

## Drill Collar Connection Make-Up Torque

| Connection |                  | OD<br>in | Minimum Make-up Torque (lb-ft) |        |        |         |         |        |        |         |
|------------|------------------|----------|--------------------------------|--------|--------|---------|---------|--------|--------|---------|
| Size       | Type             |          | 1                              | 1 1/4  | 1 1/2  | 1 3/4   | 2       | 2 1/4  | 2 1/2  | 2 13/16 |
| API        | NC23             | 3        | *2,508                         | *2,508 | *2,508 |         |         |        |        |         |
|            |                  | 3 1/8    | *3,330                         | *3,330 | 2,647  |         |         |        |        |         |
|            |                  | 3 1/4    | 4,000                          | 3,387  | 2,647  |         |         |        |        |         |
| 2 3/8      | Regular          | 3        |                                | *2,241 | *2,241 | 1,749   |         |        |        |         |
|            |                  | 3 1/8    |                                | *3,028 | 2,574  | 1,749   |         |        |        |         |
|            |                  | 3 1/4    |                                | 3,285  | 2,574  | 1,749   |         |        |        |         |
| 2 7/8      | PAC <sup>3</sup> | 3        |                                | *3,797 | *3,797 | 2,926   |         |        |        |         |
|            |                  | 3 1/8    |                                | *4,966 | 4,151  | 2,926   |         |        |        |         |
|            |                  | 3 1/4    |                                | 5,206  | 4,151  | 2,926   |         |        |        |         |
| 2 3/8      | API IF           | 3 1/2    |                                | *4,606 | *4,606 | 3,697   |         |        |        |         |
| API        | NC26             | 3 3/4    |                                | 5,501  | 4,668  | 3,697   |         |        |        |         |
| 2 7/8      | Slim Hole        |          |                                |        |        |         |         |        |        |         |
| 2 7/8      | Regular          | 3 1/2    |                                | *3,838 | *3,838 | *3,838  |         |        |        |         |
|            |                  | 3 3/4    |                                | 5,766  | 4,951  | 4,002   |         |        |        |         |
|            |                  | 3 7/8    |                                | 5,766  | 4,951  | 4,002   |         |        |        |         |
| 2 7/8      | Extra Hole       | 3 3/4    |                                | *4,089 | *4,089 | *4,089  |         |        |        |         |
| 3 1/2      | DbL. Streamline  | 3 7/8    |                                | *5,352 | *5,352 | *5,352  |         |        |        |         |
| 2 7/8      | Mod. Open        | 4 1/8    |                                | *8,059 | *8,059 | 7,433   |         |        |        |         |
| 2 7/8      | API IF           | 3 7/8    |                                | *4,640 | *4,640 | *4,640  | *4,640  |        |        |         |
| API        | NC31             | 4 1/8    |                                | *7,390 | *7,390 | *7,390  | 6,853   |        |        |         |
| 3 1/2      | Regular          | 4 1/8    |                                | *6,466 | *6,466 | *6,466  | *6,466  | 5,685  |        |         |
|            |                  | 4 1/4    |                                | *7,886 | *7,886 | *7,886  | 7,115   | 5,685  |        |         |
|            |                  | 4 1/2    |                                | 10,471 | 9,514  | 8,394   | 7,115   | 5,685  |        |         |
| 3 1/2      | Slim Hole        | 4 1/4    |                                | *8,858 | *8,858 | 8,161   | 6,853   | 5,391  |        |         |
|            |                  | 4 1/2    |                                | 10,286 | 9,307  | 8,161   | 6,853   | 5,391  |        |         |
|            |                  |          |                                |        |        |         |         |        |        |         |
