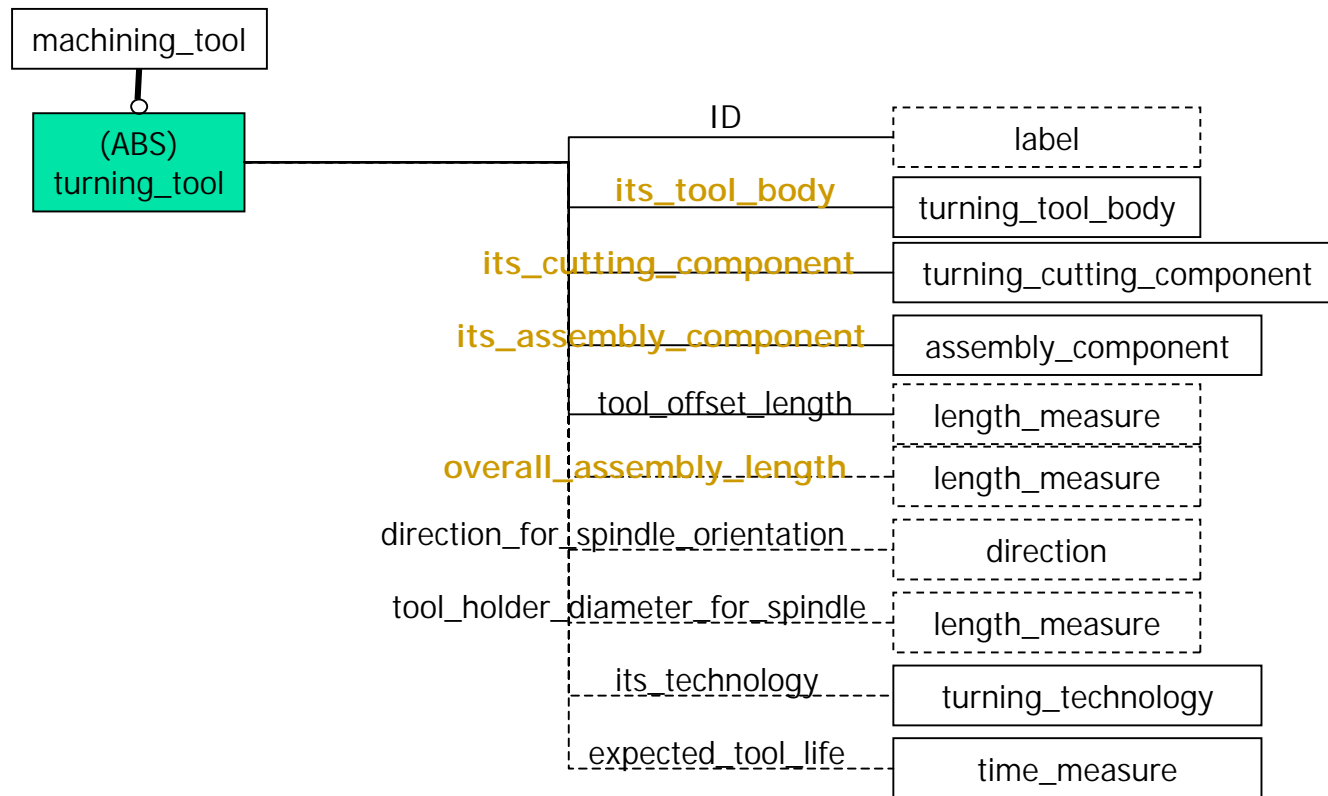


- Blade or holder with maximum blade width

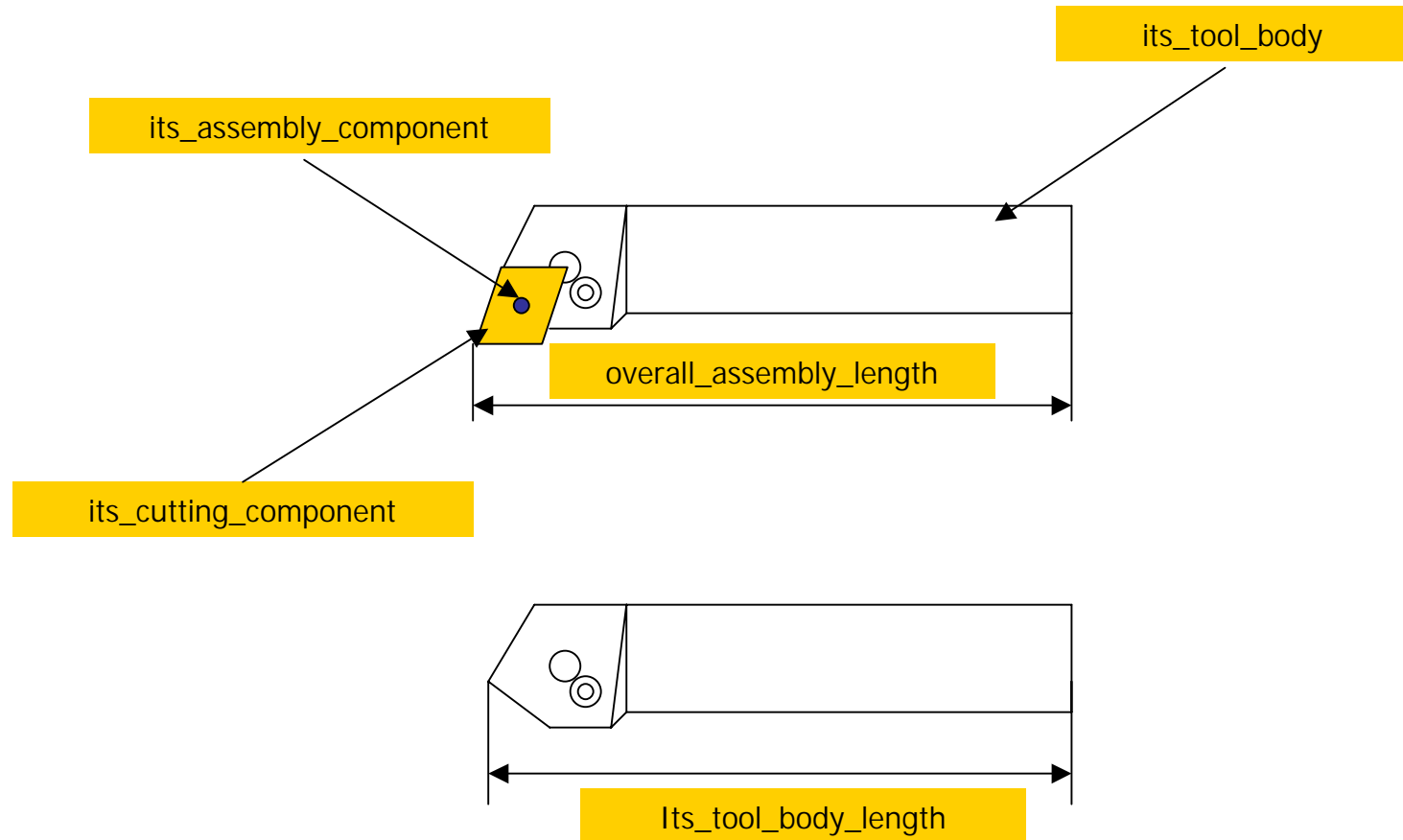
Blade holder

4.3 Attributes of turning_tool

* Selectively taken from ISO 13399 (administrative information, e.g., manufacturers,,, are excluded)

