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Figure 1: Multi-Component Prototype

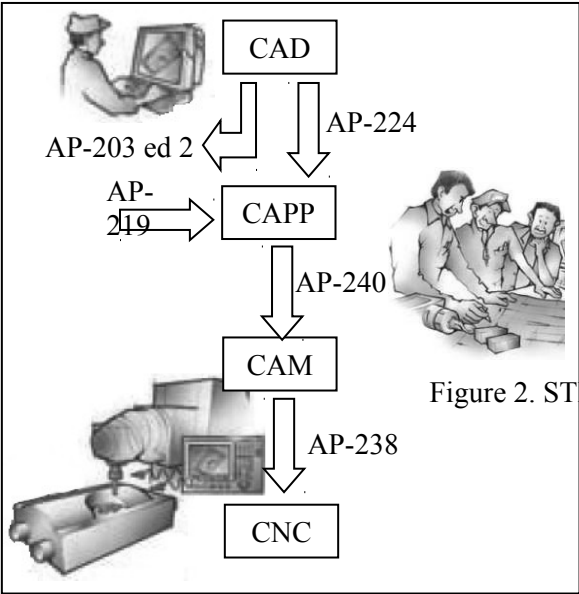


Figure 2. STEP A

Informations STEP AP-224	
<b>Part_model</b> <ul style="list-style-type: none"><li>◆ Part</li><li>◆ Single-piece part</li><li>◆ Mating condition</li></ul>	<ul style="list-style-type: none"><li>◆ Part</li><li>◆ Manufacturing assembly</li><li>◆ Part fasteners</li></ul>
<b>Manufacturing Features</b> <ul style="list-style-type: none"><li>◆ Slot</li><li>◆ Hole</li><li>◆ Thread</li><li>◆ ...</li></ul>	<b>Tolerances</b> <ul style="list-style-type: none"><li>◆ Geometric tolerances</li><li>◆ Dimension tolerances</li><li>◆ Material condition modifiers</li><li>◆ Tolerance range</li></ul>
<b>Feature definition items</b> <ul style="list-style-type: none"><li>◆ Path</li><li>◆ Profile</li><li>◆ Taper</li><li>◆ Hole bottom</li><li>◆ Slot end</li></ul>	<b>Manufacturing Part Properties</b> <ul style="list-style-type: none"><li>◆ Material Property</li><li>◆ Surface finish</li><li>◆ Process Property</li><li>◆ Hardness</li></ul>
<b>Part administration data</b> <ul style="list-style-type: none"><li>◆ Approval</li><li>◆ Person and Organization</li><li>◆ Orders</li></ul>	<b>Shape Representation</b> <ul style="list-style-type: none"><li>◆ Brep model</li><li>◆ Explicit base shape</li><li>◆ Implicit base shape</li></ul>

