

TECHNOLOGY OF MANUFACTURING FLANGES FROM COMPOSITION MATERIALS FOR CONSTRUCTIONS OF TYPE COCOON

The article is devoted to the development of technology for manufacturing flanges of the carbon fiber plastic tank for cryogenic fuel components. The results of the development of tooling and development of manufacturing technology flange. Presents the results of the work done on the example of the manufacture of an experienced flange design. [dx.doi.org/10.29010/085.4]

Keywords: carbon fiber; flange; fuel tank; tooling; layout; PCM manufacturing technology.

Introduction

Currently, the use of tanks and cylinders of non-metallic materials is widespread. The use of non-metallic materials in rocket and space technology is especially relevant. their use in the construction of tanks and hulls of rocket engines of solid fuel (solid propellant rocket motors) [1] can significantly reduce the weight of the structure. However, to make connections of such structures with return lines, aggregates, etc., it is inevitable that it is necessary to use metal embedded elements. As a rule, for the “cocoon” type structures,

embedded metal flanges are used [3], the typical design of the flanges is shown in Figure 1. The use of such elements can significantly increase the mass of the structure (sometimes more than 70%), especially for small-sized ones, where the structure of the embedded flange is not due to strength, and structural limitations (depth of threaded holes, development of surfaces for sealing elements, etc.)

At the moment, in the state-owned enterprise “Yuzhnoye” Design Office, work is underway to design and manufacture an experimental design of a cryogenic carbon-fiber fuel tank. Since the tank is supposed to be used in a wide range of temperatures, the choice of the material of the embedded flange is a very difficult issue. As is well known, the CTE of carbon fiber is an order of magnitude lower than the CTE of the metal [2], therefore the use of a metal flange in such a design can lead to additional temperature stresses and deformations, which as a result can lead to loss of tightness of the power shell-flange connection. Therefore, it was decided to work out the issue of manufacturing a carbon-fiber-based carbon fiber flange. The design of the carbon fiber flange is shown in Figure 2.

For the manufacture of the flange was chosen manufacturing techniques – manual display, followed by pressing in a rigid form. For which a special mold was developed (Figure 3). The mold consists of a die and a punch. The matrix has a complex shaped surface corresponding to the outer flange circumference. The punch has a reciprocal inner surface of the flange. The punch and the die are

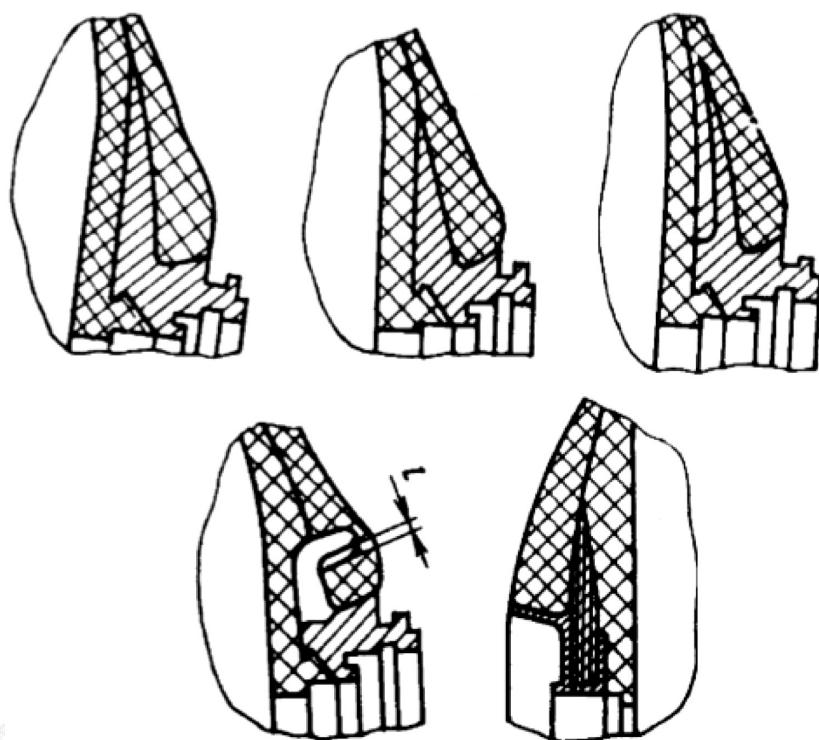


Fig. 1. Typical flange design

assembled together by means of bolts, and by tightening the bolts, the necessary contact pressure of the blank is provided.

The flange manufacturing technology consists of the following steps:

- carbon fabric impregnation (Figure 4);
- Cutting fabric into blanks according to templates (Figure 5);
- laying out cut blanks on the surface of the matrix according to a given pattern;
- assembly of the die and the punch, tightening of the bolts, ensuring the specified contact pressure;
- curing the flange blank;
- machining (Figure 6);
- insert embedded elements.

After the flange blank is cured, it is necessary to conduct its machining, which consists in removing the burr of fabric and the binder along the outer diameter of the pen.

Since The flange material, laminated carbon fiber and direct threading is not possible, then through holes were inserted into the flange to ensure the connection of the flange with the lid and test equipment, which were then glued to the embedded elements (Figure 7).