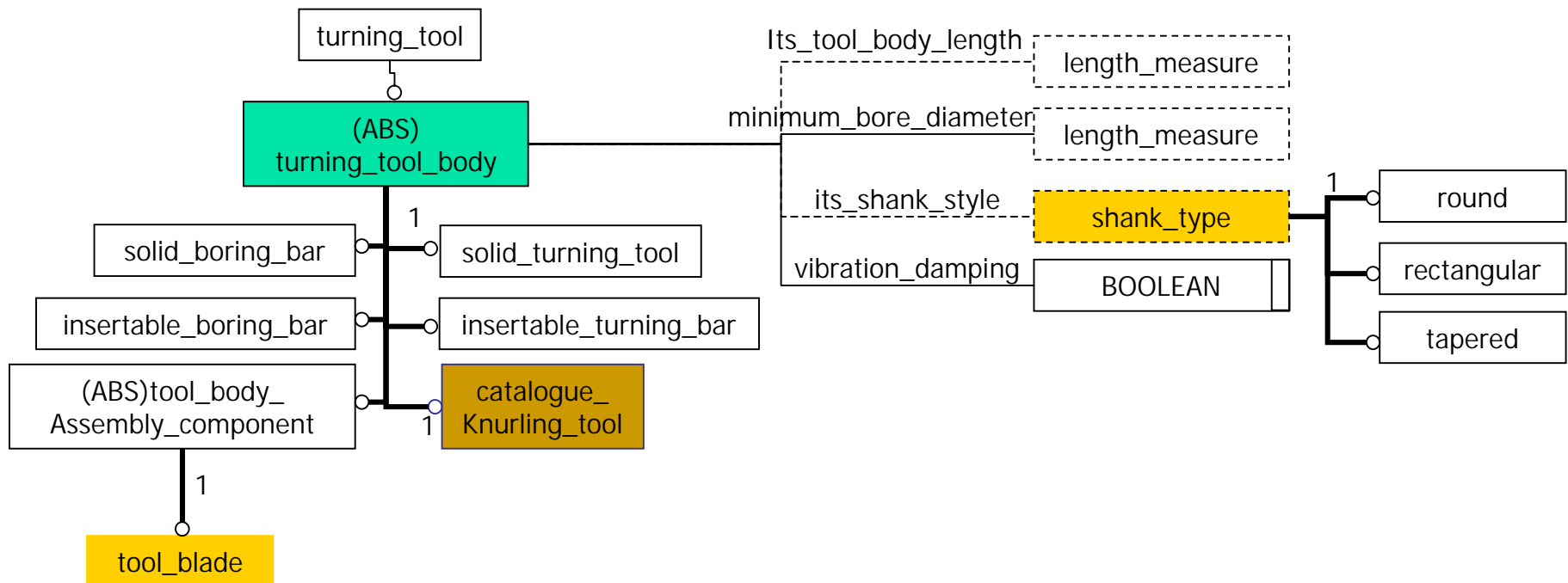


Informative: overall_assembly_length (turning_tool) vs. tool_body_length (turning_tool_body)



