assembling the composite laminates together generally includes instructing the use of an adhesive between the composite laminates, wherein the adhesive is configured to bond the composite laminates together when the adhesive is cured.

The present disclosure also provides a method comprising assembling a first composite laminate together with a second composite laminate to form a particular repair part configured to repair a particular damaged composite structure, wherein the first composite laminate comprises one or more first laminae of fully cured fiber-reinforced composite material, wherein the first composite laminate is flexible such that the first composite laminate is configured to be selectively conformable to a first radius of curvature, and wherein the first composite laminate is pre-shaped to have at least a first portion and a second portion arranged at a first non-parallel angle with one another, wherein the second composite laminate comprises one or more second laminae of fully cured fiber-reinforced composite material, wherein the second composite laminate is flexible such that the second composite laminate is configured to be selectively conformable to a second radius of curvature, wherein the second composite laminate is pre-shaped to have at least a third portion and a fourth portion arranged at a second non-parallel angle with one another, and wherein the first radius of curvature and the second radius of curvature are predetermined based on the particular damaged composite part; applying an adhesive between the first composite laminate and the second composite laminate, wherein the adhesive is configured to bond the first composite laminate to the second composite laminate when the adhesive is cured, thereby forming the particular repair part, and wherein the adhesive is configured to be cured at a first temperature that is less than a second temperature at which the first composite laminate and the second composite laminate were cured; curing the adhesive at or below the first temperature, after the first composite laminate is assembled together with the second composite laminate using the adhesive; and fastening the particular repair part to the particular damaged composite structure via one or more bolts, wherein the curing the adhesive is performed before the fastening the particular repair part to the particular damaged composite structure.

The present disclosure also provides a method comprising shaping and curing a plurality of composite laminates until each respective composite laminate is fully cured and has a respective three-dimensional shape such that each respective composite laminate has at least a respective first portion and a respective second portion arranged at a non-parallel angle with one another, wherein each respective composite laminate comprises one or more respective laminae of fiber-reinforced composite material, wherein each respective composite laminate is configured to be selectively conformable to a respective predetermined radius of curvature, and wherein the shaping and curing the plurality of composite laminates comprises curing each composite laminate at or above a first temperature; forming an inventory comprising the plurality of composite laminates, wherein the inventory is configured such that one or more of the composite laminates of the inventory are configured to be assembled together with one or more other of the composite laminates of the inventory in a plurality of different orientations and combinations to create a plurality of different possible repair parts; and determining a customized sequence of two or more of the composite laminates from the inventory to be assembled together in a stacked assembly to form a particular repair part, wherein the particular repair part is configured to repair a particular damaged composite structure, and wherein the customized sequence is selected based on a respective size, thickness, shape, and/or fiber orientation of the respective composite laminate to create the particular repair part that meets predetermined criteria for repairing the particular damaged composite structure.

CLAIMS

~~1. A method (100), comprising:~~

~~forming (105) a first composite laminate (36'), wherein the first composite laminate (36') comprises one or more first laminate (28) of fully cured fiber-reinforced composite material, wherein the first composite laminate (36') is flexible such that the first composite laminate (36') is configured to be selectively conformable to a first radius of curvature;~~

~~forming (105) a second composite laminate (36''), wherein the second composite laminate (36'') comprises one or more second laminate (30) of fully cured fiber-reinforced composite material, wherein the second composite laminate (36'') is flexible such that the second composite laminate (36'') is configured to be selectively conformable to a second radius of curvature, wherein the first composite laminate (36') and the second composite laminate (36'') are configured to be assembled together to form a repair part (50) configured to repair a damaged composite structure (12); and~~

~~providing (112) instructions for assembling the first composite laminate (36') together with the second composite laminate (36'') to form the repair part (50) configured to repair the damaged composite structure (12), wherein the providing (112) instructions comprises instructing the use of an adhesive (44) between the first composite laminate (36') and the second composite laminate (36''), wherein the adhesive (44) is configured to bond the first composite laminate (36') to the second composite laminate (36'') when the adhesive (44) is cured, thereby forming (102) the repair part (50), and wherein the adhesive (44) is configured to be cured at a first temperature that is less than a second temperature at which the first composite laminate (36') and the second composite laminate (36'') were cured.~~