Figure 3: MCP concept

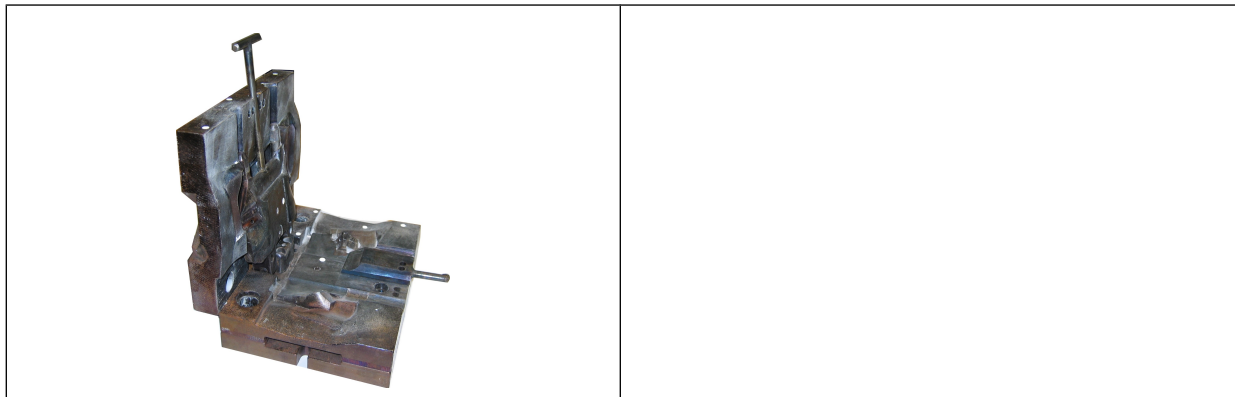


Figure 4: Automotive seal

Mark	type of feature STEP AP-224		Evolutivity	Quality			OBS
				IT FORM	IT POS	IT ORIENT	
A	Profile_feature_1	General_shape_profil	no	poli 320			appearance
B	Slot_1	Open_slot_end_type	no				
C	Round_hole_1	Through_bottom_condition	yes				
D	Profile_feature_2	Rectangular_closed_shape_profil	no				
E	Profile_feature_10	Rectangular_closed_shape_profil	no				
F	Profile_feature_3	General_shape_profil	no				
G	Round_hole_2		0 yes				
H	Boss_1	Rectangular_boss	no				
I	Profile_feature_4	General_shape_profil	no				
J	Boss_2	General_boss with General_top_condition	yes				
K	Boss_3	Rectangular_boss	no				
L	Profile_feature_5	General_shape_profil	no				
M	Profile_feature_6	Rectangular_closed_shape_profil	no				
N	Slot_2	Open_slot_end_type	no				
O	Profile_feature_10	General_shape_profil	no				
P	Rib_top_1		0 no				
Q	Profile_feature_7	General_shape_profil	yes				
R	Profile_feature_8	Rectangular_closed_shape_profil	no				
S	Profile_feature_9	General_shape_profil	yes				
T	Boss_2	General_boss	no				
U	Slot_3	Open_slot_end_type	yes				
Z	Block_Base_shape		no				

Figure 5: AP-224 entities

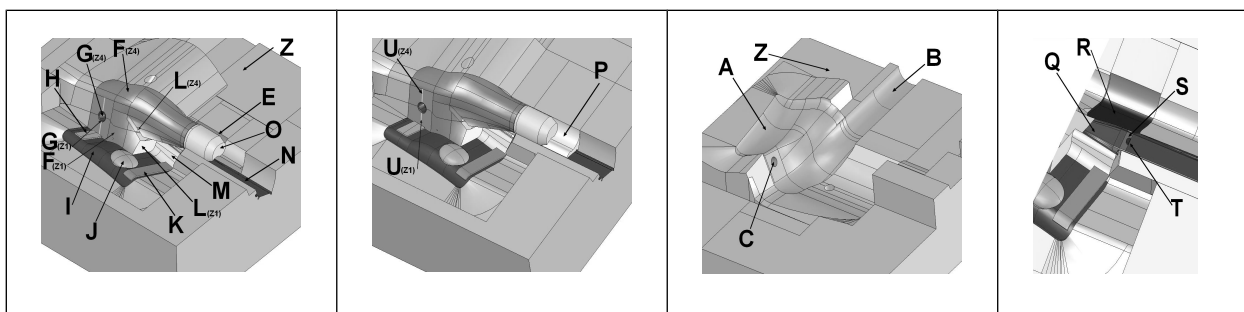
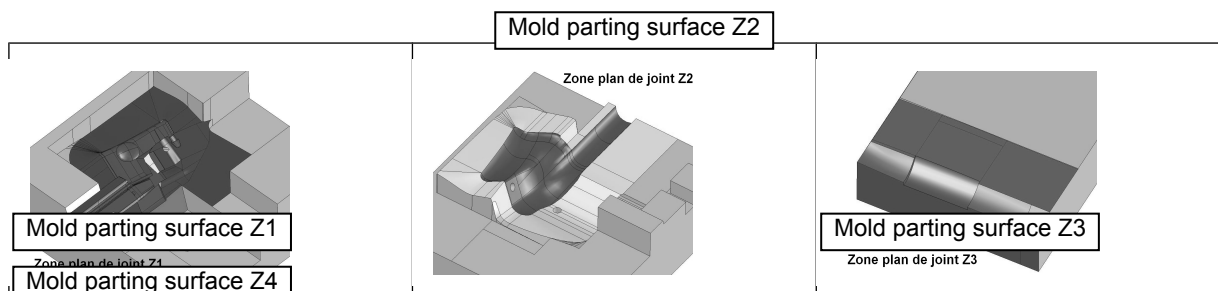


