i. grinding swarfs or chips to understand mechanism of material removal
ii. grinding forces and specific grinding energy
iii. grinding cycle
iv. long cycle grinding to investigate wheel loading
v. long cycle grinding to investigate wheel wear
vi. grinding temperature through appropriate numerical modelling of thermal phenomenon in grinding
vii. surface integrity –
    a. surface topography and surface finish
    b. surface and sub-surface cracks
    c. residual stress-
        - ✓ through numerical modelling
        - ✓ through actual measurement using X ray diffraction technique
        - ✓ ***participation of GTRE/DRDO for estimation of residual stress would be required.***
    d. micro-structural changes through metallography and X-ray diffraction techniques **(for XRD technique participation of GTRE/DRDO would be required)**
    e. micro-hardness changes
    f. correlation between estimated grinding zone temperatures with different aspects of surface integrity.

(b) Summary of proposed research/ facilities and objectives (brief statement about the proposed investigation, its conduct, and the anticipated results in not more than 200 words)

The proposed project would attempt to study detailed grindability characteristics of BurTi alloy that is used in IP and HP compressors and ceramics (or a carbon fibre reinforced ceramic matrix composite) under high speed deep grinding domain employing single layer electroplated superabrasive grinding wheel. The methodology would be primarily experimental along with numerical approaches for estimation of grinding temperature and residual stress.

Titanium alloys are typically ground using SiC wheel. But to achieve the benefit of high speed grinding, super-abrasive wheels like mono-layer cBN wheel would be used. For grinding the ceramic or carbon fibre reinforced ceramic matrix composites, single layer electroplated diamond wheels would be employed. The chips would be collected while plunge surface grinding the work materials to study mechanism of material removal. Grinding forces and specific grinding energy affect the surface integrity of the ground component. Effect of different grinding parameters on forces and specific energy would be experimentally investigated. Long cycle grinding would be studied to assess probability of wheel loading and to explore mechanism of wheel wear. The temperature and residual stress would be estimated using numerical approach. Residual stress would also be actually measured using XRD techniques to assess effect of different grinding parameters.

	Most importantly grindability of these materials is rather poor. Improvement in grindability would be attempted through high speed grinding, with application of minimum quantity lubrication, with or without cryogenic gas cooling and ultrasonic assistance.
	(c) Key words grinding, burn resistant titanium alloy, ceramic, ceramic matrix composite,
	(d) Classification of the project (Please state whether basic research, applied research, facility set up, dissemination of information, process development, hardware development, study or exploratory or review of investigation, miscellaneous) applied research, facility setup, process development
7	Background and justification (Basis for the proposal with a brief review of the state of the art in the subject, followed by an outline of the relevance and importance of the project in particular towards research/development/design related to Aircraft, Helicopters, Missiles and all other Air Borne Vehicles Grindability studies of titanium and nickel based super-alloys have been going on for a considerable amount of time both in academia and industries. Grindability of titanium and nickel based super-alloys is considered to be poor because of low thermal conductivity, high hot hardness and reactivity with most of the grit materials. Initially grinding of such super-alloys used to be undertaken using conventional grinding wheels at reduced grinding velocity and material removal rate. Improvement in grindability was attempted using super-abrasive wheels, which enhanced the achievable material removal rate and provided better temperature control and surface integrity. For example, Guo et al. [1] studied grindability of Ti-6Al-4V using SiC wheels as recently as 2011, emphasizing on grinding forces, energy and ground surface topography. It has been a moderate speed grinding operation with moderate material removal rate. Similarly, Tso [2] reported on grindability of Inconel. He studied grindability in terms of grinding forces, specific cutting energy and wheel wear while employing alumina, SiC, and cBN wheels. The combination of process parameters yielded low material removal rate at a low grinding speed of 10-20 m/s. These initial studies could not take the advantage of high speed grinding and super-abrasive wheels. Patil et al. [3] studied grindability of Inconel 718 using monolayer cBN grinding wheel under high efficiency deep grinding domain. They mainly investigated the role of high grinding speed (180 m/s) on chip morphology and grinding forces. The above papers are representative only. The complete domain of literature indicates difficulty in grinding of titanium and nickel based super-alloys which can be tackled to some extent by using super-abrasive wheels instead of conventional wheels. Soo et al. [4] and Hood et al. [5] are two more representative papers on grinding of a burn