

# Tool Wear and Surface Integrity When Machining Inconel 718 Under Cryogenic Conditions: Liquid Nitrogen and Carbon Dioxide

S. Chaabani <sup>1,2, a)</sup>, Mikel Cuesta <sup>1)</sup>, P.J. Arrazola <sup>1)</sup>, Y. Ayed <sup>2)</sup>, G. Germain <sup>2)</sup>

<sup>1</sup> *Faculty of Engineering, Mondragon University, Loramendi 4, Arrasate 20500, Spain*

<sup>2</sup> *Arts et Metiers, LAMPA, 2 boulevard du Ronceray, 49035 Angers, France*

<sup>a)</sup>Corresponding author: [schaabani@mondragon.edu](mailto:schaabani@mondragon.edu)

**Abstract.** Nickel-based superalloys are widely exploited in turbojets components which are subjected to intense thermal and mechanical loadings during their operation. In fact, they exhibit excellent mechanical properties over a wide range of temperature and high corrosion and creep resistance. However, these materials induce several problems related to the shaping by machining due to essentially high heat resistance, high hardening tendency, high chemical affinity with tool material and low thermal conductivity leading to very high temperature in the cutting zone. In this context, assisted machining processes aim to improve the machinability of certain materials that are difficult to cut. Indeed, in order to keep the tool cold, it has been proposed to use cryogenic fluids (liquid nitrogen LN<sub>2</sub> and carbon dioxide CO<sub>2</sub>) as coolant for effectively reducing temperatures since their vaporization temperatures are equal to -196° C and -75° C respectively. In this context, previous researches have focused on the study of the efficiency of this technique with respect to the machinability of several materials such as titanium alloys and nickel-based alloys. It has been shown that the tool life is improved when machining titanium alloys, unlike nickel-based alloys. For this reason, this paper is devoted to a comparison between two cryogenic fluids (LN<sub>2</sub> and CO<sub>2</sub>) with regard to their effects on tool life and surface integrity of the workpiece (residual stresses, surface roughness and the affected layer) when machining Inconel 718 considering as reference the conventional lubrication.