Figure 6: AP-224 entities



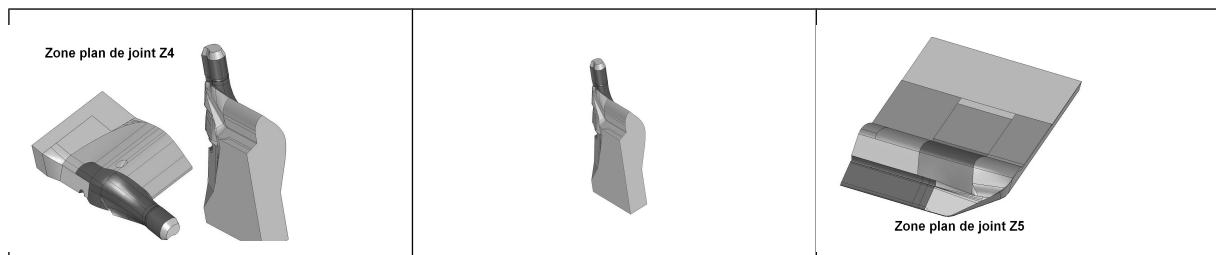


Figure 7: Mold parting surfaces

															L1	Contact	L14	Contact	L27	Inclusion	L40	Inclusion																		
															L2	Inclusion	L15	Inclusion	L28	Contact	L41	Contact																		
															L3	Inclusion	L16	Inclusion	L29	Inclusion	L42	Contact																		
															L4	Inclusion	L17	Intersection	L30	Contact	L43	Inclusion																		
															L5	Inclusion	L18	Contact	L31	Contact	L44	Egal																		
															L6	Contact	L19	Contact	L32	Contact	L45	Inclusion																		
															L7	Contact	L20	Contact	L33	Contact	L46	Inclusion																		
															L8	Inclusion	L21	Contact	L34	Inclusion	L47	Inclusion																		
															L9	Inclusion	L22	Contact	L35	Inclusion	L48	Inclusion																		
															L10	Inclusion	L23	Contact	L36	Contact	L49	Egal																		
															L11	Contact	L24	Contact	L37	Contact	L50	Intersection																		
															L12	Contact	L25	Contact	L38	Inclusion	L51	Egal																		
															L13	Inclusion	L26	Contact	L39	Contact	L52	Egal																		
A																																								
B	L1																																							
C	L2	-																																						
D	-	-	-																																					
E	-	-	-	-	L6																																			
F (Z1)	-	-	-	-	-																																			
F (Z4)	-	-	-	-	-	L44																																		
G (Z1)	-	-	-	-	-	L10	-																																	
G (Z4)	-	-	-	-	-	-	L47	L49																																
H	-	-	-	-	-	-	L11	-	-	-																														
I	-	-	-	-	-	-	L12	-	-	-	-	L19																												
J	-	-	-	-	-	-	-	-	-	-	-	-	L20																											
K	-	-	-	-	-	-	-	-	-	-	-	-	L21	-																										
L (Z1)	-	-	-	-	-	-	-	-	-	-	-	-	L22	-	-																									
L (Z4)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L51																								
M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																							
N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																						
O	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																					
P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																				
Q	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																			
R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																		
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																	
T	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																
U (Z1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-															
U (Z4)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-														
Z	L3	L4	-	L8	L9	L16	L45	-	-	-	L5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
															A	B	C	D	E	F (Z1)	F (Z4)	G (Z1)	G (Z4)	H	I	J	K	L (Z1)	L (Z4)	M	N	O	P	Q	R	S	T	U (Z1)	U (Z4)	Z