| API        | NC35             | 4 1/2    |                                |        |        | *9,038  | *9,038  | *9,038 | 7,411  |         |
|            |                  | 4 3/4    |                                |        |        | 12,273  | 10,826  | 9,202  | 7,411  |         |
|            |                  | 5        |                                |        |        | 12,273  | 10,826  | 9,202  | 7,411  |         |
| 3 1/2      | Extra Hole       | 4 1/4    |                                |        |        | *5,161  | *5,161  | *5,161 | *5,161 |         |
| 4          | Slim Hole        | 4 1/2    |                                |        |        | *8,479  | *8,479  | *8,479 | 8,311  |         |
| 3 1/2      | Mod. Open        | 4 3/4    |                                |        |        | *12,074 | 11,803  | 10,144 | 8,311  |         |
|            |                  | 5        |                                |        |        | 13,283  | 11,803  | 10,144 | 8,311  |         |
|            |                  | 5 1/4    |                                |        |        | 13,283  | 11,803  | 10,144 | 8,311  |         |
| 3 1/2      | API IF           | 4 3/4    |                                |        |        | *9,986  | *9,986  | *9,986 | *9,986 | 8,315   |
| API        | NC 38            | 5        |                                |        |        | *13,949 | *13,949 | 12,907 | 10,997 | 8,315   |
| 4 1/2      | Slim Hole        | 5 1/4    |                                |        |        | 16,207  | 14,643  | 12,907 | 10,997 | 8,315   |
|            |                  | 5 1/2    |                                |        |        | 16,207  | 14,643  | 12,907 | 10,997 | 8,315   |

| Size  | Type                     | OD    | 1 1/2 | 1 3/4   | 2       | 2 1/4   | 2 1/2   | 2 13/16 | 3       | 3 1/4  |
|-------|--------------------------|-------|-------|---------|---------|---------|---------|---------|---------|--------|
|       |                          | in    |       |         |         |         |         |         |         |        |
| 3 1/2 | H-90°                    | 4 3/4 |       | *8,786  | *8,786  | *8,786  | *8,786  | *8,786  |         |        |
|       |                          | 5     |       | *12,794 | *12,794 | *12,794 | *12,794 | 10,408  |         |        |
|       |                          | 5 1/4 |       | *17,094 | 16,929  | 15,137  | 13,151  | 10,408  |         |        |
|       |                          | 5 1/2 |       | 18,522  | 16,929  | 15,137  | 13,151  | 10,408  |         |        |
| 4     | Full Hole                | 5     |       | *10,910 | *10,910 | *10,910 | *10,910 | *10,910 |         |        |
| API   | NC40                     | 5 1/4 |       | *15,290 | *15,290 | *15,290 | 14,969  | 12,125  |         |        |
| 4     | Mod. Open                | 5 1/2 |       | *19,985 | 18,886  | 17,028  | 14,969  | 12,125  |         |        |
| 4 1/2 | Dbl. Streamline          | 5 3/4 |       | 20,539  | 18,886  | 17,028  | 14,969  | 12,125  |         |        |
|       |                          | 6     |       | 20,539  | 18,886  | 17,028  | 14,969  | 12,125  |         |        |
| 4     | H-90°                    | 5 1/4 |       | *12,590 | *12,590 | *12,590 | *12,590 | *12,590 |         |        |
|       |                          | 5 1/2 |       | *17,401 | *17,401 | *17,401 | *17,401 | 16,536  |         |        |
|       |                          | 5 3/4 |       | *22,531 | *22,531 | 21,714  | 19,543  | 16,536  |         |        |
|       |                          | 6     |       | 25,408  | 23,671  | 21,714  | 19,543  | 16,536  |         |        |
|       |                          | 6 1/4 |       | 25,408  | 23,671  | 21,714  | 19,543  | 16,536  |         |        |
| 4 1/2 | API Regular              | 5 1/2 |       | *15,576 | *15,576 | *15,576 | *15,576 | *15,576 |         |        |
|       |                          | 5 3/4 |       | *20,609 | *20,609 | *20,609 | 19,601  | 16,629  |         |        |
|       |                          | 6     |       | 25,407  | 23,686  | 21,749  | 19,601  | 16,629  |         |        |