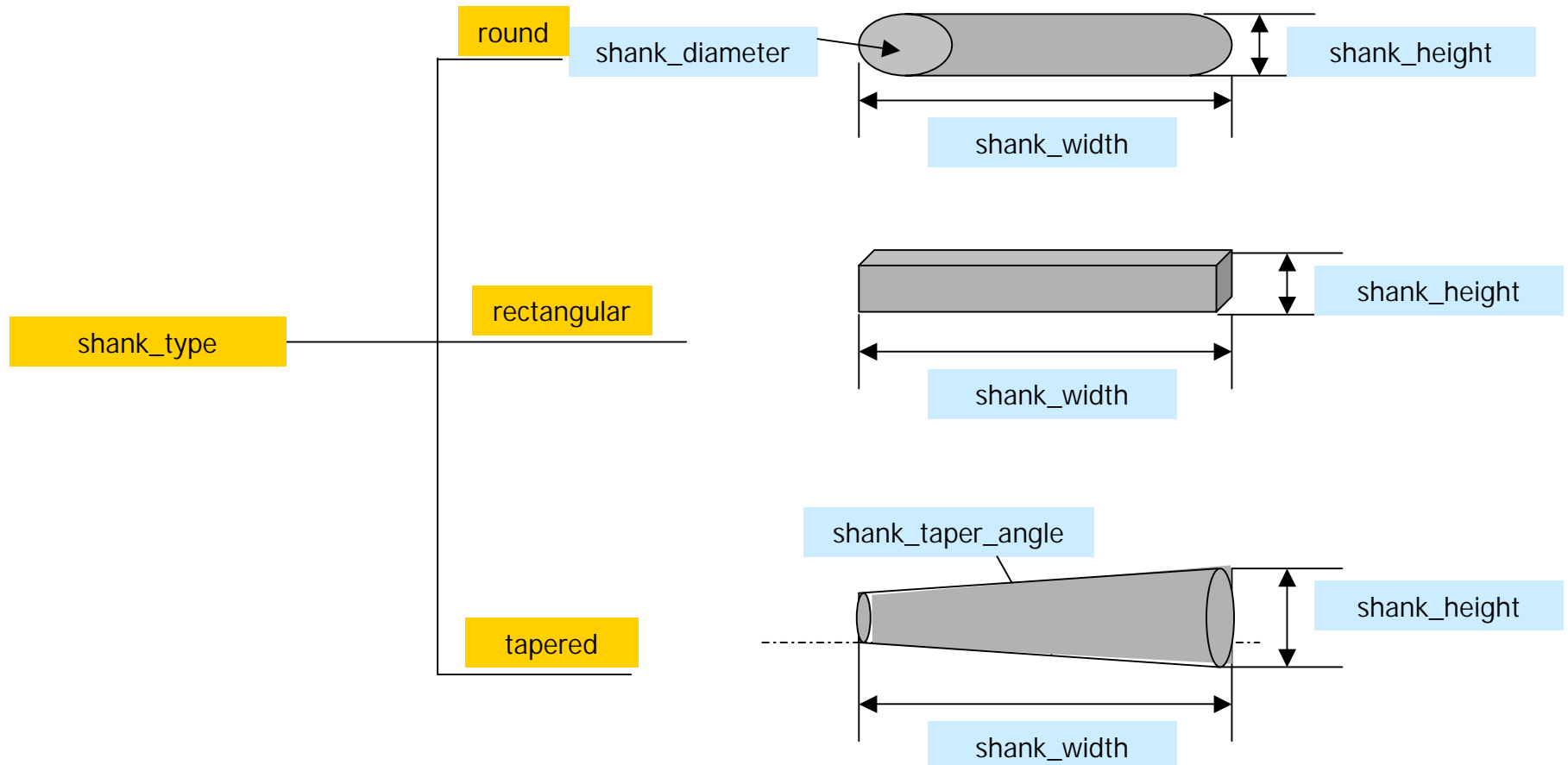
4.4 turning_tool_body

1. *catalogue_knurling_tool* is newly defined
2. Mostly based on ISO 13399 excluding blade_holder, ..., intermediate_insert_holder.



