

Brief on technology for Brake Piston Insulator for LCA

Introduction

Aeronautical Development Agency (ADA), Bangalore is developing a Light Combat Aircraft (LCA) in association with HAL and DRDO laboratories. LCA has got hydraulically operated brake system. The brake torque plate accommodates a set of four piston / cylinder liner assemblies to constitute a hydraulic manifold. The shuttle valve provides the hydraulic inlet ports to the brake manifold and is directly mounted on the torque plate. The hydraulic pressure generated by pilots in the brake system actuates the four hydraulic pistons which in turn actuates the brakes. The piston insulator is mounted on the brake pistons. Hence it is a critical component for wheel and brake assembly of LCA.

During the braking action of the aircraft, the brake converts the aircraft kinetic energy to thermal energy and thereby increasing the brake heat sink temperature. The generated heat has to be dissipated fast so that generated temperatures do not impair the strength of various wheel and brake components surrounding the brake. The piston insulators mounted on the brake pistons reduces the influx of conducted heat from the heat sink side to the hydraulic oil in the brake system circuit thereby preventing the abnormal temperature rise of hydraulic oil. The rise in temperature of hydraulic oil in a closed circuit may result in undue build up of oil pressure in the brake lines. During the braking action, the piston insulator has to endure high compressive loads corresponding to brake pressures and high temperatures due to braking. Therefore, the selected material for insulator must primarily be exhibit high compressive strength and low thermal conductivity. Hence the insulator material basically made up of sintered stainless steel with refractory additives.

Background and necessity

DMRL has indigenously developed a powder metallurgy based technology for producing the stainless steel based brake insulators. The process involves many challenging steps such as preparation of powders mixture with correct composition and uniform distribution of all powders using ball milling, uniaxial compaction in a die to get desired green density, sintering in hydrogen atmosphere, machining/surface finishing and characterization like density, hardness, surface roughness, compressive strength and thermal

conductivity. The laboratory has also developed the necessary processing facilities (such as ball milling system, uniaxial compaction in die in which only single insulator can be compacted at a time, turning and grinding facilities).

The final components (Diameter 26.85 – 26.97mm, Thickness 7.30 – 7.42mm, Hole dia 3.0 ± 0.1 mm, and Chamfer $1.50 \times 45^\circ$) are shown in fig.1. Typical properties of insulator material are given in Table-1.

Defence Research Metallurgical Laboratory, Kanchanbagh, Hyderabad has successfully developed Brake Piston Insulator for Wheel and Brake Assembly of LCA. DMRL has also received the type approval certificate (Type approval No. 1684, Dtd.: 10.03.2011) from the Centre for Military Airworthiness & Certification (CEMILAC) after 700 numbers of taxi trials.

However in last 2-3 years there has been a spurt in the requirements of these insulators by HAL, Lucknow and ADA, Bengaluru. But the lab scale facility within DMRL is insufficient to meet these demands. A survey carried out by this laboratory puts the immediate requirements for the HAL and ADA to be higher than what can be produced at DMRL. Thus there is a need to identify the vendors to produce the insulators at large scale at the earliest to meet the immediate requirements of these insulators for the LCA. This approach will satisfy the country's immediate requirements as well as make it fully self reliant in this area.