|       |                          | 6 1/4 |       | 25,407  | 23,686  | 21,749  | 19,601  | 16,629  |         |        |
| API   | NC44                     | 5 3/4 |       | *20,895 | *20,895 | *20,895 | *20,895 | 18,161  |         |        |
|       |                          | 6     |       | *26,453 | 25,510  | 23,493  | 21,257  | 18,161  |         |        |
|       |                          | 6 1/4 |       | 27,300  | 25,510  | 23,493  | 21,257  | 18,161  |         |        |
|       |                          | 6 1/2 |       | 27,300  | 25,510  | 23,493  | 21,257  | 18,161  |         |        |
| 4 1/2 | API Full Hole            | 5 1/2 |       |         | *12,973 | *12,973 | *12,973 | *12,973 | *12,973 |        |
|       |                          | 5 3/4 |       |         | *18,119 | *18,119 | *18,119 | *18,119 | 17,900  |        |
|       |                          | 6     |       |         | *23,605 | *23,605 | 22,028  | 19,921  | 17,900  |        |
|       |                          | 6 1/4 |       |         | 27,294  | 25,272  | 22,028  | 19,921  | 17,900  |        |
|       |                          | 6 1/2 |       |         | 27,294  | 25,272  | 22,028  | 19,921  | 17,900  |        |
| 4 1/2 | Extra Hole               | 5 3/4 |       |         |         | *17,738 | *17,738 | *17,738 | *17,738 |        |
| API   | NC46                     | 6     |       |         |         | *23,422 | *23,422 | 22,426  | 20,311  |        |
| 4     | API IF                   | 6 1/4 |       |         |         | 28,021  | 25,676  | 22,426  | 20,311  |        |
| 4 1/2 | Semi IF                  | 6 1/2 |       |         |         | 28,021  | 25,676  | 22,426  | 20,311  |        |
|       | Dbl. StreamlineMod. Open | 6 3/4 |       |         |         | 28,021  | 25,676  | 22,426  | 20,311  |        |
| 4 1/2 | H-90°                    | 5 3/4 |       |         |         | *18,019 | *18,019 | *18,019 | *18,019 |        |
|       |                          | 6     |       |         |         | *23,681 | *23,681 | 23,159  | 21,051  |        |
|       |                          | 6 1/4 |       |         |         | 28,732  | 26,397  | 23,159  | 21,051  |        |
|       |                          | 6 1/2 |       |         |         | 28,732  | 26,397  | 23,159  | 21,051  |        |
|       |                          | 6 3/4 |       |         |         | 28,732  | 26,397  | 23,159  | 21,051  |        |
| 5     | H-90°                    | 6 1/4 |       |         |         | *25,360 | *25,360 | *25,360 | *25,360 | 23,988 |
|       |                          | 6 1/2 |       |         |         | *31,895 | *31,895 | 29,400  | 27,167  | 23,988 |
|       |                          | 6 3/4 |       |         |         | 35,292  | 32,825  | 29,400  | 27,167  | 23,988 |
|       |                          | 7     |       |         |         | 35,292  | 32,825  | 29,400  | 27,167  | 23,988 |

| Size  | Type              | OD    | 2 | 2 1/4   | 2 1/2   | 2 13/16 | 3       | 3 1/4   | 3 1/2   | 3 3/4 |
|-------|-------------------|-------|---|---------|---------|---------|---------|---------|---------|-------|
|       |                   | in    |   |         |         |         |         |         |         |       |
| 4 1/2 | API IF            | 6 1/4 |   | *23,004 | *23,004 | *23,004 | *23,004 | *23,004 |         |       |
|       | API NC50          | 6 1/2 |   | *29,679 | *29,679 | *29,679 | *29,679 | 26,675  |         |       |
| 5     | Extra Hole        | 6 3/4 |   | *36,742 | 35,824  | 32,277  | 29,966  | 26,675  |         |       |
| 5     | Mod. Open         | 7     |   | 38,397  | 35,824  | 32,277  | 29,966  | 26,675  |         |       |
| 5 1/2 | Dbl. Streamline   | 7 1/4 |   | 38,397  | 35,824  | 32,277  | 29,966  | 26,675  |         |       |
| 5     | Semi IF           | 7 1/2 |   | 38,397  | 35,824  | 32,277  | 29,966  | 26,675  |         |       |
| 5 1/2 | H-90 <sup>4</sup> | 6 3/4 |   | *34,508 | *34,508 | *34,508 | 34,142  | 30,781  |         |       |
|       |                   | 7     |   | *41,993 | 40,117  | 36,501  | 34,142  | 30,781  |         |       |
|       |                   | 7 1/4 |   | 42,719  | 40,117  | 36,501  | 34,142  | 30,781  |         |       |
