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DESIGN FEATURES OF PROTECTIVE CLOTHING FOR MILITARY PILOTS

Abstract: The article deals with the problem of design and development of modern protective clothing for military aircraft pilots of the Armed Forces of Ukraine by expanding the information base of design and technological solutions. Completeness and purpose of protective equipment for aircraft team are established and analysed. The range of existing protective clothing produced by the leading world and Ukrainian manufacturers is systemized. The information concerning the design and technological solutions is studied and summarized, the features of design and manufacturing of these products is described, the classification of their elements based on different characteristics is developed.

Keywords: military aircraft pilots, flight apparel, protective clothing, military, equipment.

I. Introduction.

Currently, the flight and technical apparel for pilots (FTA) of domestic production does not fully protect pilots from all types of danger and requires the development of new design and technological solutions and the selection of modern materials.

There are a limited number of publications on types, structural and technological peculiarities of protective clothing for the military. At the same time, there is no system data base for component elements and their purpose, which can be used in designing and manufacturing products.

The basis for further research is the scientific works and researches by Kolosnichenko M.V., Tretiakova L.D. and other specialists devoted to the scientific and theoretical basis for the creation of military and protective clothing [2-5].

The purpose of this research is to study, analyze and classify varieties of flight and technical apparel in order to improve the process of its design.

II. Statement of the problem.

Air Forces of Ukraine is one of the main carriers of the military potential of the Ukrainian Armed Forces.

This highly maneuverable armed force is aimed, jointly with the Air Defense Forces, for protecting the airspace of the state, damaging the enemy's objects from the airspace, aviation support for domestic forces, airborne landing, air transportation of material assets and air reconnaissance.

In accordance with Order No. 232 of April 29, 2016, of the Ministry of Defense of Ukraine "On the Provision of Servicemen of the Armed Forces of Ukraine" norms No. 13 "The provision of the aircrew of the Armed Forces of Ukraine with flight apparel" were approved, according to which a protective suit (jacket and trousers) is used [1].

The development of functional protective clothing for pilots is an urgent scientific and technical task that involves providing the military with a modern assortment of reliable, ergonomic, aesthetic sewing products in demand.

III. Results.

The history of pilots`s apparel is connected with development of aviation and aeronautics. Until now, flight apparel continues to be refined, taking into account modern requirements, in particular due to the emergence of new materials and

technologies. Thus, in aviation, a reasonable choice of parts, units of products, completeness of pilot`s clothes, crew members and ground personnel is necessary and sufficient.

The protective equipment of the aircrew is intended for:

protection against adverse factors of flight and the environment in different climate-geographic regions;

creation, together with other on-board and ground-based means of ensuring the vital functions, of the necessary conditions for the crews to perform their duties at all stages of the flight and on the ground;

salvage in emergency situations during the evacuation on land;

survival during autonomous stay in a deserted area [3].

Depending on the intended purpose, the protective equipment of a flight crew is classified into (Fig. 1):

high-altitude (oxygen masks, high-altitude compensating suits with socks and gloves, sealed helmets);

antigravity (anti-G suits, anti-G devices);

waterproof (marine life-saving kits, swimming bats, vests);

anti-shock (protective helmets, body armor);

temperature effects protective (seasonal flight clothing, footwear, gloves, hats, ventilation apparel).

It should be noted that equipment designed to protect military air force pilots from harmful environmental influences and ensure the safety of work is produced according to established norms and is issued for use only to those servicemen of state aviation, whose work relates to the operation, maintenance and repair of weapons, military, special equipment and aviation equipment and is divided into flight and technical apparel (FTA) and high-altitude equipment [6].

