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Duct for aftertreatment system

Abstract

A duct for an aftertreatment system includes a body defining a first end and a second end and a flange coupled to the body at the first end of the body. The flange defines an outer edge. The duct includes a projection coupled to and extending from the flange along a first direction. The projection and the flange lie in a same plane. The projection defines a first side edge and a second side edge that is angularly spaced apart from the first side edge. The duct is adapted to be coupled with a component of the aftertreatment system via each of the outer edge of the flange, the first side edge of the projection, and the second side edge of the projection. The component includes at least one of a diesel oxidation catalyst of the aftertreatment system and a selective catalytic reduction module of the aftertreatment system.

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Background/Summary

TECHNICAL FIELD

(1) The present disclosure relates to an engine system including an aftertreatment system, and more particularly, to a duct for the aftertreatment system and a method of assembling the aftertreatment system.

BACKGROUND

(2) An engine system includes an engine, such as an internal combustion engine, to generate operating power. In order to comply with emission regulation standards, the engine system includes an aftertreatment system that is disposed downstream of the engine. The aftertreatment system may remove and/or control particulate matter that may be present in exhaust gases exiting the engine before the exhaust gases are let into atmosphere. The aftertreatment system typically includes a diesel oxidation catalyst (DOC), a selective catalytic reduction (SCR) module, and a mixing tube disposed between the DOC and the SCR module. Each of the DOC and the SCR module is housed in a canister. To fluidly couple the mixing tube with a corresponding canister of the DOC and the SCR module, the aftertreatment system further includes a pair of ducts. The duct may be coupled with a corresponding canister of the DOC or the SCR module via welding.

(3) In order to weld the duct to the canister, some space/gap is desired between the duct and the canister. However, due to a design of conventional ducts and canisters, the space between the duct

and the canister is minimal. Such a minimal space between the components renders a welding zone between the duct and the canister inaccessible to a weld torch, which may increase assembly efforts and assembly time required to assemble the aftertreatment system.
(4) U.S. Pat. No. 10,577,996 describes an exhaust conduit having a wall with an inner surface that at least partially defines a flow channel, a first fin positioned within the flow channel and attached to the inner surface, a second fin positioned within the flow channel and attached to the inner surface such that the first fin is spaced apart from the second fin. A support strip is attached to the inner surface, attached to the first fin at a first location spaced apart from the inner surface, and attached to the second fin at a second location spaced apart from the inner surface.
SUMMARY OF THE DISCLOSURE
(5) In one aspect of the present disclosure, a duct for an aftertreatment system is provided. The duct includes a body defining a first end and a second end. The duct also includes a flange coupled to the body at the first end of the body. The flange defines an outer edge. The duct further includes a projection coupled to and extending from the flange along a first direction. The projection and the flange lie in a same plane. The projection defines a first side edge and a second side edge that is angularly spaced apart from the first side edge. The duct is adapted to be coupled with a component of the aftertreatment system via each of the outer edge of the flange, the first side edge of the projection, and the second side edge of the projection. The component includes at least one of a diesel oxidation catalyst (DOC) of the aftertreatment system and a selective catalytic reduction (SCR) module of the aftertreatment system.
(6) In one aspect of the present disclosure, an engine system is provided. The engine system includes an engine. The engine system also includes an aftertreatment system adapted to treat exhaust gases exiting the engine. The aftertreatment system includes a diesel oxidation catalyst (DOC) adapted to receive the exhaust gases from the engine. The aftertreatment system also includes a mixing tube in fluid communication with the DOC and adapted to receive the exhaust gases from the DOC. The aftertreatment system further includes a selective catalytic reduction (SCR) module in fluid communication with the mixing tube and adapted to receive the exhaust gases from the mixing tube. The aftertreatment system includes at least one duct. The at least one duct includes a body defining a first end and a second end. The at least one duct includes a flange coupled to the body at the first end of the body. The flange defines an outer edge. The duct further includes a projection coupled to and extending from the flange along a first direction. The projection and the flange lie in a same plane. The projection defines a first side edge and a second side edge that is angularly spaced apart from the first side edge. The duct is adapted to be coupled with a component of the aftertreatment system via each of the outer edge of the flange, the first side edge of the projection, and the second side edge of the projection. The component includes at least one of the DOC and the SCR module of the aftertreatment system.
(7) In another aspect of the present disclosure, a method of assembling an aftertreatment system is provided. The method includes providing a duct of the aftertreatment system. The duct includes a body defining a first end and a second end. The duct also includes a flange coupled to the body at the first end of the body. The flange defines an outer edge. The duct further includes a projection coupled to and extending from the flange along a first direction. The projection and the flange lie in a same plane. The projection defines a first side edge and a second side edge that is angularly spaced apart from the first side edge. The method also includes coupling the duct with a component of the aftertreatment system via each of the outer edge of the flange, the first side edge of the projection, and the second side edge of the projection. The component includes at least one of a diesel oxidation catalyst (DOC) of the aftertreatment system and a selective catalytic reduction (SCR) module of the aftertreatment system.

