

DEVELOPMENT OF A BUTT JOINTED THERMOPLASTIC STIFFENED SKIN CONCEPT

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ABSTRACT

A novel thermoplastic skin concept, with co-consolidated stringers, is being brought to technology readiness level (TRL) 6. This implies manufacturing and mechanical testing of full scale demonstrator products. The stringers are T-shaped and made of flat preforms that are butt jointed to each other and to the panel skin. An injection molded filler increases strength. The skin is fiber placed over the stringer preforms and the product is co-consolidated at melt temperature. Because of the butt-joints, manufacturing is relatively simple. The result is a tough thermoplastic product that can compete on weight and cost with state-of-the-art thermoset composite panels. Development and testing of the panel concept is being done in a step-by-step process. Consecutive building blocks are: coupons, three-stringer subcomponent panels and finally full scale skin panels. The main panel represents the mid-section of a business jet horizontal tail. The panel will be assembled into a 12 meter span torsion box and tested in the second half of 2011.

1. INTRODUCTION

1.1 General

Since first appearing on the market in the 1980's, high-end thermoplastic composites have held promise for aircraft structure. High toughness and unique processing possibilities, such as press-forming and welding, have fueled this promise. Through the years, a growing amount of applications has appeared a.o. with OEM's such as Airbus, Boeing and Gulfstream. Missing to date has been the step to truly large primary structure components. This step is currently being made through a dedicated effort. This paper explains the development process towards this type of structure and in particular an ongoing process to obtain a certifiable large thermoplastic composite skin with butt-joined stiffeners.

1.2 Current thermoplastic composite applications

As a result of nearly two decades of development, a growing number of products is currently manufactured and designed in thermoplastic composites. As a good example of the processing advantages of thermoplastics, large numbers of ribs and stiffeners are manufactured with the press-forming process. On the new 787 and Airbus A350, the extensive use of composites for fuselage has prompted the creation of large numbers of brackets, clips and cleats in thermoplastic. Figure 1 shows a press-formed stiffener by Dutch specialist manufacturer DTC.