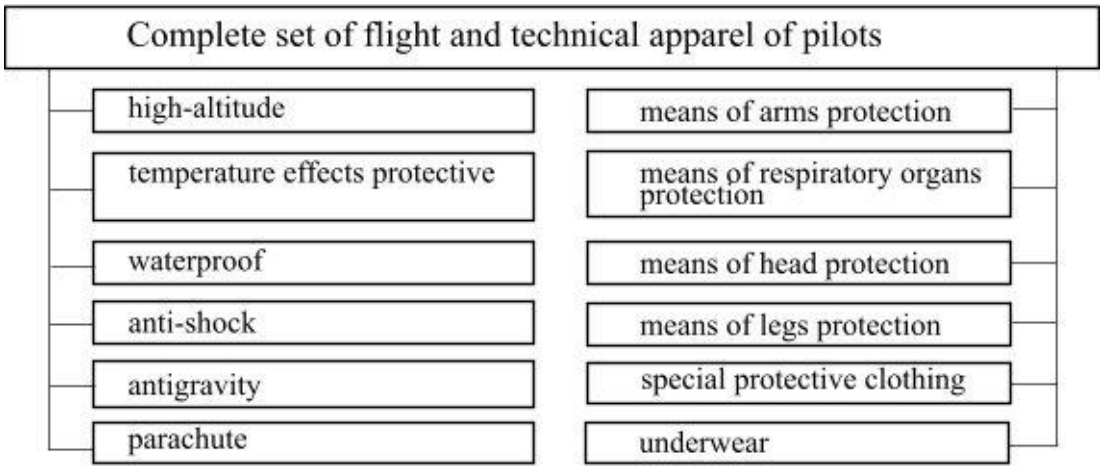

Figure 1 – Classification of types of flight and technical apparel

Flight and technical apparel includes not only special protective suits, but also high-altitude equipment. The Air Forces Command is looking for solutions to the problems of providing flight and technical apparel and high-altitude equipment, because Ukraine does not have enterprises that have a full cycle of its production. Until now, the equipment from the legacy of the Soviet era is used.

Today, modern apparel for the flight technicians is being actively developed. It must fully satisfy the requirements of Ukrainian pilots based on the realities of daily service and the conditions of combat and search and rescue operations [7].

Designing protective clothing for military pilots is a difficult task which is based on the research of working conditions and is a prerequisite for developing requirements and nomenclature of quality indicators; carrying out theoretical and experimental researches for the purpose of scientifically grounded selection and formation of rational packages of materials for manufacturing. The main component of the apparel design process is the creation of structural and technological solutions that will provide a sufficient level of protection and minimum weight, provided the maximum strength of ergonomic products.

In the course of the analysis it was established that the flight and technical apparel for military aviation pilots has a multi-layered structure of the package and consists of three layers: underwear, protective clothing and high-altitude equipment in the warm season.

Among the range of existing clothing on the market of domestic manufacturers a variety of apparel kits is presented, which most often consist of jackets and trousers. It was found out that overalls are the most demanded among foreign manufacturers.

They ensure a high level of protection and satisfaction of demands, as they are more ergonomic (they do not restrict freedom of movement, are quickly and conveniently removed and dressed). Characteristics of design and technological solutions for protective clothing for military aircraft pilots are shown in Fig. 2.

The main purpose of flight overalls is to provide life support of the pilot in the conditions of flight, including in the event of overloads, emergency depressurization, as well as salvage and survival after the evacuation from the aircraft. It should be noted that the overalls should fully comply with the completeness of the flight equipment, which depends on the altitude of the aircraft.

In the process of protective clothing designing, one of the main tasks is to ensure the speed and convenience of dressing and removing. Therefore, it is necessary to provide means of connection and elements that provide full disclosure and do not restrict movements (Fig. 3).

Ensuring the adaptation of the design to the morphological features of the pilot's body is carried out by adjusting the length and width of the product at the expense of the structural and decorative elements placed along the waist, bottom of the sleeve and trousers (Fig. 4, 5, 6).

In order to ensure a comfortable climate of the space under the clothing, ventilation openings that can be located in leg seams, in underarm, and in a seam of back yoke are designed in protective clothing (Fig. 7).

Additional overlays in the areas of the most intensive wear - the area of the elbow and knee joints, the upper parts of the rear half provide longer life of the product and allow maintaining a stable size and shape during the specified lifetime. The ergonomics of the product is ensured by the volume of the overlays, which is achieved through the gores and folds (Fig. 8).