Description

BRIEF DESCRIPTION OF DRAWINGS

(1) FIG. **1** illustrates a schematic view of an exemplary engine system;
(2) FIG. **2** illustrates a perspective view of an aftertreatment system associated with the engine system of FIG. **1**, according to an embodiment of the present disclosure;
(3) FIG. **3** illustrates a perspective view of a first duct of the aftertreatment system of FIG. **2**, according to an embodiment of the present disclosure;
(4) FIG. **4** illustrates a top view of a portion of the first duct of FIG. **3**;
(5) FIG. **5** illustrates a cross-sectional view of the first duct of FIG. **3**;
(6) FIG. **6** illustrates a perspective view of a second duct of the aftertreatment system of FIG. **2**, according to an embodiment of the present disclosure; and
(7) FIG. **7** illustrates a flowchart for a method of assembling the aftertreatment system, according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

(8) Wherever possible, the same reference numbers will be used throughout the drawings to refer to same or like parts.
(9) FIG. **1** illustrates a schematic view of an exemplary engine system **100**. The engine system **100** may be used in a variety of machines (not shown) including, but not limited to, mobile machines (such as, mining or construction machines), stationary machines, and like. The engine system **100** includes an engine **102**. The engine **102** may be any type of engine, such as, an internal combustion engine, may be of any size, with any number of cylinders, any type of combustion chamber, such as, cylindrical, rotary spark ignition, compression ignition, 4-stroke and 2-stroke, etc., and in any configuration, such as, “V,” in-line, radial, etc.
(10) The engine **102** may include a number of components (not shown), such as, a crankshaft, a fuel system, an inlet manifold, an intake port, an exhaust port, and the like. Further, the engine **102** includes a number of cylinders **104** that define one or more combustion chambers (not shown). Moreover, exhaust gases generated based on combustion of fuels in the combustion chambers is directed towards an exhaust manifold **106** of the engine **102**. The exhaust manifold **106** is in fluid communication with the cylinders **104**. It should be noted that the exhaust gases exiting the engine **102** may include particulate matter, such as, carbon monoxide (CO), ammonia, and oxides of nitrogen (NOx), such as, nitric oxide (NO), nitrous oxide (N.sub.2O), and nitrogen dioxide (NO.sub.2).
(11) The engine system **100** also includes an aftertreatment system **110** to treat the exhaust gases exiting the engine **102**. Specifically, the aftertreatment system **110** may operate to reduce/eliminate a concentration of the particulate matter in the exhaust gases, before the exhaust gases are let into atmosphere. The aftertreatment system **110** is fluidly connected to the exhaust manifold **106** of the engine **102**.
(12) FIG. **2** illustrates a perspective view of the aftertreatment system **110**, according to an embodiment of the present disclosure. In the illustrated embodiment of FIG. **2**, the aftertreatment system **110** includes a diesel oxidation catalyst (DOC) **112**. The aftertreatment system **110** also includes a mixing tube **114**. The aftertreatment system **110** further includes a selective catalytic reduction (SCR) module **116**. In some examples, the aftertreatment system **110** may further include a diesel particulate filter, an ammonia oxidation catalyst, and various temperature, pressure, and exhaust gas constituent sensors, based on application requirements.
(13) The DOC **112** receives the exhaust gases from the engine **102**. The DOC **112** defines an inlet side **120** that is coupled to the exhaust manifold **106** of the engine **102** and an outlet side **122** that is opposite to the inlet side **120**. The exhaust gases coming from the engine **102** flow along the DOC **112** from the inlet side **120** to the outlet side **122** of the DOC **112**. It should be noted that the DOC **112** includes various catalyst materials disposed within a first canister **117**. The catalyst materials may collect, absorb, and/or convert CO and/or NOx present in the exhaust gases. Accordingly, CO

