Accordingly, there is a need in the art for improved methods and systems for applying coatings or paints of decorative designs, such as airline livery designs, to exterior surfaces of air vehicles, that provide advantages over known methods and systems.

SUMMARY

This need for improved methods and systems for applying coatings or paints of decorative designs, such as airline livery designs, to exterior surfaces of air vehicles, is satisfied. As discussed in the below detailed description, embodiments of improved methods and systems for applying coatings or paints of decorative designs, such as airline livery designs, to exterior surfaces of air vehicles may provide significant advantages over known methods and systems.

In one embodiment of the disclosure, there is provided a method for applying an aerodynamically functional coating to an exterior surface. The method comprises the step of preparing an uncoated substrate surface to obtain a prepared substrate surface configured to receive an aerodynamically functional coating. The method further comprises applying a primer on the prepared substrate surface to obtain a primed substrate surface with a primer layer. The method further comprises applying and curing a basecoat field color on the primer layer to obtain a basecoat field color layer. The method further comprises masking for a basecoat design color on the basecoat field color layer. The method further comprises applying and curing the basecoat design color on the basecoat field color layer to obtain a first basecoat design color layer. The method further comprises masking for, applying, and curing a subsequent basecoat design color layers on the basecoat field color layer. The method further comprises applying and curing a clearcoat on the basecoat field color and basecoat design color layer to obtain a first clearcoat layer. The method further comprises mechanically aero-contouring a plurality of coating edges to reduce one or more coating edge peaks and coating edge angles of abutting coating edges between the basecoat design color layers, to obtain an aero-contoured surface that retains desired flow characteristics and ensures aerodynamic performance. The method further comprises applying to the aero-contoured surface additional clearcoat which is cured, to obtain one or more additional clearcoat layers. The method further comprises obtaining a coated substrate surface coated with the aerodynamically functional coating formed by the basecoat field color layer, the first basecoat design color layer, the subsequent basecoat design color layers, the first clearcoat layer, and the one or more additional clearcoat layers.

There is also provided a method for applying an aerodynamically functional coating to an exterior surface. The method comprises the step of preparing an uncoated substrate surface to obtain a prepared substrate surface configured to receive an aerodynamically functional coating. The method further comprises applying and

curing a primer on the prepared substrate surface to obtain a primed substrate surface with a primer layer. The method further comprises applying and curing a monocoat design color on the primer layer to obtain a first monocoat design color layer. The method further comprises applying and curing a clearcoat on the first monocoat design color layer to obtain a first clearcoat layer. The method further comprises masking for, applying, and curing any subsequent monocoat design color layers, and applying and curing any subsequent first clearcoat layers, respectively, on the primer layer. The method further comprises mechanically aero-contouring a plurality of coating edges to obtain an aero-contoured surface. The method further comprises applying to the aero-contoured surface additional clearcoat which is cured, to obtain one or more additional –clearcoat layers. The method further comprises obtaining a coated substrate surface coated with the aerodynamically functional coating formed by the first monocoat color layer, the first clearcoat layer, any subsequent monocoat color layers, any subsequent first clearcoat layers, and the one or more additional clearcoat layers.

In another embodiment of the disclosure, there is provided an aero-contoured coating system. The aero-contoured coating system comprises an aerodynamically functional coating. The aerodynamically functional coating comprises at least one or more color layers. The aerodynamically functional coating further comprises one or more first clearcoat layers applied and cured over the one or more color layers to obtain a pre-aero-contoured coating. The one or more first clearcoat layers are preferably configured for abrasion and aero-contouring to obtain an aero-contoured surface. The aerodynamically functional coating comprises one or more additional clearcoat layers applied and cured over the aero-contoured surface. The aero-contoured coating system further comprises a structure having a prepared and primed substrate surface configured to receive the aerodynamically functional coating. The aero-contoured coating system further comprises an aero-contouring device to abrade a plurality of flow surfaces on the pre-aero-contoured coated surface of the aerodynamically functional coating to obtain the aero-contoured surface. The aero-contoured coating system further comprises one or more masking elements for masking the one or more color layers of the aerodynamically functional coating during application of the one or more color layers over the prepared and primed substrate surface; wherein the aerodynamically functional coating comprises a basecoat-clearcoat (BC-CC) aerodynamically functional coating comprising: a basecoat field color layer applied and cured over the prepared and primed substrate surface; one or more basecoat design color layers applied and cured over the basecoat field color layer; the first clearcoat layer applied and cured on the visible basecoat

field color and the basecoat design color layer; and, one or more additional clearcoat layers applied over the aero-contoured surface; wherein abrading a plurality of flow surfaces on the preaero-contoured coated surface of the aerodynamically functional coating to obtain the aero-contoured surface comprises mechanically aero-contouring a plurality of coating edges to reduce one or more coating edge peaks and coating edge angles of abutting coating edges between the basecoat design color layers, obtain an aero-contoured surface that retains desired flow characteristics and ensures aerodynamic performance.