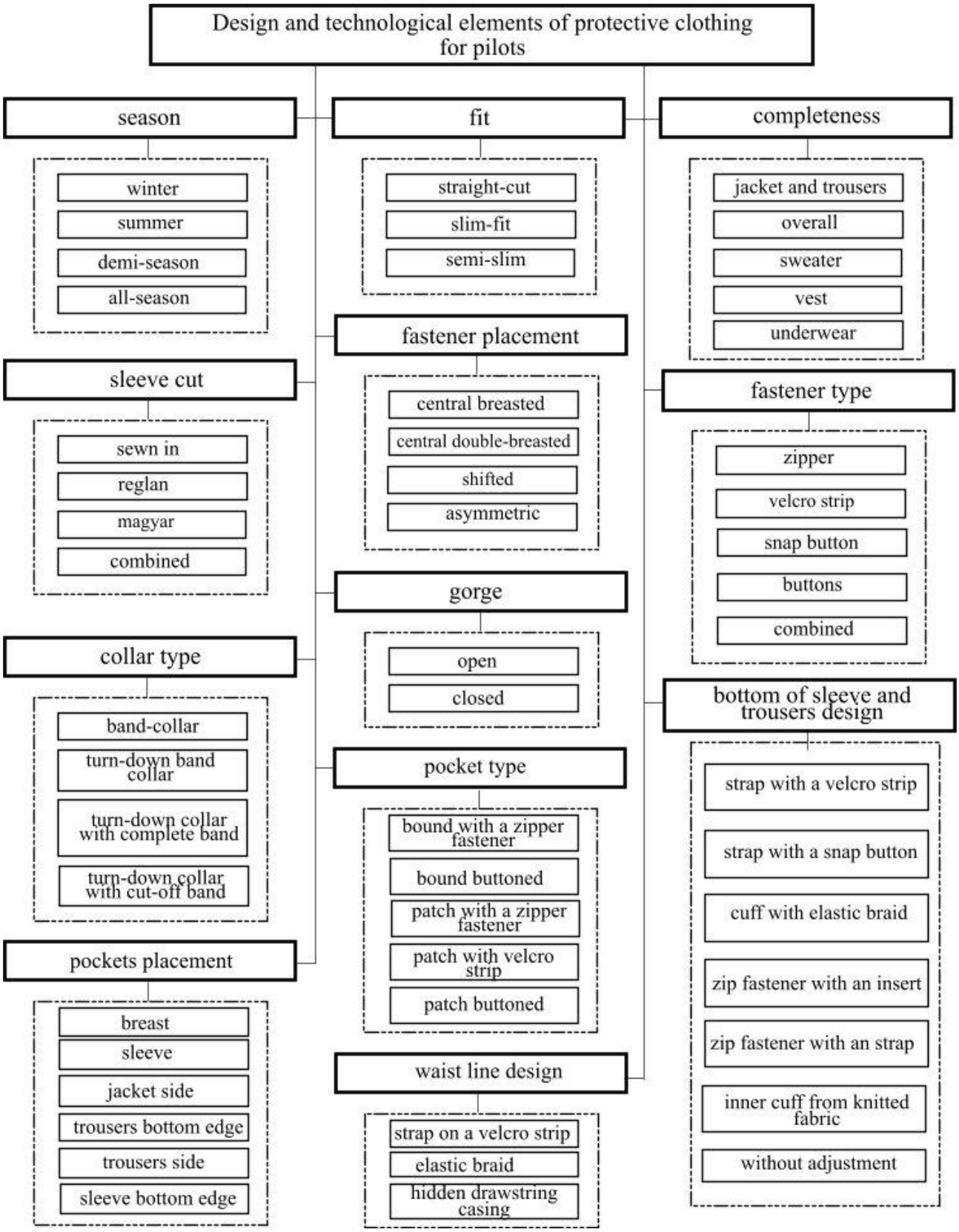

Figure 2 – Characteristics of design and technological solutions for protective clothing for military aircraft pilots