and NOx present in the exhaust gases may get oxidized and may get converted into CO.sub.2 and NO.sub.2.
(14) Further, the mixing tube **114** is in fluid communication with the DOC **112** and receives the exhaust gases from the DOC **112**. The mixing tube **114** includes an inlet side **124** in fluid communication with the outlet side **122** of the DOC **112** to receive the exhaust gases from the DOC **112** and an outlet side **126** that is opposite to the inlet side **124** of the mixing tube **114**. The mixing tube **114** promotes mixing of the exhaust gases with a reductant, for example, diesel exhaust fluid to improve a performance of the aftertreatment system **110**. The aftertreatment system **110** also includes a reductant injector **113** that injects the reductant in the exhaust gases.
(15) Moreover, the SCR module **116** is in fluid communication with the mixing tube **114** and receives the exhaust gases from the mixing tube **114**. Accordingly, the mixing tube **114** is arranged between the DOC **112** and the SCR module **116**. The SCR module **116** includes an inlet side **128** that is in fluid communication with the outlet side **126** of the mixing tube **114** and an outlet side **130** that may be exposed to atmosphere. The SCR module **116** includes one or more catalyst materials disposed within a second canister **118**. The catalyst materials may reduce NOx present in the exhaust gases by converting NOx into nitrogen (N.sub.2) and water (H.sub.2O).
(16) Further, the aftertreatment system **110** includes one or more ducts **132**, **134**. The present disclosure is related to the duct **132**, **134** for the aftertreatment system **110**. The one or more ducts **132** is a first duct **132** that provides fluid communication between the DOC **112** and the mixing tube **114**. The duct **132** will be hereinafter interchangeably referred to as “the first duct **132**”. The one or more ducts **134** is a second duct **134** that provides fluid communication between the mixing tube **114** and the SCR module **116**. The duct **134** will be hereinafter interchangeably referred to as “the second duct **134**”. As shown in FIG. **2**, the first duct **132** fluidly couples the DOC **112** and the mixing tube **114**, while the second duct **134** fluidly couples the SCR module **116** and the mixing tube **114**. It should be noted that the first duct **132** is similar to the second duct **134** in terms of design and dimensions.
(17) Referring to FIG. **3**, a perspective view of the first duct **132** is illustrated. The first duct **132** will now be explained in detail with reference to FIG. **3**. The first duct **132** includes a body **136** defining a first end **138** and a second end **140**. The second end **140** is disposed opposite to the first end **138**. The first duct **132** is coupled to the DOC **112** proximal to the first end **138** of the body **136**. Further, the first duct **132** is coupled to the mixing tube **114** proximal to the second end **140** of the body **136**. Thus, the first end **138** of the body **136** is in fluid communication with the outlet side **122** of the DOC **112** and the second end **140** of the body **136** is in fluid communication with the inlet side **124** of the mixing tube **114**. Further, the first duct **132** is coupled to the mixing tube **114** proximal to the second end **140** of the body **136**, to facilitate flow of the exhaust gases from the DOC **112** towards the mixing tube **114**. In an example, the first duct **132** may be coupled with the mixing tube **114** using coupling elements, such as, mechanical fasteners, mounting brackets, and the like. Moreover, the reductant injector **113** (see FIG. **2**) may be coupled to the body **136**, such that the reductant injector **113** injects the reductant in the exhaust gases while the exhaust gases flow through the first duct **132**.
(18) The body **136** of the first duct **132** has an elbow shape. Further, the body **136** defines a flow passage **142** extending from the first end **138** to the second end **140** to facilitate flow of the exhaust gases through the body **136**. An inlet opening (not shown) is defined at the first end **138** and an outlet opening **141** is defined at the second end **140**. The outlet opening **141** facilitates an exit of the exhaust gases from the first duct **132**.
(19) The first duct **132** is coupled with a component **112** via a welded joint. The component **112** includes the DOC **112** herein. The DOC **112** may be hereinafter interchangeably referred to as “the component **112**”. Specifically, the first end **138** of the first duct **132** is coupled to the first canister **117** of the DOC **112** via the welded joint.
(20) The first duct **132** also includes a flange **144** coupled to the body **136** at the first end **138** of the

