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Arts et Métiers Institute of Technology

Figure 1: Multi-Component Prototype

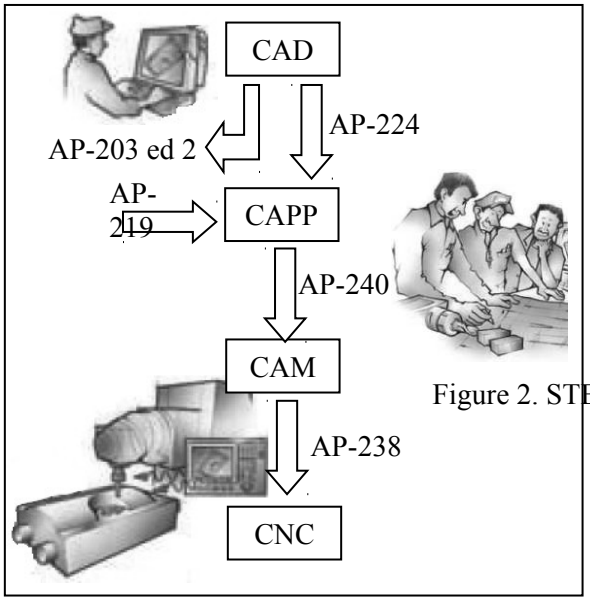


Figure 2. STEP A

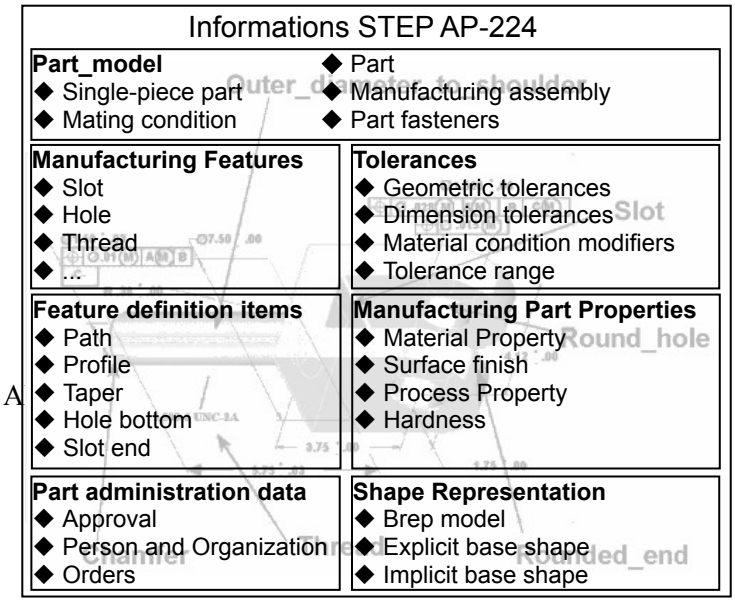


Figure 3: MCP concept

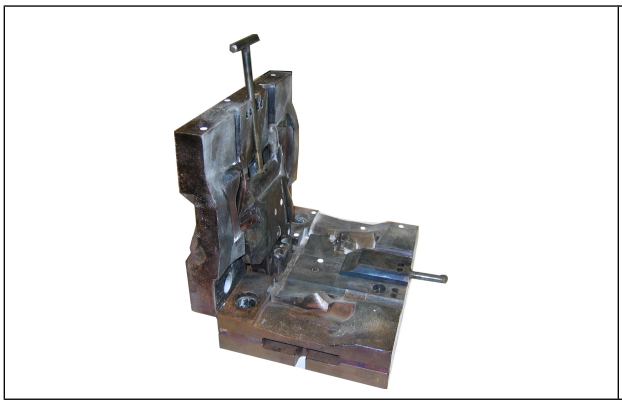


Figure 4: Automotive seal

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

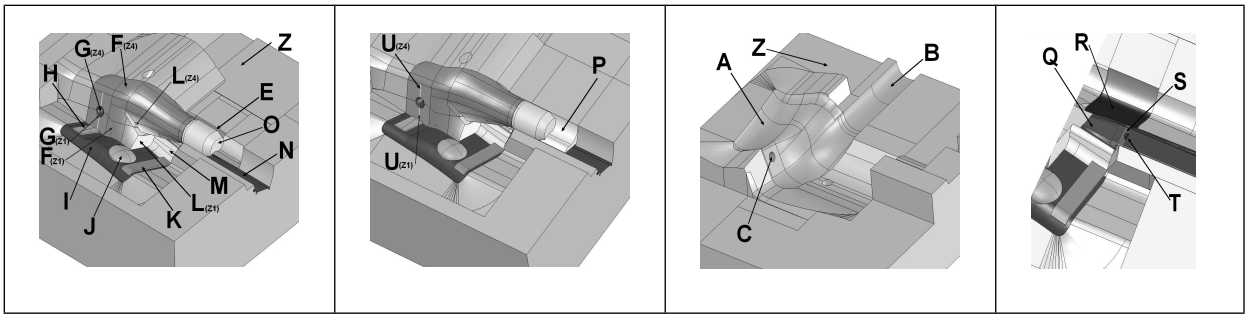
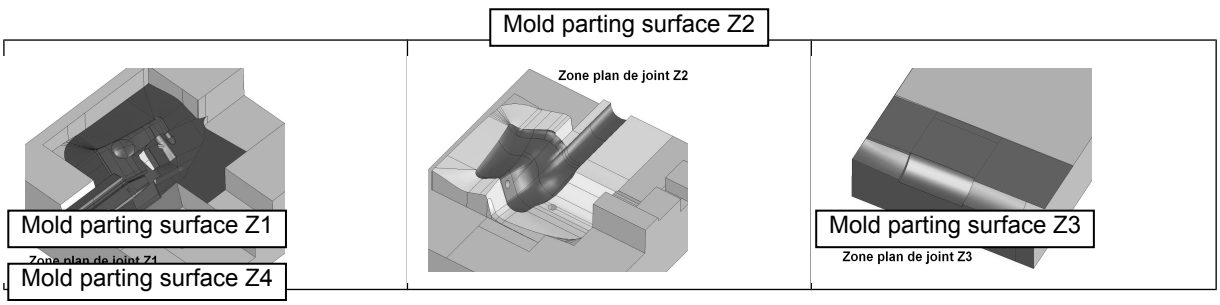


Figure 6: AP-224 entities



Mold parting surface Z5

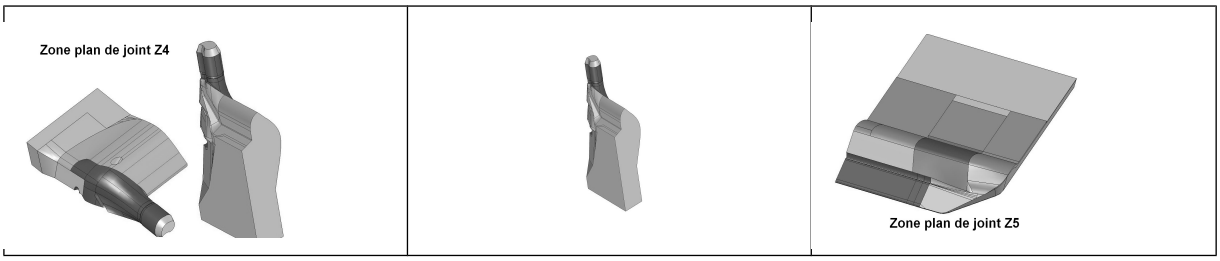


Figure 7: Mold parting surfaces

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)	-	-	-	-	-	L13	-	-	-	-	L22	-	-											
L (Z4)	-	-	-	-	-	-	L46	-	-	-	-	-	-	L51										
M	-	-	-	-	-	-	-	-	-	-	L23	-	L24	L18	-									
N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-								
