1. INTRODUCTION

It is well acknowledged that the functional performance of a manufactured component is heavily influenced by the quality and reliability of the surface produced both in terms of topography as well as metallurgical and mechanical state of the subsurface layers. Efforts have been made by several investigators in the past few decades to investigate the relationships among the machining process parameters, the nature of the surface alterations produced and their effect on product’s functional performance. The driving force behind this has been the constant need to address the growing demand on component performance, reliability and durability, thereby stimulating the development of materials with enhanced resistance to severe loading conditions and aggressive environment, together with the development of high-performance manufacturing methods. The difficult-to-machine alloys are a group of alloys that require higher cutting energy when compared with low-strength alloys (e.g., plain carbon steel). This group includes several alloys used for aerospace and nuclear applications, which can be classified into three major categories: nickel-based alloys (e.g., Inconel), iron-based alloys (e.g., austenitic stainless steels) and titanium-based alloys. As metal cutting is the purposeful fracture of the layer to be removed, not only the strength of the work material but also the strain at fracture should be considered. The product of these two mechanical characteristics indicates the energy that has to be spent in fracturing a unit volume of the work material, allowing chip formation. Because of high strength and fracture strain of such alloys, high cutting forces and heat are generated during their machining. Most of the energy in the cutting process is largely converted into heat.

This heat is generated by plastic deformation and friction at the tool–chip and the tool–work piece interfaces. The high heat generated when combined with the low thermal conductivity of these alloys (about 30% of the plain carbon steel) will produce high localised temperatures. Austenitic stainless steels are considered as difficult-to-machine materials because of their low thermal conductivity, and high mechanical and micro structural sensitivity to strain and stress-rate.

The history of EDM techniques goes as back as the 1770s when an English Scientist invented it. In 1970s, commercially developed wire EDM began to be a viable technique that helped shape the metal working industry, what we are see today. In the mid 1980s, the electrical discharge machine techniques were transferred to a machine tool. This migration made EDM more widely
available and appealing over traditional machining processes. EDM has been replacing drilling, milling, grinding and other traditional machining operations and is now a well-established machining option in many manufacturing industries throughout the world.

It is capable of machining geometrically-complex or hard material components that are precise and difficult-to-machine such as heat treated tool steels, composites, super alloys, ceramics, carbides and heat resistant steels etc. which are widely used in die and mould making industries, aerospace, aeronautics and nuclear industries.

WEDM is considered as a unique adoption of the conventional EDM process, which uses an electrode to initialize the sparking process. However, WEDM utilizes a continuously travelling wire electrode made of thin copper, brass or tungsten of diameter 0.05-0.30 mm, which is capable of achieving very small corner radii. The wire is kept in tension using a mechanical tensioning device reducing the tendency of producing inaccurate parts. During the WEDM process, the material is eroded ahead of the wire and there is no direct contact between the work piece and the wire eliminating the mechanical stresses during machining. The important concern in the EDM process is the optimization of the process parameters such as pulse current intensity (Ip), pulse duration (Ton), pulse off time (T off), open circuit voltage (V), dielectric fluid types and flow rate to maximize the material removal rate and minimize the surface roughness and the tool wear.

**D–SERIES TOOLS AND APPLICATIONS**

This is a high carbon, high chromium (air hardening) tool steel. It was formulated to combine both the abrasion resistance and air-hardening characteristics. Common applications for these tool steels include forging dies, die-casting die blocks, and drawing dies.

Typical Applications of D-Grade tool steel include Burnishing Tools, File Cutting, Paper Cutters, Die Bending, Blanking, Coining, Cold Heading Die Inserts, Embossing, Cold Extrusion, Cold Forming, Lamination, Cold Swaging, Thread Roll, Cold Trimming, Wire Drawing, Gages, Paper Knives, Rotary Slitters, Cold Shear Knives, Woodworking Knives, Knurling tools and Lathe Centre Knives