



Short Communication

Production acceptance trial of indigenous manufactured helmet: Field experience and lessons drawn

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ABSTRACT

Effective trial of indigenously developed flying clothing like a helmet on aircrew is important before final acceptance. The prototype indigenously designed helmet by an Indian manufacturer was subjected to a final Production Acceptance Trial (PAT) at a flying base for operational capability. Ground and in-flight evaluation of helmet was conducted involving aircrew. Most of the parameters for trials were satisfactory. Certain observations were brought out by the aircrew and trial team, which were later rectified by the manufacturer. The rectified helmet was subjected to repeat PAT and finally accepted for bulk production. This paper highlights the importance of such trials, lessons drawn, and recommendations for future trials.

Keywords: Prototype, Production acceptance trial, Aircrew helmet

INTRODUCTION

Flying clothing like an aircrew helmet is an important aspect of aircrew support equipment inside an aircraft cockpit.^[1] Various parameters of helmet such as sizing, fitment, noise attenuation, visor quality, the Field Of Vision (FOV), and integration with a mask are critical to assist aircrew in flying duties and provide protection.^[2,3] Laboratory testing and trial of flying clothing like a helmet on aircrew are critical before final acceptance.^[4] The development and acceptance of aircrew helmet is achieved in stages such as defining requirements, laboratory tests, and determination of operational acceptability by conducting appropriate ground and flight trials involving the user aircrew population.^[5-8] The Production Acceptance Trial (PAT) for an indigenously developed helmet was conducted at a flying base to assess the integration of the indigenous helmet with the mask and other components of the aircraft. The objective was to obtain feedback from the pilot population and identify issues regarding various aspects of the suitability of helmet from the user's point of view. PAT is a critical step to identify shortcomings and make rectifications before indigenously developed flying clothing like helmet is finally accepted for use in services. This paper brings out various aspects of PAT for indigenously developed helmet, lessons drawn, and recommendations for future trials.

THE APPROACH

The composition of the trial team included – DRDO scientists, air HQ flying clothing cell representatives, aerospace medicine specialists (The author), and the vendor representative. Indigenously designed helmets Figure 1, Original Equipment Manufacturer (OEM) helmets,

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indigenously designed masks, helmet assessment questionnaire, and Vernier caliper Figure 2 were used for the PAT. A total of eight male aircrews of varied seniority and experience and current on aircraft type participated in the trial. The age range was between 23 and 40 with a mean \pm SD of 30.25 ± 5.23 years. The weight range was between 62 and 75 with a mean \pm SD of 68.07 ± 4.16 kg. The flying experience of the subjects in the form of flying hours was 881.25 ± 636.85 as mean \pm SD. Size correlation between Indian and OEM (ALPHA) helmet with corresponding head dimensions was done to select the appropriate subject for the correct helmet size.

The trial was conducted in two phases, that is, the first phase of ground trial and second phase of flight trial. In the first phase of ground trial, various parameters such as overhead clearance, strength of RT/Intercom, adequacy of helmet chord length with full head movement, FOV inside, and outside of the cockpit were evaluated [Figure 3]. Overall integration of helmet with mask, operational maneuverability, comfort, and neck movement was assessed. In the second phase of flight trial, day and night sorties were planned with various exercises such as composite, low level tactical, and NF to



Figure 1: Helmet with padding and edge rolls.



Figure 2: Measurement of gap between visor and mask with vernier caliper.

check the overall operational acceptance of helmet. At the end of both phases of trials, helmet assessment sheet (Debrief form) was filled up by aircrew to obtain feedback [Table 1].

DISCUSSION

PAT is one of the steps of the multistage development protocol of indigenous flying clothing. It is done as a final step to obtain user population comments on sample manufactured by the vendor before prototype flying clothing goes into bulk production and induction into services. Before PAT, flying clothing is tested mainly in laboratory settings and only on a few aircrews. A few issues may still be missed in early steps of the developmental protocol. PAT is finally aimed to address any such issue. PAT was conducted at a flying base involving an aircrew for accepting an indigenously developed helmet for use in services. Most of the aspects of trial were satisfactory except for a few observations brought out in the trial. Helmet parameters such as donning and doffing, fitment and padding, comfort under high G, RT strength, visor transparency, refractive index, and distortion were found satisfactory. Although most of the helmet sizes matched the corresponding sizing schedule, a couple of aircrews had to change the size of forehead roll to achieve better fitment. Extra forehead rolls with extra width amounting to 5% of each bulk production were recommended to be supplied by the vendor to cater to uncommon sizes. A couple of subjects reported higher magnification of the Main Instrument Panel (MIP), which indicated visor may be defective in terms of refractive index. The Qualification Test Procedure (QTP) includes all tests for testing visor parameters but QTP is not done on the entire bulk production of visors by the vendor, creating a possibility of defective visors being fitted in the helmet. The Certificate Of Conformance (COC) which confirms that QTP has been performed on sample visors from the vendor was also not mentioned as a prerequisite before being accepted for trials. It was recommended that sample visors to be tested for an optical property by the



Figure 3: Cockpit trial depicting visor mask gap.

Table 1 : Helmet assessment sheet responses.