According to an aspect of the present invention there is provided a method for applying an aerodynamically functional coating to an exterior surface, the method comprising the steps of: preparing an uncoated substrate surface to obtain a prepared substrate surface configured to receive an aerodynamically functional coating, applying a primer on the

prepared substrate surface to obtain a primed substrate surface with a primer layer, applying and curing a basecoat field color on the primer layer to obtain a basecoat field color layer, masking for a basecoat design color on the basecoat field color layer, applying and curing the basecoat design color on the basecoat field color layer to obtain a first basecoat design color layer, masking for, applying, and curing a subsequent basecoat design color layers on the basecoat field color layer, applying and curing a clearcoat on basecoat field color and basecoat design color to obtain a first clearcoat layer, mechanically aero-contouring a plurality of coating edges to reduce one or more coating edge peaks and coating edge angles of abutting coating edges between the basecoat design color layers, obtain an aero-contoured surface , applying to the aero-contoured surface additional clearcoat which is cured, to obtain one or more additional clearcoat layers; and, obtaining a coated substrate surface coated with the aerodynamically functional coating formed by the basecoat field color layer, the first basecoat design color layer, the subsequent basecoat design color layers, the first clearcoat layer, and the one or more additional clearcoat layers. Advantageously there is a method wherein the aero-contouring step comprises the sub-steps of: using an aero-contouring device to abrade the plurality of coating edges on a pre-aero-contoured coated surface to obtain an aero-contoured surface, removing with a removal element any color transfer on the aero-contoured surface, removing with the aero-contouring device any surface inclusions on the aero-contoured surface, performing a fine abrasion of the aero-contoured surface using a fine abrasion element, and cleaning and drying the aero-contoured surface. Advantageously there is a method wherein the step of applying additional clearcoat further comprises applying an optically clear film, either over the one or more additional clearcoat layers or in place of the one or more additional clearcoat layers, to obtain an optically clear film layer. Advantageously there is a method wherein the first clearcoat layer and the one or more additional clearcoat layers each have a thickness of from at least about 1 mil, and wherein the optically clear film layer has a thickness of from at least about 2 mils. Advantageously there is a method wherein the aero-contouring step reduces one or more coating edge peaks and coating edge angles of the plurality of coating edges. Advantageously there is a method further comprising after the step of masking for, applying, and curing any subsequent basecoat design color layers on the basecoat field color layer, the step of masking for, applying, and curing one or more special effect design color layers on the first basecoat design color layer or on one or more of the subsequent basecoat design color layers. Advantageously there is a method wherein the exterior surface comprises an aerodynamic surface of a structure, the structure comprising one or more of a tail of an air vehicle,

including a vertical stabilizer tail portion and horizontal stabilizer tail portions; wings of an air vehicle, including winglets; fuselage of an air vehicle; and nacelles of an air vehicle. There is provided a method for applying an aerodynamically functional coating to an exterior surface, the method comprising the steps of: preparing an uncoated substrate surface to obtain a prepared substrate surface configured to receive an aerodynamically functional coating, substrate surface with a primer layer, applying and curing a monocoat design color on the primer layer to obtain a first monocoat design color layer, applying and curing a clearcoat on the first monocoat design color layer to obtain a first clearcoat layer, masking for, applying, and curing any subsequent monocoat design color layers, and applying and curing any subsequent first clearcoat layers, respectively, on the primer layer;, mechanically aero-contouring a plurality of coating edges to obtain an aero-contoured surface, applying to the aero-contoured surface additional clearcoat which is cured, to obtain one or more additional clearcoat layers, and, obtaining a coated substrate surface coated with the aerodynamically functional coating formed by the first monocoat color layer, the first clearcoat layer, any subsequent monocoat color layers, any subsequent first clearcoat layers, and the one or more additional clearcoat layers. Advantageously there is a method wherein the aero-contouring step comprises the sub-steps of: smoothing and sanding the plurality of coating edges surfaces on a pre-aero-contoured coated surface via mechanical abrasion with an aero-contouring device to obtain an aero-contoured surface, removing with a removal element any color transfer on the aero-contoured surface, removing with the aero-contouring device any surface inclusions on the aero-contoured surface, performing a fine abrasion of the aero-contoured surface using a fine abrasion element, and, cleaning and drying the aero-contoured surface. Advantageously there is a method wherein the step of applying additional clearcoat further comprises applying an optically clear film, either over the one or more additional clearcoat layers or in place of the one or more additional clearcoat layers, to obtain an optically clear film layer. Advantageously there is a method wherein the first clearcoat layer, any subsequent first clearcoat layers, and the one or more additional clearcoat layers each have a thickness of from at least about 1 mil, and wherein the optically clear film layer has a thickness of from at least about 2 mils. Advantageously there is a method wherein the aero-contouring step reduces one or more coating edge peaks and coating edge angles of the plurality of coating edges. Advantageously there is a method further comprising after the step of masking for, applying, and curing any subsequent monocoat design color layers, the step of masking for, applying, and curing one or more special effect design color layers on the first monocoat design color layer or on one or more of the subsequent monocoat