O	-	-	-	-	-	-	L14	-	-	-	-	-	-	-	-	-	-							
P	-	-	-	L7	-	-	-	-	-	-	-	-	-	-	-	-	L30	-						
Q	-	-	-	-	-	-	-	-	-	-	-	-	-	L25	-	L28	-	-	-					
R	-	-	-	-	L41	-	-	-	-	-	-	-	-	L26	-	-	L31	-	-	L36				
S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L32	-	-	L37	L39			
T	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L33	-	-	-	-	L42		
U (Z1)	-	-	-	-	-	L15	-	L17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
U (Z4)	-	-	-	-	-	-	L48	-	L50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	L52
Z	L3	L4	-	L8	L9	L16	L45	-	-	-	L5	-	-	L27	-	L29	L34	-	L35	L38	L40	L43	-	-
	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)

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

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, parallepipedic..	Value

Figure 11: Example of an Assembly Identity Card

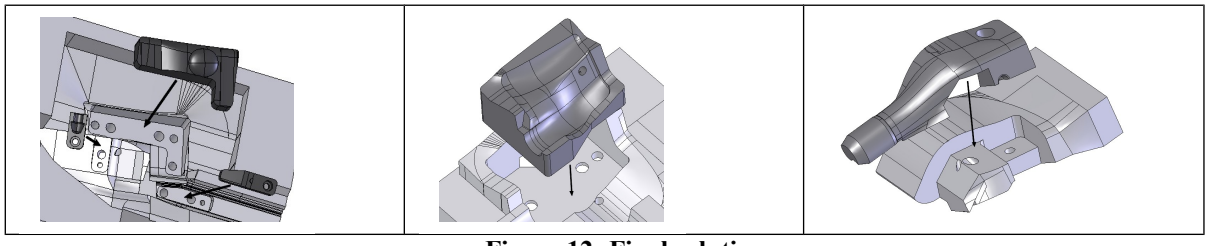


Figure 12: Final solution