~~2. The method (100) according to claim any preceding claim, wherein the providing (112) the instructions for assembling the first composite laminate (36') together with the second composite laminate (36'') comprises:~~

~~providing (112) instructions to orient the first composite laminate (36') in a first orientation with respect to a longitudinal axis of the repair part (50); and~~

~~providing (112) instructions to orient the second composite laminate (36'') in a second orientation with respect to the longitudinal axis of the repair part (50).~~

~~3. The method (100) according to claim any preceding claim, wherein the forming (105) the first composite laminate (36') comprises curing (110) at least one first lamina (28) and less than seven first laminate (28) together to form the first composite laminate (36'), and wherein the forming (105) the second composite laminate (36'') comprises curing (110) at least one second lamina (30) and less than seven second laminate (30) together to form the second composite laminate (36'').~~

~~4. The method (100) according to claim 3, wherein the curing (110) the at least one first laminate (28) together to form the first composite laminate (36') comprises curing (110) the at least one first laminate (28) together at the second temperature, wherein the curing (110) the at least one second laminate (30) together to form the second composite laminate (36'') comprises curing (110) the at least one second laminate (30) together at the second temperature, wherein the second temperature is at least 300 °F (149 °C), and wherein the first temperature at which the adhesive (44) is configured to be cured is less than 275 °F (135 °C).~~

~~5. The method (100) according to claim any preceding claim, further comprising:~~

~~forming (105) one or more additional composite laminates (36'''), wherein each respective composite laminate (36''') of the one or more additional composite laminates (36''') comprises one or more additional laminate (34) of fully cured fiber-reinforced composite material, and wherein each of the one or more additional composite laminates (36''') is flexible such that it is configured to be selectively conformable to a third radius of curvature, wherein the one or more additional composite laminates (36''') are configured to be assembled together with the first composite laminate (36') and the second composite laminate (36'') to form the repair part (50), with an additional adhesive (44) positioned between each respective adjacent pair of composite laminates (36); and~~

~~providing (112) instructions for assembling the one or more additional composite laminates (36''') together with the first composite laminate (36') and the second composite laminate (36''), to form the repair part (50) configured to repair the damaged composite structure (12).~~

~~6. The method (100) according to claim 5, wherein the first composite laminate (36'), the second composite laminate (36''), and the one or more additional composite laminates (36''') are shaped complementarily to each other such that they are configured to be stacked and nested together to form the repair part (50).~~

~~7. The method (100) according to claim 6, wherein the providing (112) instructions comprises providing (112) instructions to stack the first composite laminate (36'), the second composite laminate (36''), and the one or more additional composite laminates (36''') such that respective adjacent composite laminates (36) alternate between being oriented in a first orientation and being oriented in a second orientation such that the first composite laminate (36') is oriented in the first orientation, the second composite laminate (36'') is oriented in the second orientation, and at least one of the one or~~

~~more additional composite laminates (36''') is oriented in the first orientation, wherein the first orientation is different from the second orientation.~~

~~8. The method (100) according to claim any preceding claim, wherein the forming (105) the first composite laminate (36') comprises forming (105) a plurality of first composite laminates (36'), wherein at least some respective first composite laminates (36') of the plurality of first composite laminates (36') are different in one or more of size, shape, fiber orientation, and material composition from other respective first composite laminates (36') of the plurality of first composite laminates (36'), wherein different respective first composite laminates (36') of the plurality of first composite laminates (36') are configured to be stacked together in a plurality of different sequences, and wherein the method (100) further comprises storing the plurality of first composite laminates (36') for later use.~~

~~9. The method (100) according to claim 8, further comprising forming (105) a catalog of first composite laminates (36') that are configured to be assembled together in a plurality of different orientations and combinations to create a plurality of different repair parts (50), wherein the plurality of different repair parts (50) are selectively customizable.~~