design color layers. Advantageously there is a method wherein the exterior surface comprises an aerodynamic surface of a structure, the structure comprising one or more of a tail of an air vehicle, including a vertical stabilizer tail portion and horizontal stabilizer tail portions; wings of an air vehicle, including winglets; fuselage of an air vehicle; and nacelles of an air vehicle.

According to a yet further aspect of the present invention there is provided an aero-contoured coating system comprising: an aerodynamically functional coating comprising at least: one or more color layers, one or more first clearcoat layers applied and cured over the one or more color layers to obtain a pre-aero-contoured coating, the one or more first clearcoat layers configured for abrasion and aero-contouring to obtain an aero-contoured surface, and, one or more additional clearcoat layers applied and cured over the aero-contoured surface, a structure having a prepared and primed substrate surface configured to receive the aerodynamically functional coating, an aero-contouring device to abrade a plurality of flow surfaces on the pre-aero-contoured coated surface of the aerodynamically functional coating to obtain the aero-contoured surface, and, one or more masking elements for masking the one or more color layers of the aerodynamically functional coating during application of the one or more color layers over the prepared and primed substrate surface.; wherein the aerodynamically functional coating comprises a basecoat-clearcoat (BC-CC) aerodynamically functional coating comprising: a basecoat field color layer applied and cured over the prepared and primed substrate surface; one or more basecoat design color layers applied and cured over the basecoat field color layer; the first clearcoat layer applied and cured on the basecoat field color and basecoat design color layer; and, one or more additional clearcoat layers applied over the aero-contoured surface; wherein abrading a plurality of flow surfaces on the preaero-contoured coated surface of the aerodynamically functional coating to obtain the aero-contoured surface comprises mechanically aero-contouring a plurality of coating edges to reduce one or more coating edge peaks and coating edge angles of abutting coating edges between the basecoat design color layers, obtain an aero-contoured surface that retains desired flow characteristics and ensures aerodynamic performance. Advantageously there is a system wherein the aerodynamically functional coating comprises a basecoat-clearcoat (BC-CC) aerodynamically functional coating comprising: a basecoat field color layer applied and cured over the prepared and primed substrate surface, one or more basecoat design color layers applied and cured over the basecoat field color layer, the first clearcoat layer applied and cured on any visible basecoat field color and any visible basecoat design color layer, and, one or more additional clearcoat

layers applied over the aero-contoured surface. Advantageously there is a system further comprising an optically clear film layer, either applied over the one or more additional clearcoat layers or applied in place of the one or more additional clearcoat layers. Advantageously there is a system wherein the aerodynamically functional coating comprises a monocoat-clearcoat (MC-CC) aerodynamically functional coating comprising: a first monocoat design color layer applied and cured over the prepared and primed substrate surface, the first clearcoat layer applied and cured over the first monocoat design color layer, one or more subsequent monocoat-clearcoat layers applied and cured over the primer layer, and, one or more additional clearcoat layers applied over the aero-contoured surface. Advantageously there is a system further comprising an optically clear film layer, either applied over the one or more additional clearcoat layers or applied in place of the one or more additional clearcoat layers.