body **136**. The flange **144** defines an outer edge **146**. As such, the flange **144** and the outer edge **146** extend along a circumference of the body **136** at the first end **138**. The first duct **132** further includes a projection **148** coupled to and extending from the flange **144** along the first direction D1. The flange **144** and the projection **148** lie in a same plane.

(21) As shown in FIG. **4**, the projection **148** defines a length L1 orthogonal to the first direction D1 and a width W1 along the first direction D1. In some examples, the length L1 lies in a range of 40 millimeters (mm) to 100 mm and the width W1 lies in a range of 20 mm to 60 mm. Referring now to FIG. **5**, the projection **148** also defines a thickness T1 orthogonal to the first direction D1. In some examples, the thickness T1 lies in a range of 3 mm and 6 mm.

(22) Referring again to FIG. **4**, the projection **148** defines a first side edge **152** and a second side edge **154** that is angularly spaced apart from the first side edge **152**. The first duct **132** is coupled to the component **112** of the aftertreatment system **110** via each of the outer edge **146** of the flange **144**, the first side edge **152** of the projection **148**, and the second side edge **154** of the projection **148**. Further, each of the first side edge **152** and the second side edge **154** has a curved shape. As apparent from FIG. **4**, the projection **148** is shaped like a beak. In some examples, the first side edge **152** and the second side edge **154** may be spaced apart from each other by an angle A1 that lies in a range of 60 degrees to 120 degrees.

(23) The first side edge **152** defines a first radius of curvature R1. Further, the second side edge **154** defines a second radius of curvature R2. In the illustrated embodiment of FIG. **4**, the first radius of curvature R1 is same as the second radius of curvature R2. In some examples, the first radius of curvature R1 and the second radius of curvature R2 lie in a range of 50 mm to 150 mm. It should be noted that the ranges for the length L1, the width W1, the thickness T1 (see FIG. **5**), the first radius of curvature R1, and the second radius of curvature R2 provided herein are exemplary in nature, and the values of the length L1, the width W1, the thickness T1, the first radius of curvature R1, and the second radius of curvature R2 may vary based on a size of the first duct **132**.

(24) As shown in FIG. **4**, the projection **148** further includes a third side edge **156** extending between the first side edge **152** and the second side edge **154**. The third side edge **156** has a linear profile. The first duct **132** is further coupled with the component **112** via the third side edge **156** of the projection **148**.

(25) The projection **148** further includes a first arcuate portion **162** extending between the first side edge **152** and the outer edge **146** of the flange **144**. The first duct **132** is further coupled with the component **112** via the first arcuate portion **162**. Further, the projection **148** includes a second arcuate portion **164** extending between the second side edge **154** and the outer edge **146** of the flange **144**. The first duct **132** is further coupled with the component **112** via the second arcuate portion **164**. Each of the first arcuate portion **162** and the second arcuate portion **164** defines a third radius of curvature R3. In some examples, the third radius of curvature R3 lies in a range of 10 mm to 30 mm, without any limitations. The body **136**, the flange **144**, and the projection **148** of the first duct **132** are integral with each other. Further, the first duct **132** may be made of a metal or an alloy. In an example, the first duct **132** may be manufactured by a casting process.