~~10. The method (100) according to claim any preceding claim, further comprising determining a customized sequence of one or more first composite laminates (36') and one or more second composite laminates (36'') for forming (102) the repair part (50).~~

~~11. The method (100) according to claim 10, further comprising shipping the one or more first composite laminates (36') and the one or more second composite laminates (36'') to a third party, wherein the determining the customized sequence is performed in parallel with the shipping.~~

~~12. The method (100) according to claim 1, wherein the providing (112) instructions for assembling the first composite laminate (36') together with the second composite laminate (36'') comprises providing (112) instructions for curing (110) the adhesive (44) while the first composite laminate (36'), the second composite laminate (36''), and the adhesive (44) are assembled together to form a stacked assembly (42), and while the stacked assembly (42) is positioned apart from the damaged composite structure (12).~~

~~13. The method (100) according to claim 12, wherein the providing (112) instructions comprises providing (112) instructions for curing (110) the stacked assembly (42) in an autoclave.~~

~~14. The method (100) according to claim any preceding claim, further comprising providing (112) instructions to bolt the repair part (50) to the damaged composite structure (12) such that the repair part (50) spans a damaged portion of the damaged composite structure (12), thereby repairing the damaged composite structure (12).~~

~~15. A repair part (50) configured to repair a damaged composite structure (12), wherein the repair part (50) comprises:~~

~~a first composite laminate (36'), wherein the first composite laminate (36') comprises between one and seven first laminate (28) of fully cured fiber-reinforced composite material;~~

~~a second composite laminate (36''), wherein the second composite laminate (36'') comprises between one and seven second laminate (30) of fully cured fiber-reinforced composite material;~~

~~a first adhesive (44) positioned between and bonding the first composite laminate (36') and the second composite laminate (36'');~~

~~a third composite laminate (36'''), wherein the third composite laminate (36''') comprises between one and seven third laminate (32) of fully cured fiber-reinforced composite material; and~~

~~a second adhesive (44) positioned between and bonding the second composite laminate (36'') and the third composite laminate (36'''), wherein the first adhesive (44) and the second adhesive (44) are configured to be cured at a first temperature that is lower than a second temperature at which the first composite laminate (36'), the second composite laminate (36''), and the third composite laminate (36''') were cured, wherein the repair part (50) is customized for the damaged composite structure (12).~~

1. A method, comprising:

assembling a first composite laminate together with a second composite laminate to form a particular repair part configured to repair a particular damaged composite structure, wherein the first composite laminate comprises one or more first laminae of fully cured fiber-reinforced composite material, wherein the first composite laminate is flexible such that the first composite laminate is configured to be selectively conformable to a first radius of curvature, and wherein the first composite laminate is pre-shaped to have at least a first portion and a second portion arranged at a first non-parallel angle with one another, wherein the second composite laminate comprises one or more second laminae of fully cured fiber-reinforced composite material, wherein the second composite laminate is flexible such that the second composite laminate is configured to be selectively conformable to a second radius of curvature, wherein the second composite laminate is pre-shaped to have at least a third portion and a fourth portion arranged at a second non-parallel angle with one another, and wherein the first radius of curvature and the second radius of curvature are predetermined based on the particular damaged composite part;

applying an adhesive between the first composite laminate and the second composite laminate, wherein the adhesive is configured to bond the first composite laminate to the second composite

laminate when the adhesive is cured, thereby forming the particular repair part, and wherein the adhesive is configured to be cured at a first temperature that is less than a second temperature at which the first composite laminate and the second composite laminate were cured;

curing the adhesive at or below the first temperature, after the first composite laminate is assembled together with the second composite laminate using the adhesive; and

fastening the particular repair part to the particular damaged composite structure via one or more bolts, wherein the curing the adhesive is performed before the fastening the particular repair part to the particular damaged composite structure.

