

CLAIMS:

1. A fuel-impermeable structural unit for use as a structural element of a fuel tank, comprising
a multi-ply structure made of one or more composite material and polymers, and
a sealing polymeric film structurally bonded to and coating the entire surface of
at least one face of the multi-ply structure, wherein said polymeric film:
is integrated with an underlying external layer of said multi-ply structure,
is impermeable to the fuel,
is not reactive with the fuel, and
can bind to an adhesive for fixing one or more rigid elements thereto.
2. The unit according to claim 1, wherein said multi-ply structure comprises a plurality of composite or polymeric plies, held together by a cured resin.
3. The unit according to claim 1, wherein said multi-ply structure is in the form of a laminate structure.
4. The unit according to claim 1, wherein said multi-ply structure comprises at least one low-density core, encased between solid plies.
5. The unit according to claim 4, wherein said core is in the form of a honeycomb structure.
6. The unit according to claim 4, wherein said core is in the form of a foam core.
7. The unit according to any one of claims 1 to 6, wherein said sealing polymeric film is made of thermoplastic polyurethane.
8. The unit according to any one of claims 1 to 6, wherein said sealing polymeric film is made of a thermosetting nitrile-phenolic copolymer.
9. The unit according to any one of claims 1 to 6, wherein said sealing polymeric film is made of a combination of a thermoplastic polyurethane and a thermosetting nitrile-phenolic.
10. The unit according to any one of claims 1 to 9, wherein said structural element of the fuel tank is a skin.

11. The unit according to any one of claims 1 to 9, wherein said structural element of the fuel tank is a spar.
12. The unit according to any one of claims 1 to 9, wherein said structural element of the fuel tank is a support rib.
13. The unit according to any one of claims 1 to 12, wherein said unit includes at least one designated zone comprising said sealing polymeric film coated and structurally bonded to said at least one face of the multi-ply structure, wherein said at least one designated zone is designated for binding to an adhesive for fixing one or more rigid elements thereto.
14. The unit according to claim 13, wherein the unit is a skin of the fuel tank.
15. The unit according to claim 14, wherein at least one said rigid element is a spar.
16. The unit according to claim 14, wherein at least one said rigid element is a rib.
17. A fuel tank, comprising a skin and one or more rigid elements, wherein
said skin is made of one or more fuel-impermeable structural units, each of the one or more said units comprising a multi-ply structure made of one or more composite material and polymers, and a sealing polymeric film structurally bonded to and coating the entire surface of at least one face of the multi-ply structure, wherein said polymeric film is integrated with an underlying external layer of said multi-ply structure, is impermeable to the fuel, is not reactive with the fuel, and can bind to an adhesive for fixing one or more rigid elements thereto;
the one or more rigid elements defining at least end walls of the fuel tank, said rigid elements being bonded to respective designated zones of the skin comprising said sealing polymeric film coated and structurally bonded to said at least one face of the multi-ply structure, via said adhesive.
18. The fuel tank according to claim 17, the one or more rigid elements further comprising at least one of one or more support ribs and one or more spars.
19. The fuel tank according to claim 18, the skin being fixed to at least the respective ribs and/or the respective spars by one or more adhesives applied at least between a

connecting surface of the respective ribs and/or the respective spars, and the polymeric film of said skin.

20. The fuel tank according to any one of claims 17 to 19, wherein said multi-ply structure is in the form of a sandwich structure comprising a light-weight core encased between dense composite plies.

21. The fuel tank according to claim 20, wherein said core is in the form of a honeycomb structure or in the form of a foam core.

22. The fuel tank according to any one of claims 17 to 19, wherein said multi-ply structure is in the form of a laminate structure.

23. The fuel tank according to any one of claims 17 to 22, wherein the skin is formed out of a single said fuel-impermeable structural unit forming a closed-loop structure.

24. The fuel tank according to any one of claims 17 to 22, wherein said skin comprises two or more said fuel-impermeable structural units.

