



Science Arts & Métiers (SAM)

is an open access repository that collects the work of Arts et Métiers Institute of Technology researchers and makes it freely available over the web where possible.

This is an author-deposited version published in: <https://sam.ensam.eu>
Handle ID: <http://hdl.handle.net/10985/6869>

To cite this version :

Pascal MOGNOL, Jean-Yves HASCOET, Mickaël RIVETTE - Method to obtain hybrid rapid tools with elementary component assembly - Rapid Prototyping Journal - Vol. 19, n°2, p.77-87 - 2013

Any correspondence concerning this service should be sent to the repository

Administrator : scienceouverte@ensam.eu



Figure 1: Multi-Component Prototype

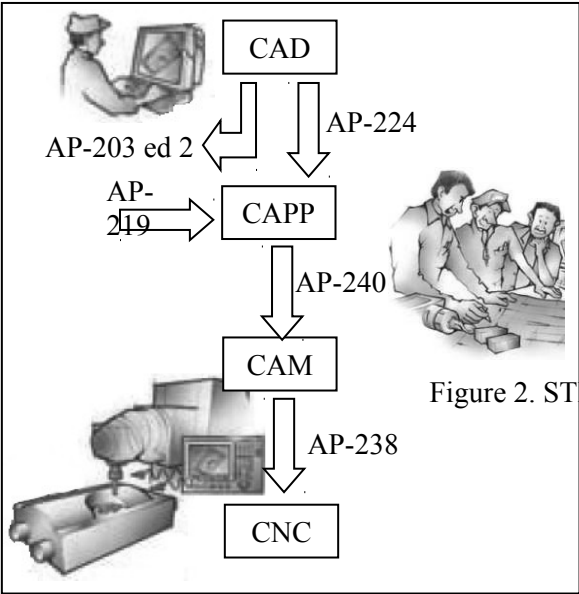


Figure 2. STEP A

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

Figure 3: MCP concept

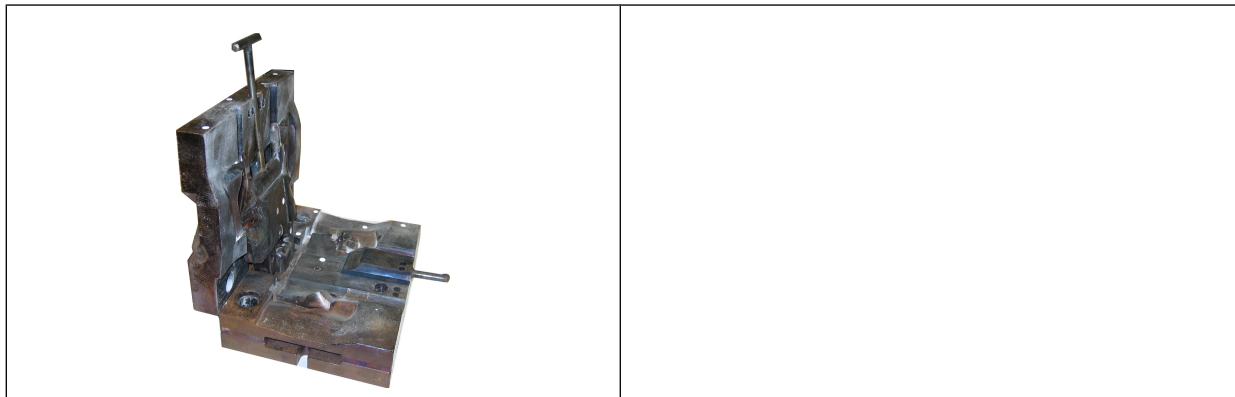


Figure 4: Automotive seal

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

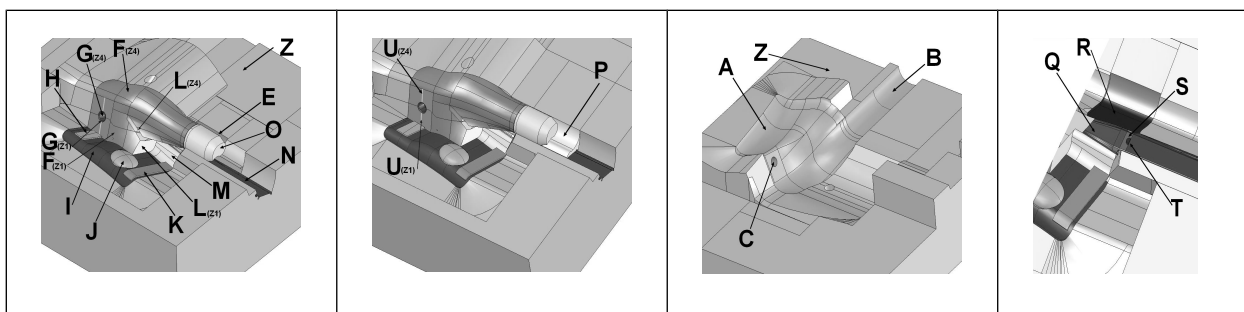
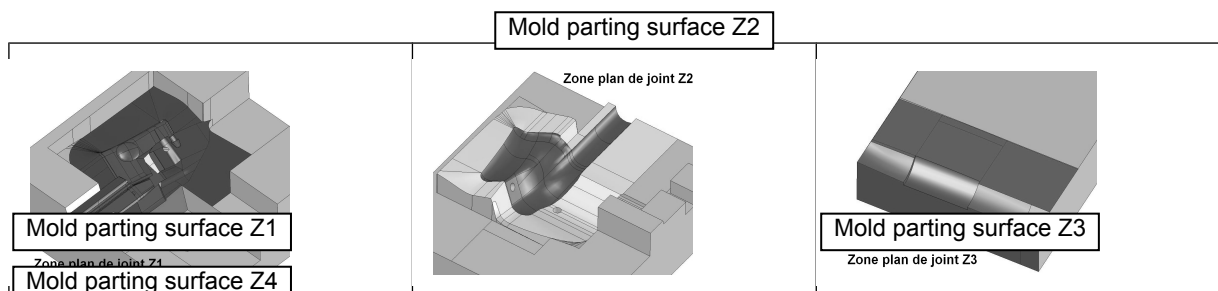


Figure 6: AP-224 entities



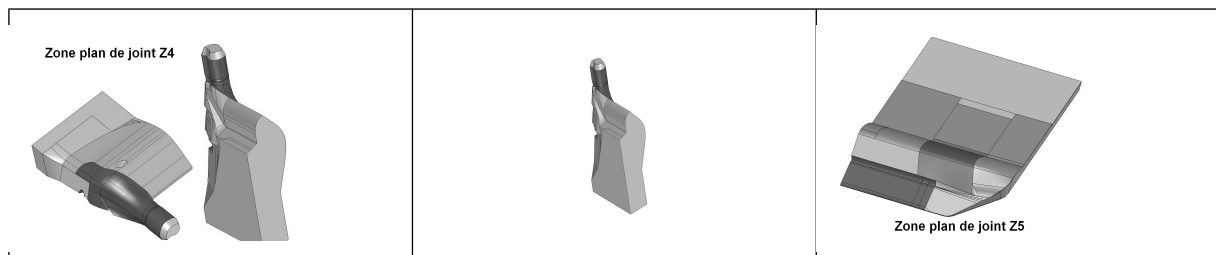


Figure 7: Mold parting surfaces

													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																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		

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

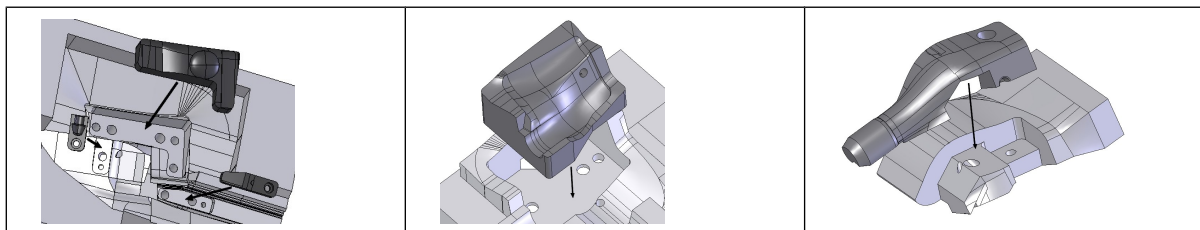


Figure 12: Final solution