This thesis focuses on an experimental study of the anode area of the hybrid water-gas DC arc plasma torch that is used in many industrial applications, including plasma spraying, hydrocarbon reforming, pyrolysis, and organic waste gasification. The effects of ambient pressure and plasma generation conditions on the torch's plasma jet were studied, with particular focus on the torch's anode area. Movement of the anode arc attachment is described in detail, including its speed, range of its motion on the anode surface, restrike periods, and the frequency of its many sudden decelerations and re-accelerations. It was found that the anode erosion can be compared relatively simply by quick processing of high-speed camera videos. The anode erosion was also measured directly. Many electric probe measurements were made in the anode area of this plasma torch for the first time. By using these electric probes, shock waves, turbulent vortices, and plasma potential fluctuations were studied directly. It was found that a mean plasma electric field and a mean plasma electrical conductivity in the anode area can be satisfactorily estimated also non-intrusively by quick processing of high-speed camera videos. Moreover, schlieren videos of the plasma jet in the anode area were created.