(26) Referring now to FIG. **6**, a perspective view of the second duct **134** is illustrated. The second duct **134** will now be explained with reference to FIG. **6**. The second duct **134** is substantially similar to the first duct **132** in terms of design and dimensions, with common components being referred to by the same numerals. The second duct **134** includes the body **136** defining the first end **138** and the second end **140**. The second duct **134** is coupled to the SCR module **116** proximal to the first end **138** of the body **136**. Further, the second duct **134** is coupled to the mixing tube **114** proximal to the second end **140** of the body **136**. The duct **132** is coupled to the mixing tube **114** proximal to the second end **140** of the body **136**, to facilitate flow of the exhaust gases from the mixing tube **114** towards the SCR module **116**. In an example, the second duct **134** may be coupled with the mixing tube **114** using coupling elements, such as, mechanical fasteners, mounting brackets, and the like.

(27) The second duct **134** is coupled with a component **116** via a welded joint. The component **116** includes the SCR module **116** herein. The SCR module **116** may be hereinafter interchangeably referred to as “the component **116**”. Specifically, the first end **138** of the second duct **134** is coupled to the second canister **118** of the SCR module **116** via the welded joint.
(28) The second duct **134** also includes the flange **144** coupled to the body **136** at the first end **138** of the body **136**. The flange **144** defines the outer edge **146**. The second duct **134** further includes the projection **148** coupled to and extending from the flange **144** along the first direction D1. The flange **144** and the projection **148** lies in the same plane. The projection **148** defines the first side edge **152** and the second side edge **154** that is angularly spaced apart from the first side edge **152**. The second duct **134** is coupled to the component **116** of the aftertreatment system **110** via each of the outer edge **146** of the flange **144**, the first side edge **152** of the projection **148**, and the second side edge **154** of the projection **148**.
(29) The projection **148** further includes the third side edge (not shown in FIG. **6**) which is same as the third side edge **156** shown in FIG. **4**. The projection **148** further includes a first arcuate portion (not shown in FIG. **6**) which is same as the first arcuate portion **162** shown in FIG. **4**. Further, the projection **148** includes a second arcuate portion (not shown in FIG. **6**) which is same as the second arcuate portion **164** shown in FIG. **4**. The body **136**, the flange **144**, and the projection **148** of the second duct **134** are integral with each other. Further, the second duct **134** may be made of a metal or an alloy. In an example, the second duct **134** may be manufactured by a casting process.
(30) It is to be understood that individual features shown or described for one embodiment may be combined with individual features shown or described for another embodiment. The above described implementation does not in any way limit the scope of the present disclosure. Therefore, it is to be understood although some features are shown or described to illustrate the use of the present disclosure in the context of functional segments, such features may be omitted from the scope of the present disclosure without departing from the spirit of the present disclosure as defined in the appended claims.
INDUSTRIAL APPLICABILITY
(31) The present disclosure relates to the duct **132**, **134** for the aftertreatment system **110** and a method **700** of assembling the aftertreatment system **110**. The duct **132**, **134** includes the projection **148**. The projection **148** is shaped like a beak that improves weld torch accessibility in a welding zone between the duct **132**, **134** and the first and second canister **117**, **118**, respectively, which may improve a welding process of the duct **132**, **134** with the first and second canister **117**, **118**, respectively. Further, the first side edge **152**, the second side edge **154**, the first arcuate portion **162**, and the second arcuate portion **164** are embodied as curved surfaces that may simplify welding of the duct **132**, **134** with the first and second canister **117**, **118**, respectively.
(32) The ducts **132**, **134** described herein may reduce an assembly time of the aftertreatment system **110** and may improve assembly line productivity. Further, the ducts **132**, **134** may also reduce assembly efforts, by simplifying an assembly process of the duct **132**, **134** with the first and second canister **117**, **118**, respectively. Furthermore, the projection **148** provides a cost effective solution of improving weld torch accessibility without modifying a design of the body **136** of the ducts **132**, **134**.
(33) FIG. **7** illustrates a flowchart for the method **700** of assembling the aftertreatment system **110**. At step **702**, the duct **132**, **134** of the aftertreatment system **110** is provided. The duct **132**, **134** includes the body **136** defining the first end **138** and the second end **140**. The duct **132**, **134** also includes the flange **144** coupled to the body **136** at the first end **138** of the body **136**. The flange **144** defines the outer edge **146**. The duct **132**, **134** further includes the projection **148** coupled to and extending from the flange **144** along the first direction D1. The projection **148** and the flange **144** lie in the same plane. The projection **148** defines the first side edge **152** and the second side edge **154** that is angularly spaced apart from the first side edge **152**.
(34) At step **704**, the duct **132**, **134** is coupled with the component **112**, **116** of the aftertreatment