Thus, the developed design of the flange can significantly reduce the weight of the structure and ensures

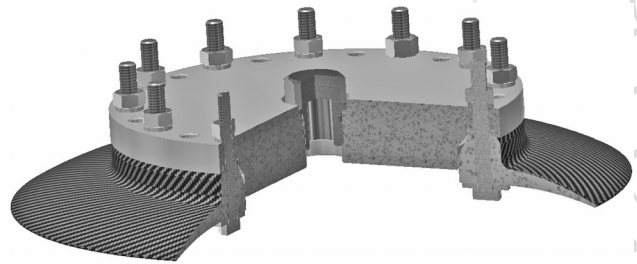


Fig. 2. 3D-model of the flange of the fuel tank



Fig. 3. Mold for flange manufacturing



Fig. 4. Carbon fabric impregnation

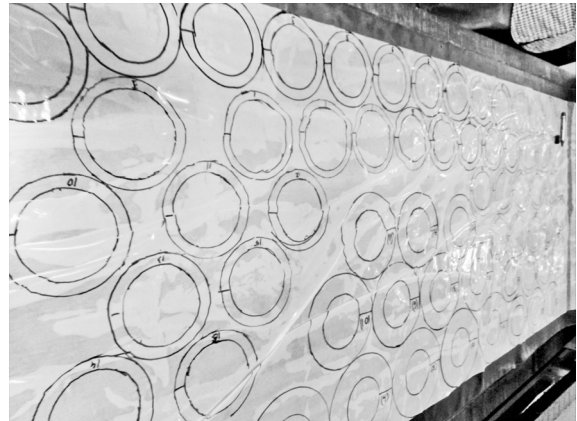


Fig. 5. Cutting carbon fabric



Fig. 6. Mechanical processing of the workpiece

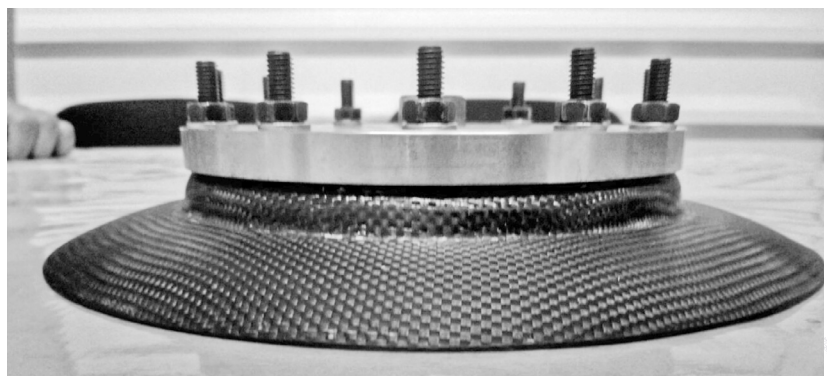


Fig. 7. Flange with cover

the joint operation of the flange-power shell connection in a wide temperature range. In the future, the carbon fiber flange will be used in the manufacture of a cryogenic fuel tank.

References

- [1] Bulanov I.M., Vorobey V.V. Tekhnologiya raketnykh i aerokosmicheskikh konstruksiy iz kompozitsionnykh materialov [Tekst]: ucheb. dlya vuzov / I.M. Bulanov, V.V. Vorobey. – M.: Izd-vo MGTU im. N.E. Baulana, 1998 g. – 516 s.
- [2] Gagauz P.M., Gagauz F.M., Karpov YA.S., Krivenda S.P. Proyektirovaniye i konstruirovaniye izdeliy iz kompozitsionnykh materialov. Teoriya i praktika: uchebnik / P.M.Gagauz, F.M.Gagauz, YA.S.Karpov, S.P.Krivenda; pod.obshch.red. YA.S.Karpova – KH.: Nats. aerokosm. un-t im. N.Ye.Zhukovskogo, 2015 – 672 s.
- [3] Sanin F.P., Kuchma L.D., Dzhur Ye.A, Sanin A.F. Tverdotoplivnyye raketnyye dvigateli. Materialy i tekhnologii [Tekst] : ucheb. posobiye / F.P. Sanin, L.D. Kuchma, Ye.A. Dzhur, A.F. Sanin. – Dnepropetrovsk: Izd-vo Dnepropetr. un-ta, 1999. – 320 s.

УДК 620.22:621.454.2

Шилин С. А., Литот А. В.

Государственное предприятие «Конструкторское бюро “Южное” им. М. К. Янгеля». Украина, г. Днепр

ТЕХНОЛОГИЯ ИЗГОТОВЛЕНИЯ ФЛАНЦЕВ ИЗ КОМПОЗИЦИОННЫХ МАТЕРИАЛОВ ДЛЯ КОНСТРУКЦИЙ ТИПА КОКОН

Статья посвящена разработке технологии изготовления фланцев топливного бака из углепластика для криогенных компонентов топлива. Приведены результаты разработки технологической оснастки и отработки технологии изготовления фланца. Представлены результаты проделанной работы на примере изготовления опытной конструкции фланца. [dx.doi.org/10.29010/085.4]

Ключевые слова: углепластик; фланец; топливный бак; оснастка; выкладка; технология изготовления ПКМ.

Литература

- [1] Буланов И.М., Воробей В.В. Технология ракетных и аэрокосмических конструкций из композиционных материалов [Текст]: учеб. для вузов / И.М. Буланов, В.В. Воробей. – М.: Изд-во МГТУ им. Н.Э. Баулана, 1998 г. – 516 с.
- [2] Гагауз П.М., Гагауз Ф.М., Карпов Я.С., Кривенда С.П. Проектирование и конструирование изделий из композиционных материалов. Теория и практика: учебник / П.М.Гагауз, Ф.М.Гагауз, Я.С.Карпов, С.П.Кривенда; под.общ.ред. Я.С.Карпова – Х.: Нац. аэрокосм. ун-т им. Н.Е.Жуковского, 2015 – 672 с.
- [3] Санин Ф.П., Кучма Л.Д., Джур Е.А, Санин А.Ф. Твердотопливные ракетные двигатели. Материалы и технологии [Текст] : учеб. пособие / Ф.П. Санин, Л.Д. Кучма, Е.А. Джур, А.Ф. Санин. – Днепропетровск: Изд-во Днепропетр. ун-та, 1999. – 320 с.