2. A method, comprising:

shaping and curing a plurality of composite laminates until each respective composite laminate is fully cured and has a respective three-dimensional shape such that each respective composite laminate has at least a respective first portion and a respective second portion arranged at a non-parallel angle with one another, wherein each respective composite laminate comprises one or more respective laminae of fiber-reinforced composite material, wherein each respective composite laminate is configured to be selectively conformable to a respective predetermined radius of curvature, and wherein the shaping and curing the plurality of composite laminates comprises curing each composite laminate at or above a first temperature;

forming an inventory comprising the plurality of composite laminates, wherein the inventory is configured such that one or more of the composite laminates of the inventory are configured to be assembled together with one or more other of the composite laminates of the inventory in a plurality of different orientations and combinations to create a plurality of different possible repair parts; and

determining a customized sequence of two or more of the composite laminates from the inventory to be assembled together in a stacked assembly to form a particular repair part, wherein the

particular repair part is configured to repair a particular damaged composite structure, and wherein the customized sequence is selected based on a respective size, thickness, shape, and/or fiber orientation of the respective composite laminate to create the particular repair part that meets predetermined criteria for repairing the particular damaged composite structure.

3. The method according to claim 2, further comprising:

assembling the customized sequence of composite laminates together to form the stacked assembly according to the customized sequence, thereby forming the particular repair part.

4. The method according to claim 3, wherein the assembling the customized sequence of composite laminates together comprises:

applying an adhesive between each pair of adjacent composite laminates of the stacked assembly, wherein the adhesive is configured to bond the stacked assembly together when the adhesive is cured, wherein the adhesive is configured to be cured at or below a second temperature that is less than the first temperature; and

curing the adhesive at or below the second temperature, after the customized sequence of composite laminates are assembled together using the adhesive.

5. The method according to claim 2, wherein the determining the customized sequence of one or more of the composite laminates from the inventory to be assembled together in the stacked assembly further comprises determining a respective orientation for each respective composite laminate in the customized sequence.

6. The method according to claim 5, wherein the determining the respective orientation for each respective composite laminate in the customized sequence comprises determining each respective orientation relative to a longitudinal axis of the particular repair part.

7. The method according to claim 2, wherein each respective composite laminate of the inventory comprises less than seven laminae of fiber-reinforced composite material.

8. The method according to claim 2, wherein the first temperature is at least 300 °F (149 °C), and wherein the second temperature is less than 275 °F (135 °C).

9. The method according to claim 2, wherein the customized sequence comprises a sequence that alternates between a first orientation and a second orientation such that a first composite laminate of the sequence is oriented in the first orientation, a second composite laminate of the sequence is oriented in the second orientation, and at least one additional composite laminate of the sequence is oriented in the first orientation, wherein the first orientation is different from the second orientation.

10. The method according to claim 2, wherein at least some respective composite laminates of the inventory are different in one or more of size, shape, fiber orientation, number of laminae, and material composition from at least some other composite laminates of the inventory.

11. The method according to claim 4, wherein the curing the adhesive comprises curing the adhesive while the stacked assembly is positioned apart from the damaged composite structure.

12. The method according to claim 11, wherein the curing the adhesive comprises curing the stacked assembly in an autoclave.

13. The method according to claim 4, further comprising fastening the particular repair part to the particular damaged composite structure via one or more fasteners, such that the particular repair part spans a damaged portion of the particular damaged composite structure, thereby repairing the particular damaged composite structure.

14. The method according to claim 13, wherein the assembling the customized sequence of composite laminates together to form the particular repair part comprises assembling a plurality of customized sequences of composite laminates together to form a plurality of particular repair parts, and wherein the fastening the particular repair part comprises fastening–the plurality of particular repair parts to the particular damaged composite structure such that at least one area of overlap is formed between a first respective repair part of the plurality of particular repair parts and a second respective repair part of the plurality of particular repair parts.

15. The method according to claim 4, further comprising positioning the particular repair part on the particular damaged composite structure during the curing the adhesive, such that the particular damaged composite structure serves as a tooling surface for the particular repair part as the adhesive is cured.

16. The method according to claim 13, wherein the one or more fasteners comprise one or more bolts.

17. The method according to claim 2, further comprising:

removing a damaged portion of the particular damaged composite structure; and

fastening the particular repair part to the particular damaged composite structure after the damaged portion is removed from the particular damaged composite structure.