

## 1 Supplementary Materials

2 With the development of oil drilling technology, land and deep-sea oil and gas resources have  
 3 successively entered the exploration and development stage, which also puts forward higher  
 4 requirements for the strength of drill pipes [33-34]. At present, the highest strength of the API  
 5 series drill pipe is the S135 grade drill pipe, but as the drilling depth increases, it can no longer  
 6 meet the drilling requirements of some ultra-deep wells. In addition to producing and supplying  
 7 in accordance with API Spec 5D, domestic and foreign oil well drill pipe manufacturers have  
 8 also developed high-performance non-API grade drill pipes to meet the special needs of users.  
 9 Therefore, drilling tool manufacturers have successively developed V-150 high-strength drill  
 10 pipes which have been widely used [35]. Compared with API S135 drill pipe, the strength of  
 11 V-150 high-strength drill pipe can be increased by at least 103 MPa, which not only increases  
 12 the drilling depth, but also increases the water hole size appropriately, which can increase  
 13 drilling discharge, reduce circulating pressure consumption, and increase drilling efficiency by  
 14 more than 50% . This is of great significance for ultra-deep well drilling and ocean exploration  
 15 [36-37].

## 16 References

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