system **110** via each of the outer edge **146** of the flange **144**, the first side edge **152** of the projection **148**, and the second side edge **154** of the projection **148**. The component **112**, **116** includes the DOC **112** of the aftertreatment system **110** or the SCR module **116** of the aftertreatment system **110**. The step **704** further includes welding the duct **132**, **134** with the component **112**, **116**.

(35) The projection **148** further includes the third side edge **156** extending between the first side edge **152** and the second side edge **154**. The third side edge **156** has the linear profile. The step **704** further includes coupling the duct **132**, **134** with the component **112**, **116** via the third side edge **156**.

(36) The projection **148** further includes the first arcuate portion **162** extending between the first side edge **152** and the outer edge **146** of the flange **144**. The projection **148** further includes the second arcuate portion **164** extending between the second side edge **154** and the outer edge **146** of the flange **144**. The step **704** further includes coupling the duct **132**, **134** with the component **112**, **116** via the first arcuate portion **162**. The step **704** further includes coupling the duct **132**, **134** with the component **112**, **116** via the second arcuate portion **164**.

(37) The aftertreatment system **110** includes the mixing tube **114**. The method **700** further includes a step at which the duct **132**, **134** is coupled with the mixing tube **114** proximal to the second end **140** of the body **136**.

(38) While aspects of the present disclosure have been particularly shown and described with reference to the embodiments above, it will be understood by those skilled in the art that various additional embodiments may be contemplated by the modification of the disclosed machines, systems and methods without departing from the spirit and scope of what is disclosed. Such embodiments should be understood to fall within the scope of the present disclosure as determined based upon the claims and any equivalents thereof.

Claims

1. A duct for an aftertreatment system, the duct comprising: a body defining a first end and a second end; a flange coupled to the body at the first end of the body, wherein the flange defines an outer edge; and a projection shaped like a beak, the projection coupled to and extending from the flange along a first direction in a welding zone, wherein the projection and the flange lie in a same plane, wherein the projection defines a first side edge and a second side edge that is angularly spaced apart from the first side edge, wherein the duct is adapted to be coupled with a component of the aftertreatment system via each of the outer edge of the flange, the first side edge of the projection, and the second side edge of the projection, and wherein the component includes at least one of a diesel oxidation catalyst (DOC) of the aftertreatment system and a selective catalytic reduction (SCR) module of the aftertreatment system.
2. The duct of claim 1, wherein the projection further includes a third side edge extending between the first side edge and the second side edge, wherein the third side edge has a linear profile, and wherein the duct is further coupled with the component via the third side edge.
3. The duct of claim 1, wherein the first side edge defines a first radius of curvature, wherein the second side edge defines a second radius of curvature, and wherein the first radius of curvature is same as the second radius of curvature.
4. The duct of claim 1, wherein the projection further includes: a first arcuate portion extending between the first side edge and the outer edge of the flange, wherein the duct is further coupled with the component via the first arcuate portion; and a second arcuate portion extending between the second side edge and the outer edge of the flange, wherein the duct is further coupled with the component via the second arcuate portion.
5. The duct of claim 1, wherein the body of the duct has an elbow shape.
6. The duct of claim 1, wherein the aftertreatment system includes a mixing tube, and wherein the