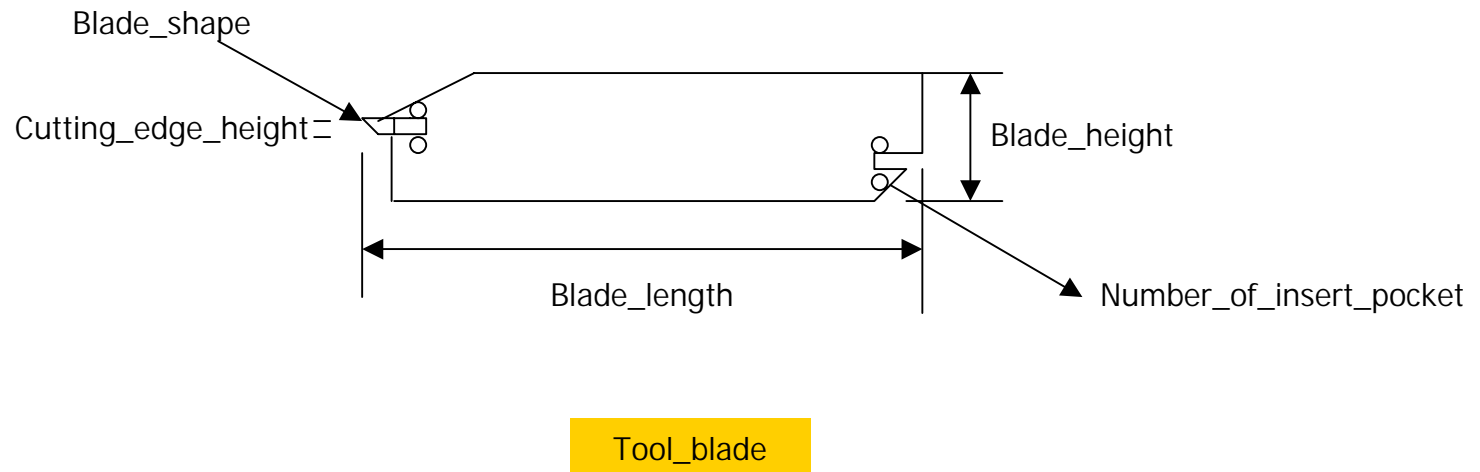
4.4.1 shank_type

1. Necessary for collision avoidance between tool body and workpiece



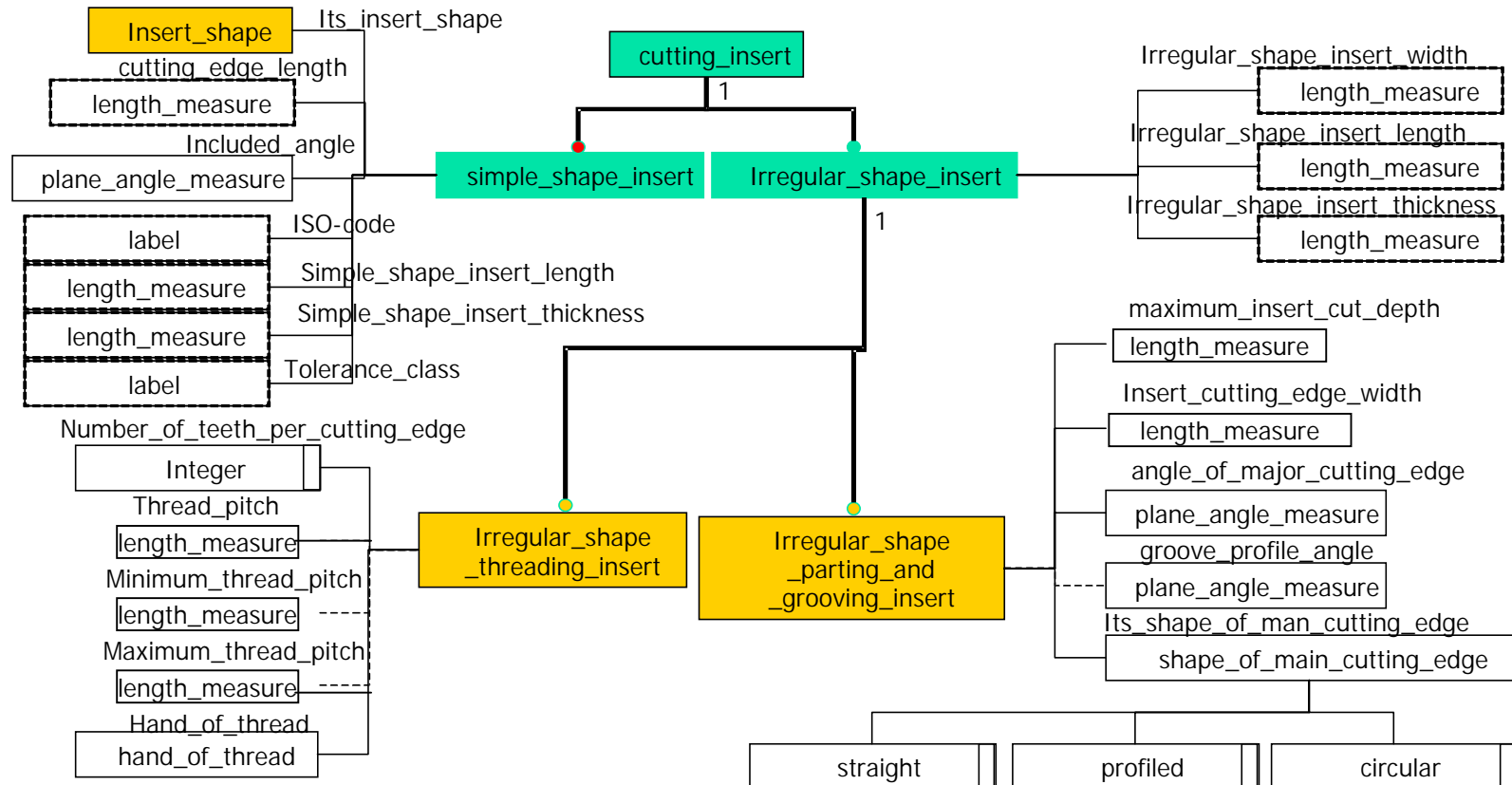
4.4.2 tool_blade

1. Commonly used one in practice











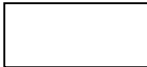

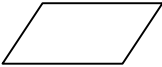
Cornel_Paulus | Length: measure

4.5.1 cutting_insert