S. No.	Parameter	Tick appropriate option	Responses in %
1.	Donning and doffing	Very cumbersome difficult easy very easy	Easy-87.5
2.	Fitment and padding	Uncomfortable average fit snug fit	Snug fit-87.5
3.	Does head movement cause helmet to loosen	Yes No	No-100
4.	Retention under "G"	Yes No	Yes-100
5.	Visor transparency	Clear acceptable not clear	Clear-75 Acceptable-25
6.	Visor refractive index/power	Nil slight unacceptable	Nil-87.5
7.	Visor distortion	Nil slight unacceptable	Nil-87.5
8.	Visor retention in flying maneuvers	Good acceptable unacceptable	Good-100
9.	Visor cut	Less adequate more	Less-87.5
10.	Gap b/w visor and mask	Nil acceptable unacceptable	Unacceptable-87.5
11.	RT strength on ground	1,2,3,4,5	Strength 5-100
12.	RT strength in air during maneuvers	1,2,3,4,5	Strength 5-100
13.	Any break in continuity in RT	Yes No	No-100
14.	Which mask was used ex-import Indian		Ex-Import-25 Indian-75
15.	User satisfaction level	Rate from 1-5	Rating 2-12.5 Rating 3-37.5 Rating 4-50
16.	Suggestions for improvement		Visor Mask gap needs reduction.
17.	Comparison with original equipment manufacturer helmet	More comfortable comparable less comfortable	More comfortable-25 Comparable-62.5 Less comfortable-12.5

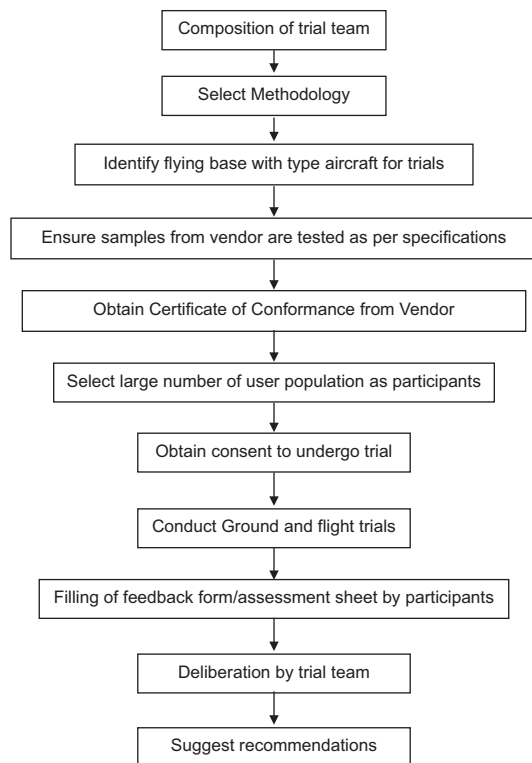
manufacturer and that COC be obtained before being subjected to user trials. Military specification document MIL-DTL-43511D for visors, specify random testing of visors to ensure Quality Assurance (QA).^[9] The trial team deliberated on this issue and with inputs from the DGQA agency, a/m Mil standard document and past experience of trial team, it was decided that 3% testing for each production lot will be adequate to monitor QA. UV transmittance test is to be conducted on at least one visor from the lot as it is a destructive test.^[9] The majority of aircrew reported that the entire MIP was not falling within FOV through the visors. This can cause distraction in flight. When compared, the dimensions of the present polycarbonate visors were found shorter as compared to original acrylic visors. Deliberations revealed that originally two visor sizes were approved to cater to five sizes of helmets, but during trials, vendor provided two sets of visors with same sizes. From further deliberations, it emerged that there is a requirement to increase the visor dimensions to ensure that entire MIP falls within the visor FOV. It was recommended that visor dimensions be increased to match the original design of prototype. The majority of pilots reported a gap between lower edge of the visor and mask. This can be reduced if the visor is adjusted in the lowermost setting. In addition, it was deliberated that gap can be reduced by increasing the visor margin dimensions

to match the original design of prototype. Poking of Scopex Mic connector under high "G" was found uncomfortable in large size helmet. It was found that connector wire loop and metal plate anchor of Scopex Mic were largely responsible for this issue. Deliberations revealed that extra wire loop could be removed along with increasing the nape pad length and reducing the forehead edge roll width to rectify the problem. Subsequently, repeat PAT was undertaken following rectifications by the manufacturer. Finally, bulk production of indigenously designed helmet was cleared and accepted.

LESSONS DRAWN

Lessons drawn are brought out in the form of a proposed protocol to conduct future such trials where the evaluation of indigenous flying clothing is under consideration. Meticulous planning, correct methodology, and importance of views of user population are the key to success of these trials. Correct composition of the team is the key to critical evaluation of flying clothing. It is valuable to include members from different streams such as scientists from manufacturer, aviation medical specialists, flying clothing cell representatives, and vendor representatives. Testing of critical parameters of flying clothing sample manufactured by vendor is important before subjecting to PAT.

PROPOSED PROTOCOL FOR PAT



CONCLUSION

The indigenously manufactured helmet prototype was subjected to PAT for final acceptance before bulk production. Involvement of aircrew, proper composition of trial team, and appropriate methodology were critical in identifying teething issues before helmet is accepted for use in services. PAT revealed certain shortcomings, which were rectified subsequently by the manufacturer. The helmet and its integration with the mask were found satisfactory for use by the end user. Rectified helmet was subjected to repeat PAT and finally accepted for bulk production. PAT is a critical step to ensure that high quality flying clothing is accepted in services for use by aircrew. Certain lessons were drawn and recommendations are made in this paper which will go long way in ensuring that these kinds of trials are conducted appropriately for maintaining flight safety and gaining long term benefits.

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Conflicts of interest

The author has none to declare.

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