duct is adapted to be coupled to the mixing tube proximal to the second end of the body.
7. The duct of claim 1, wherein the duct is coupled with the component via a welded joint.
8. An engine system comprising: an engine; and an aftertreatment system adapted to treat exhaust gases exiting the engine, the aftertreatment system including: a diesel oxidation catalyst (DOC) adapted to receive the exhaust gases from the engine; a mixing tube in fluid communication with the DOC and adapted to receive the exhaust gases from the DOC; a selective catalytic reduction (SCR) module in fluid communication with the mixing tube and adapted to receive the exhaust gases from the mixing tube; and at least one duct including: a body defining a first end and a second end; a flange coupled to the body at the first end of the body, wherein the flange defines an outer edge; and a projection shaped like a beak, the projection coupled to and extending from the flange along a first direction in a welding zone, wherein the projection and the flange lie in a same plane, wherein the projection defines a first side edge and a second side edge that is angularly spaced apart from the first side edge, wherein the at least one duct is coupled with a component of the aftertreatment system via each of the outer edge of the flange, the first side edge of the projection, and the second side edge of the projection, and wherein the component includes at least one of the DOC and the SCR module of the aftertreatment system.
9. The engine system of claim 8, wherein the projection further includes a third side edge extending between the first side edge and the second side edge, wherein the third side edge has a linear profile, and wherein the at least one duct is further coupled with the component via the third side edge.
10. The engine system of claim 8, wherein the first side edge defines a first radius of curvature, wherein the second side edge defines a second radius of curvature, and wherein the first radius of curvature is same as the second radius of curvature.
11. The engine system of claim 8, wherein the projection further includes: a first arcuate portion extending between the first side edge and the outer edge of the flange, wherein the at least one duct is further coupled with the component via the first arcuate portion; and a second arcuate portion extending between the second side edge and the outer edge of the flange, wherein the at least one duct is further coupled with the component via the second arcuate portion.
12. The engine system of claim 8, wherein the body of the at least one duct has an elbow shape.
13. The engine system of claim 8, wherein the at least one duct is coupled with the component via a welded joint.
14. The engine system of claim 8, wherein the at least one duct is a first duct that provides fluid communication between the DOC and the mixing tube, wherein the first duct is coupled to the DOC proximal to the first end of the body, and wherein the first duct is coupled to the mixing tube proximal to the second end of the body.
15. The engine system of claim 8, wherein the at least one duct is a second duct that provides fluid communication between the mixing tube and the SCR module, wherein the second duct is coupled to the SCR module proximal to the first end of the body, and wherein the second duct is coupled to the mixing tube proximal to the second end of the body.
16. A method of assembling an aftertreatment system, the method comprising: providing a duct of the aftertreatment system, the duct including: a body defining a first end and a second end; a flange coupled to the body at the first end of the body, wherein the flange defines an outer edge; and a projection shaped like a beak, the projection coupled to and extending from the flange along a first direction in a welding zone, wherein the projection and the flange lie in a same plane, and wherein the projection defines a first side edge and a second side edge that is angularly spaced apart from the first side edge; and coupling the duct with a component of the aftertreatment system via each of the outer edge of the flange, the first side edge of the projection, and the second side edge of the projection, wherein the component includes at least one of a diesel oxidation catalyst (DOC) of the aftertreatment system and a selective catalytic reduction (SCR) module of the aftertreatment system.

17. The method of claim 16, wherein the projection further includes a third side edge extending between the first side edge and the second side edge, wherein the third side edge has a linear profile, and wherein the step of coupling the duct with the component further includes coupling the duct with the component via the third side edge.
18. The method of claim 16, wherein the projection further includes a first arcuate portion extending between the first side edge and the outer edge of the flange, wherein the projection further includes a second arcuate portion extending between the second side edge and the outer edge of the flange, and wherein the step of coupling the duct with the component further includes: coupling the duct with the component via the first arcuate portion; and coupling the duct with the component via the second arcuate portion.
19. The method of claim 16, wherein the aftertreatment system includes a mixing tube, the method further comprising coupling the duct with the mixing tube proximal to the second end of the body.
20. The method of claim 16, wherein the step of coupling the duct with the component further includes welding the duct with the component.