Figure 8: Entity links

	HSM		EDM		DMLS	
Entities	Time	Cost	Time	Cost	Time	Cost
A	0,59	0,05	1,71	38,95	5,65	20,50
B	0,59	0,03	1,71	38,95	9,17	40,43
C	0,59	0,03	1,71	38,95	279,36	73,67
D	0,59	0,03	1,71	38,95	13,53	34,13
E	0,59	0,03	1,71	38,95	295,40	8863,07
F (Z1)	0,59	0,03	1,71	38,95	48,52	307,29
F (Z4)	0,59	0,03	1,71	38,95	40,32	399,48
G (Z1)	0,59	0,03	1,71	38,95	393,68	75,54
G (Z4)	0,59	0,03	1,71	38,95	393,68	75,54
H	0,59	0,05	1,71	38,95	659,64	22,16
I	0,71	0,14	1,71	38,95	1,42	6,94
J	0,59	0,03	1,71	38,95	59,52	53,67
K	0,59	0,03	1,71	38,95	211,60	154,08
L (Z1)	2,06	0,09	0,49	11,09	42,82	14,03
L (Z4)	2,06	0,09	0,49	11,09	111,67	14,03
M	0,59	0,03	1,71	38,95	196,89	88,75
N	34565,27	3199,77	0,21	2,11	4,83	0,47
O	0,59	0,04	1,71	38,95	29,41	22,98
P	0,59	0,03	1,71	38,95	56,34	433,69
Q	11,06	2,82	0,21	5,80	4,75	0,36
R	0,59	0,26	1,71	38,95	5,65	3,82
S	1080,16	721,75	0,06	15,23	16,28	0,07
T	0,59	0,03	1,71	38,95	8960,40	227,87
U (Z1)	1080,16	47,38	0,00	0,02	1966858,34	2707,83
U (Z4)	1080,16	47,38	0,00	0,02	1966858,34	2707,83

Figure 9: Marks

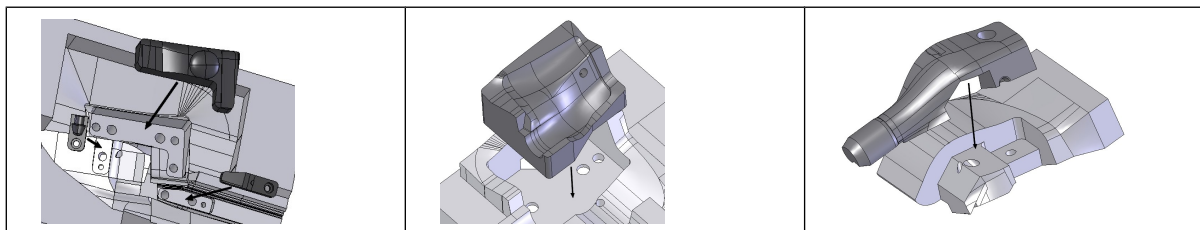
Entity breakable, without constraint		Entity unbreakable, tolerance of strong positioning	
Entity unbreakable, with functional constraint (sealing...), or evolutionary or geometrical tolerance (high)		EDM process	
Entity unbreakable, because it is evolutionary		DMLS process	
Entity breakable, weak topological link (contact)		HSM process	
Entity unbreakable, strong topological link (intersection, inclusion) or particular specification		Multi-process (e.g. HSM and DMLS possible)	
Link defining an FC (group of entities) resulting from the feasibility analysis		Entity unbreakable, constraints by a link tolerance of strong positioning	
Entity breakable, tolerance of weak positioning			

**Figure 10: Captions**

**Assembly Identity Card**

CIA						Base_Shape									
C1	Value	t1c	Value	C6		t6c	Value		Value	t1b	Value	B6		t6b	Value
C2	Value	t2c	Value	C7		t7c			Value	t2b	Value	B7		t7b	
C3		t3c	Value	C8		t8c		B3		t3b	Value	B8		t8b	
C4		t4c	Value	C9		t9c		B4		t4b	Value	B9		t9b	
C5		t5c	Value	C10		t9c		B5		t5b	Value	B10		t9b	
degree of freedom numbers						1		Material				Value			
can be Dismantled / can't be dismantled						Can be		Mechanical strength (Re)				Value			
difficulty of disassembling						1		Melting point				Value			
direct or indirect link						direct		dilation coefficient				Value			
grip or Obstacle						Obstacle		Thermal Conductivity				Value			
Number of screw						1		Porosity				Value			
Manufacturing process						Value		Manufacturing cost level				Value			
Ra						Value		Manufacturing difficulty level				Value			
dimensional quality						Value		Assembly cost level				Value			
Quality of positioning						Value		General form (cylindrical, parallelepipedic..				Value			

**Figure 11: Example of an Assembly Identity Card**



**Figure 12: Final solution**