CLAIMS

What is claimed is:

1. A method for applying an aerodynamically functional coating to an exterior surface, the method comprising the steps of:

preparing an uncoated substrate surface to obtain a prepared substrate surface configured to receive an aerodynamically functional coating;

applying a primer on the prepared substrate surface to obtain a primed substrate surface with a primer layer;

applying and curing a basecoat field color on the primer layer to obtain a basecoat field color layer;

masking for a basecoat design color on the basecoat field color layer;

applying and curing the basecoat design color on the basecoat field color layer to obtain a first basecoat design color layer;

masking for, applying, and curing a subsequent basecoat design color layers on the basecoat field color layer;

applying and curing a clearcoat on the basecoat field color and basecoat design color to obtain a first clearcoat layer;

mechanically aero-contouring a plurality of coating edges to reduce one or more coating edge peaks and coating edge angles of abutting coating edges between the basecoat design color layers, to obtain an aero-contoured surface that retains desired flow characteristics and ensures aerodynamic performance;

applying to the aero-contoured surface additional clearcoat which is cured, to obtain one or more additional clearcoat layers; and,

obtaining a coated substrate surface coated with the aerodynamically functional coating formed by the basecoat field color layer, the first basecoat design color layer, the subsequent basecoat design color layers, the first clearcoat layer, and the one or more additional clearcoat layers.

2. The method of claim 1 wherein the aero-contouring step comprises the sub-steps of:

using an aero-contouring device to abrade the plurality of coating edges on a pre-aero-contoured coated surface to obtain the aero-contoured surface;

removing with a removal element a color transfer on the aero-contoured surface;

removing with the aero-contouring device surface inclusions on the aero-contoured surface;

performing a fine abrasion of the aero-contoured surface using a fine abrasion element; and,

cleaning and drying the aero-contoured surface.

3. The method of claim 1, wherein the step of applying additional clearcoat further comprises applying an optically clear film, either over the one or more additional clearcoat layers or in place of the one or more additional clearcoat layers, to obtain an optically clear film layer.

4. The method of claim 3, wherein the first clearcoat layer and the one or more additional clearcoat layers each have a thickness of from at least about 1 mil, and wherein the optically clear film layer has a thickness of from at least about 2 mils.

5. The method of claim 1 further comprising after the step of masking for, applying, and curing a subsequent basecoat design color layers on the basecoat field color layer, the step of masking for, applying, and curing one or more special effect design color layers on the first basecoat design color layer or on one or more of the subsequent basecoat design color layers.

6. The method of claim 1, wherein the exterior surface comprises an aerodynamic surface of a structure, the structure comprising one or more of a tail of an air vehicle, including a vertical stabilizer tail portion and horizontal stabilizer tail portions; wings of an air vehicle, including winglets; fuselage of an air vehicle; and nacelles of an air vehicle.

7. An aero-contoured coating system comprising:

an aerodynamically functional coating comprising at least:

one or more color layers;

one or more first clearcoat layers applied and cured over the one or more color layers to obtain a pre-aero-contoured coating, the one or more first clearcoat layers configured for abrasion and aero-contouring to obtain an aero-contoured surface; and,

one or more additional clearcoat layers applied and cured over the aero-contoured surface;

a structure having a prepared and primed substrate surface configured to receive the aerodynamically functional coating;

an aero-contouring device to abrade a plurality of flow surfaces on the pre-aero-contoured coated surface of the aerodynamically functional coating to obtain the aero-contoured surface; and,

one or more masking elements for masking the one or more color layers of the aerodynamically functional coating during application of the one or more color layers over the prepared and primed substrate surface;

wherein the aerodynamically functional coating comprises a basecoat-clearcoat (BC-CC) aerodynamically functional coating comprising:

a basecoat field color layer applied and cured over the prepared and primed substrate surface;

one or more basecoat design color layers applied and cured over the basecoat field color layer;

the first clearcoat layer applied and cured on the basecoat field color and basecoat design color layer; and,

one or more additional clearcoat layers applied over the aero-contoured surface.;

wherein abrading a plurality of flow surfaces on the preaero-contoured coated surface of the aerodynamically functional coating to obtain the aero-contoured surface comprises mechanically aero-contouring a plurality of coating edges to reduce one or more coating edge peaks and coating edge angles of abutting coating edges between the basecoat design color layers, obtain an aero-contoured surface that retains desired flow characteristics and ensures aerodynamic performance.

8. The system of claim 7 further comprising an optically clear film layer, either applied over the one or more additional clearcoat layers or applied in place of the one or more additional clearcoat layers.

9. The system of claim 7, wherein the structure comprises one or more of a tail of an air vehicle, including a vertical stabilizer tail portion and horizontal stabilizer tail portions; wings of an air vehicle, including winglets; fuselage of an air vehicle; and nacelles of an air vehicle.