The following are the major conclusions that arise out of the present study:

1. Y-groove Tekken test indicates that the chosen Q&T steel is weldable without cracking at weld metal zone by using ferritic steel electrodes like E7018 and austenitic stainless steel electrodes. Ferritic steel electrodes are more suited than austenitic steel electrodes to avoid weld metal cracking, under low restraint conditions, since the former develops compressive residual stresses at weld metal.

2. Detailed implant test results indicate that hydrogen induced cracking (HIC) at the heat affected zone (HAZ) is predominantly influenced by diffusible hydrogen content, which is mainly dependent on the electrode material and the flux composition. Lower the diffusible hydrogen content, higher will be the HIC resistance. Regarding its dependence on electrode material, austenitic steels result in much lower diffusible hydrogen than the ferritic steels. As for its dependence on the flux coating, the lowest diffusible hydrogen content results from basic flux coating. Austenitic stainless steel electrodes with basic flux coating result in a very low diffusible hydrogen and hence offer the best resistance against HIC. Electrodes like ferritic steel electrodes, with high moisture in the flux, result in high amount of diffusible hydrogen and hence offer the lowest resistance against HIC.
3. Preheating helps in reducing HIC, since it reduces the diffusible hydrogen as well as softens the microstructure making it less susceptible to HIC. Higher the preheat temperature, higher will be the HIC resistance. For every electrode there is a certain preheat temperature at which hydrogen embrittlement is totally eliminated. For basic coated ferritic steel electrode (E7018), zero hydrogen embrittlement is achieved at a preheat temperature of 300°C. For high ferrite type austenitic stainless steel electrode with basic flux coating (E312-15), zero hydrogen embrittlement is achieved at a preheat temperature of 200°C.

4. Within austenitic stainless steels, high ferrite type electrode like E312-15 appears to be the best choice for welding of Q&T steel. At proper preheat temperature, this electrode results in the least hydrogen embrittlement. But this electrode, when used with a preheat temperature at which hydrogen embrittlement is totally avoided, results in weld metal cracking (perhaps due to sigma phase formation). For practical applications, a 'safe' welding procedure can be evolved, wherein the preheating temperature will not be so high as to produce sigma phase embrittlement, but will be high enough to create conditions at which the 'critical stress' will be higher than the actual residual stresses generated.

5. The lower ferrite types of austenitic stainless steels, like E308-15-modified-1 and E308-15-modified-2 are more resistant to HIC than the high ferrite type E312-15 electrode. This is due to the fact that the diffusible hydrogen increases with the ferrite content of austenitic stainless steel weld metal. But this advantage of the low ferrite type electrodes is lost at high preheat temperatures. The consequence of preheating is that failure occurs at the weld metal zone, either due to solidification cracking or due to low weld metal strength.
6. If the applications require absolute nil-embrittlement at the heat affected zone, then one of the following two electrodes with the specified conditions can be used:

(i) Basic flux coated ferritic steel electrode, with high preheating temperature or

(ii) Basic flux coated, high ferrite type, austenitic stainless steel electrodes, with moderate preheating temperature and post heating temperature.

The ferritic steel electrode will require much higher preheat temperature than the austenitic stainless steel electrodes. If ferritic steel electrodes of appropriate flux coating can be developed to give a very low diffusible hydrogen (less than 2ml/100g) then they can offer nil-embrittlement conditions, at lowest preheat temperatures. With the high ferrite type austenitic stainless steel electrode, E312-15, conditions of absolute nil-embrittlement at HAZ can be created with a low preheat temperature of 150°C and post heating at the same temperature.