25. The fuel tank according to any one of claims 18 to 24, wherein at least one of the spars and the support ribs is made of a unit according to any one of claims 1-16.

26. The fuel tank according to any one of claims 18 to 24, wherein both the spars and the support ribs are made of a unit according to any one of claims 1-16.

27. The fuel tank according to any one of claims 17 to 26, wherein said sealing polymeric film is made of thermoplastic polyurethane.

28. The fuel tank according to any one of claims 17 to 26, wherein said sealing polymeric film is made of a thermosetting nitrile-phenolic copolymer.

29. The fuel tank according to any one of claims 17 to 26, wherein said sealing polymeric film is made combination of a thermoplastic polyurethane and a thermosetting nitrile-phenolic.

30. A method for producing a fuel-impermeable structural unit for use as a structural element of a fuel tank, comprising:

preparing a multi-layer structure comprising a multi-ply sub-structure of one or more plies of composite materials and/or polymers impregnated with one or

- 33 -

more polymeric resin, and a sealing polymeric film applied over the entire surface of at least one face of the multi-ply sub-structure, wherein said polymeric film is impermeable to the fuel, is not reactive with the fuel, and can bind to an adhesive; and

curing the multi-layer structure under heat and/or pressure to obtain a multi-ply structure wherein the polymeric film is structurally bonded to and integrated with an underlying external ply of said multi-ply structure, thereby obtaining the unit.

31. The method according to claim 30, wherein the multi-ply sub-structure is prepared by stacking a plurality of plies of composite material and/or polymers, each ply being pre-impregnated with a thermosetting resin.

32. The method according to claim 30, wherein the multi-ply sub-structure is prepared by stacking a plurality of dry plies of composite material and/or polymers, and impregnating the plies with a thermosetting resin.

33. The method according to claim 30, wherein the multi-ply sub-structure is prepared by resin transfer molding.

34. The method according to claim 30, wherein the multi-ply sub-structure is prepared by liquid resin infusion.

35. The method according to any one of claims 30 to 34, wherein curing is carried out in an autoclave, an oven, or at ambient temperature.

36. The method according to any one of claims 30 to 35, wherein the structural element is a skin, a spar, or a support rib.

37. The method according to any one of claims 30 to 36, wherein said sealing polymeric film is made of thermoplastic polyurethane.

38. The method according to any one of claims 30 to 36, wherein said sealing polymeric film is made of a thermosetting nitrile-phenolic copolymer.

- 34 -

39. The method according to any one of claims 30 to 36, wherein said sealing polymeric film is made combination of a thermoplastic polyurethane and a thermosetic nitrile-phenolic.

40. A method of producing a fuel tank, comprising:
preparing one or more rigid elements defining at least end walls of the fuel tank,;
and
fixing one or more skin segments to the one or more rigid elements, the skin segments being made out of a fuel-impermeable structural unit as defined in any one of claims 1 to 16.

41. The method according to claim 40, comprising bonding said rigid elements to respective designated zones of the skin segments comprising said sealing polymeric film coated and structurally bonded to said at least one face of the multi-ply structure, via said adhesive.

42. The method according to any one of claims 40 to 41, the one or more rigid elements further comprising at least one of one or more support ribs and one or more spars.

43. The method according to claim 42, the skin segments being fixed to at least the respective ribs and/or the respective spars by one or more adhesives applied at least between a connecting surface of the respective ribs and/or the respective spars, and the polymeric film of said skin segments.

44. The method according to any one of claims 40 to 43, wherein said support ribs and said spars are adhered onto the polymeric film of the skin segments during said fixing.

45. The method according to claim 40 to 44, comprising applying one or more additional sealing materials at locations of contact between the rigid elements and the skin.

46. The method according to any one of claims 40 to 45, comprising applying one or more reinforcing elements over locations where the rigid elements are adhered to the skin.

47. The method according to claim 46, comprising applying a said polymeric film over the reinforcing elements.