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Thermal plasma generated by arc discharge provides the stable and intense heat source and have been used in surface treatment and welding processes in the aerospace, automotive and electronic industries. It is difficult to reliably predict and precisely control because of the lack of understanding of physical phenomenon for material processing in such a process. Therefore, many 2D studies have been conducted on free-burning arc and plasma configurations using numerous experimental results. However, thermal plasma generated by arc discharge appears in three-dimensional space, and it is necessary to study some three-dimensional physical aspects such as the effect of vortex injection in nozzle, arc attachment or arc-metal electrode interaction. Therefore, we conducted three-dimensional numerical analysis using the commercial program ANSYS CFX to predict temperature profiles between thermal plasma and metal electrode in this study. As a result, it was found that the predicted temperature profiles of thermal plasmas and metal electrode was in good agreement with experimental data and two dimensional results.