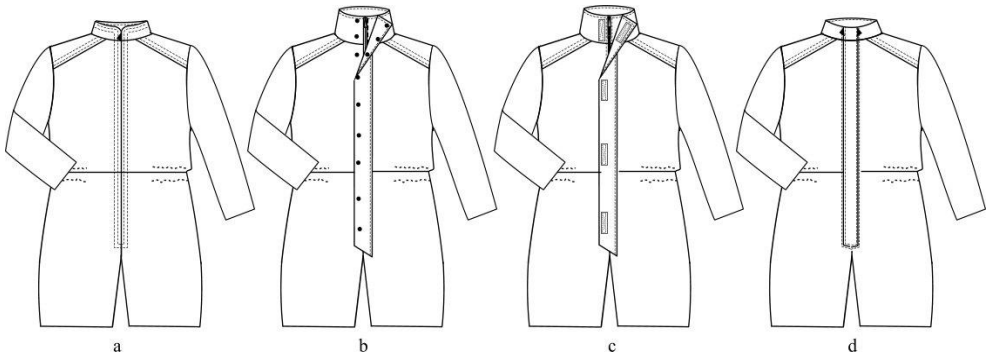

Figure 3 – Varieties of fasteners types: a - zipper;
b - zipper with a button placket; c - a zipper with a velcro strip; d - double-breasted zipper

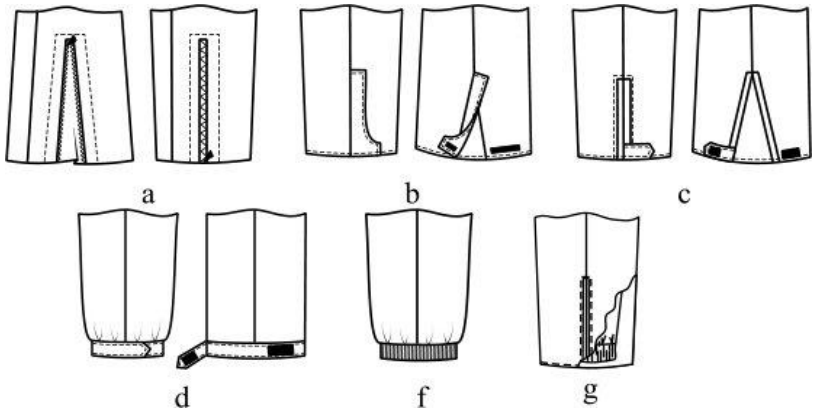

Figure 4 - Varieties of the bottom of the trousers adjustment: a - zip fastener with an insert; b - a Velcro strip with an insert; c - a strap on a velcro strip with an insert; d - a cuff with a strap on a velcro strip with an insert; f – a cuff with elastic braid; g – inner cuff from knitted fabric

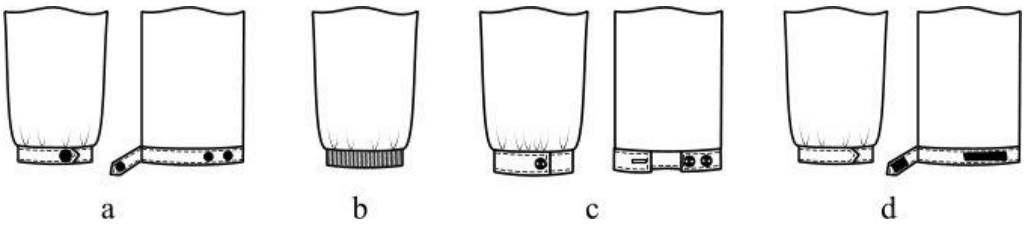

Figure 5 – Varieties of the bottom of a sleeve adjustment: a – a cuff with a strap on a snap button; b – a cuff with elastic braid; c – a cuff with buttons and buttonholes;
d – a cuff with a strap on a Velcro strip

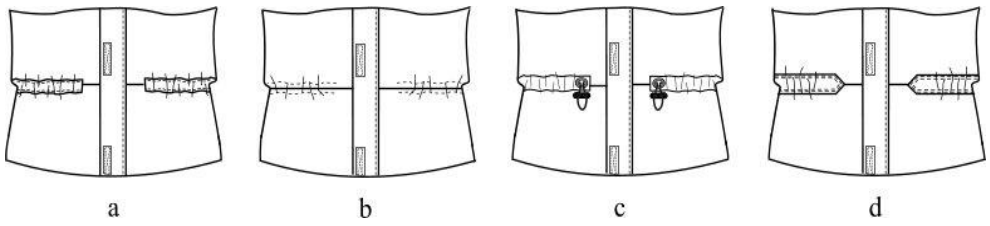

Figure 6 – Varieties of adjustment along the waist: a – a belt with elastic braid; b – hidden drawstring casing; c – a belt with drawstring casing; d – strap with elastic braid on a Velcro strip