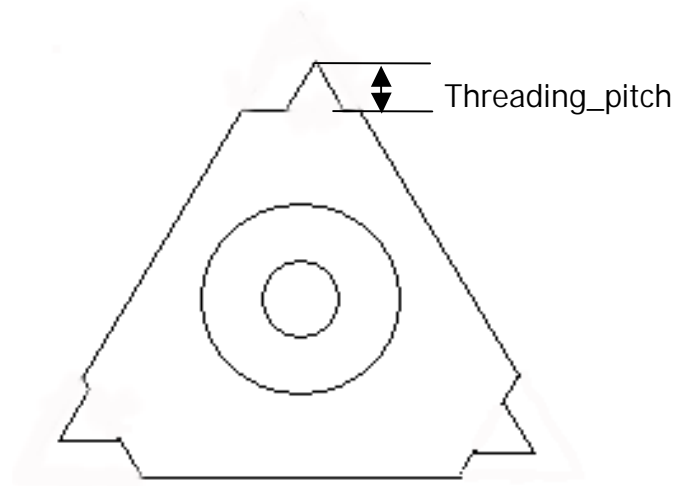


4.5.3 insert_shape

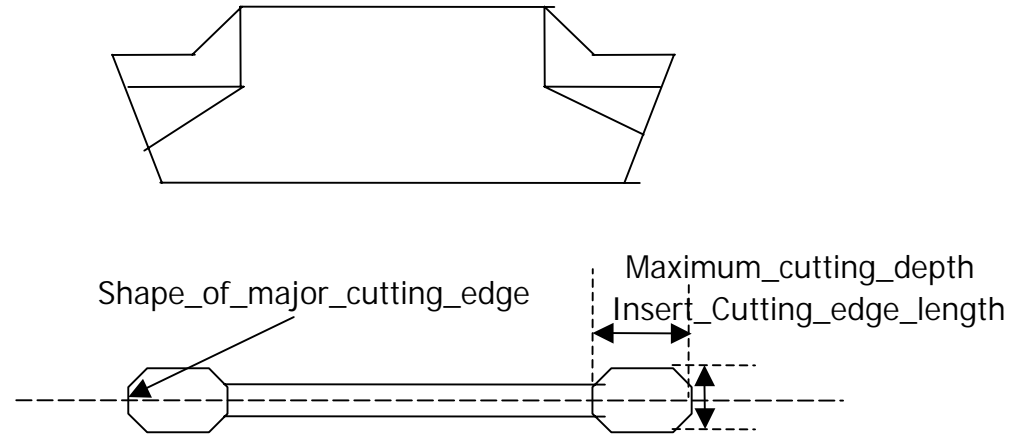
Insert type	square	triangle	diamond	parallelogram	hexagon
form					

Insert type	octagon	pentagon	trigon	rectangle	round	trapezodial
form						

4.5.4 irregular_shape_insert



Irregular_shape_threading_insert



Irregular_shape_parting_and_grooving_insert

4.6 assembly_component