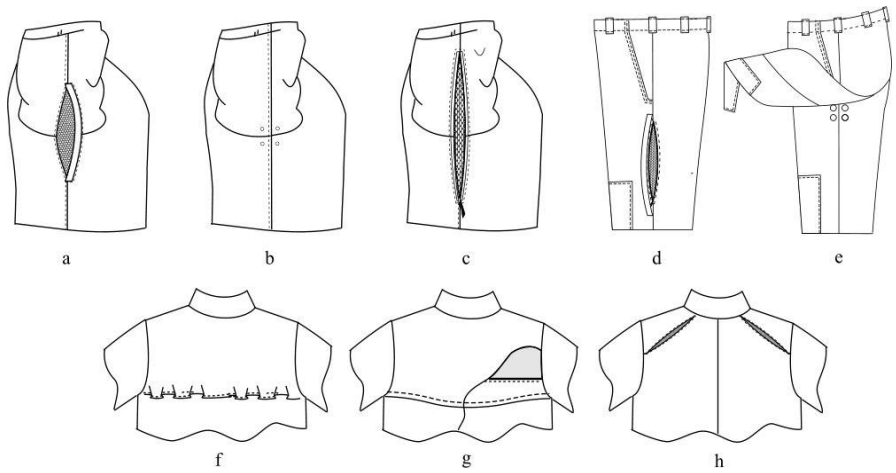

Figure 7 – Types of ventilation openings: a – underarm gore with textile net; b – underarm cut-through openings; c – in a sleeve-side seam with a zip fastener and a textile net; d - in the side seam of trousers with a gore and a textile net; e - in a leg seam with cut-through openings; f – storm flap; g - storm flap with a net; h - in back yoke with a net;

To increase the functionality of the overalls bound or patch pockets are designed, which must have a fly or a zipper to prevent the loss of things. Different documents, route maps, etc. are stored in the breast pockets. On the right leg, a patch pocket for the radio station and a battery for it is placed. On the left leg there is a pocket for a safety hook knife and a large pocket on a zip fastener. At the lower part of the trousers there is one large pocket for different purposes (for example, for documents or a pistol). On the left sleeve, a small pocket is designed for storing personal documents or a phone, a radio. Provision of information about the profession, position, scope of use, personal data is achieved using stripes, shoulder boards, chevrons, transparent pockets with a transparent film. An expedient and substantiated choice of these elements, their shape, size, location and quantity is important [8-11].

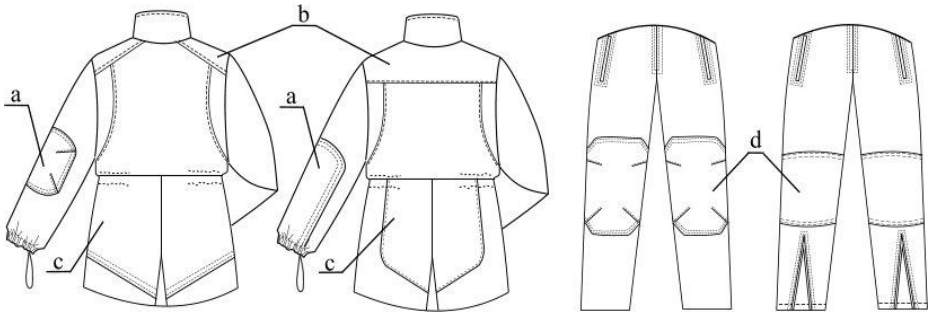

Figure 8 – Varieties of patches: a – elbow; b – shoulder yoke; c – pads; d – knee

The designed special protective clothing for military aviation pilots must be multifunctional and compatible with other personal protective equipment, fully comply with the high-altitude equipment, characteristics of a plane and flight modes.

IV. Conclusions.

On the basis of analytical studies, the complete set of protective apparel of pilots and its purpose was determined. Variants of design solutions of protective clothing for military aviation pilots and their elements on a functional basis are presented. A generalized classification of constructive-technological elements of protective clothing by purpose, a kind of fastener, pockets, a neck, a collar, a sleeve cut is developed. The further research is connected with systematization and study of the structures of packages of materials depending on the zonal location for protection against all kinds of hazards and the provision of comfortable microclimate under the clothing.

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