|       |                   | 7 1/2 |   | 42,719  | 40,117  | 36,501  | 34,142  | 30,781  |         |       |
| 5 1/2 | API Regular       | 6 3/4 |   | *31,941 | *31,941 | *31,941 | *31,941 | 30,495  |         |       |
|       |                   | 7     |   | *39,419 | *39,419 | 36,235  | 33,868  | 30,495  |         |       |
|       |                   | 7 1/4 |   | 42,481  | 39,866  | 36,235  | 33,868  | 30,495  |         |       |
|       |                   | 7 1/2 |   | 42,481  | 39,866  | 36,235  | 33,868  | 30,495  |         |       |
| 5 1/2 | API Full Hole     | 7     |   | *32,762 | *32,762 | *32,762 | *32,762 | *32,762 |         |       |
|       |                   | 7 1/4 |   | *40,998 | *40,998 | *40,998 | *40,998 | *40,998 |         |       |
|       |                   | 7 1/2 |   | *49,661 | *49,661 | 47,756  | 45,190  | 41,533  |         |       |
|       |                   | 7 3/4 |   | 54,515  | 51,687  | 47,756  | 45,190  | 41,533  |         |       |
| API   | NC56              | 7 1/4 |   |         | *40,498 | *40,498 | *40,498 | *40,498 |         |       |
|       |                   | 7 1/2 |   |         | *49,060 | 48,221  | 45,680  | 42,058  |         |       |
|       |                   | 7 3/4 |   |         | 52,115  | 48,221  | 45,680  | 42,058  |         |       |
|       |                   | 8     |   |         | 52,115  | 48,221  | 45,680  | 42,058  |         |       |
| 6 5/8 | API Regular       | 7 1/2 |   |         | *46,399 | *46,399 | *46,399 | *46,399 |         |       |
|       |                   | 7 3/4 |   |         | *55,627 | 53,346  | 50,704  | 46,936  |         |       |
|       |                   | 8     |   |         | 57,393  | 53,346  | 50,704  | 46,936  |         |       |
|       |                   | 8 1/4 |   |         | 57,393  | 53,346  | 50,704  | 46,936  |         |       |
| 6 5/8 | H-90 <sup>4</sup> | 7 1/2 |   |         | *46,509 | *46,509 | *46,509 | *46,509 |         |       |
|       |                   | 7 3/4 |   |         | *55,708 | *55,708 | 53,629  | 49,855  |         |       |
|       |                   | 8     |   |         | 60,321  | 56,273  | 53,629  | 49,855  |         |       |
|       |                   | 8 1/4 |   |         | 60,321  | 56,273  | 53,629  | 49,855  |         |       |
| API   | NC61              | 8     |   |         | *55,131 | *55,131 | *55,131 | *55,131 |         |       |
|       |                   | 8 1/4 |   |         | *65,438 | *65,438 | *65,438 | 61,624  |         |       |
|       |                   | 8 1/2 |   |         | 72,670  | 68,398  | 65,607  | 61,624  |         |       |
|       |                   | 8 3/4 |   |         | 72,670  | 68,398  | 65,607  | 61,624  |         |       |
|       |                   | 9     |   |         | 72,670  | 68,398  | 65,607  | 61,624  |         |       |
| 5 1/2 | API IF            | 8     |   |         | *56,641 | *56,641 | *56,641 | *56,641 | *56,641 |       |
|       |                   | 8 1/4 |   |         | *67,133 | *67,133 | *67,133 | 63,381  | 59,027  |       |
|       |                   | 8 1/2 |   |         | 74,626  | 70,277  | 67,436  | 63,381  | 59,027  |       |
|       |                   | 8 3/4 |   |         | 74,626  | 70,277  | 67,436  | 63,381  | 59,027  |       |
|       |                   | 9     |   |         | 74,626  | 70,277  | 67,436  | 63,381  | 59,027  |       |
|       |                   | 9 1/4 |   |         | 74,626  | 70,277  | 67,436  | 63,381  | 59,027  |       |

| Size  | Type                   | OD<br>in |  |  | 2 1/2    | 2 13/16  | 3        | 3 1/4    | 3 1/2    | 3 3/4    |
|-------|------------------------|----------|--|--|----------|----------|----------|----------|----------|----------|
| 6 5/8 | API Full Hole          | 8 1/2    |  |  | *67,789  | *67,789  | *67,789  | *67,789  | *67,789  | 67,184   |
|       |                        | 8 3/4    |  |  | *79,544  | *79,544  | *79,544  | 76,706   | 72,102   | 67,184   |
|       |                        | 9        |  |  | 88,582   | 83,992   | 80,991   | 76,706   | 72,102   | 67,184   |
|       |                        | 9 1/4    |  |  | 88,582   | 83,992   | 80,991   | 76,706   | 72,102   | 67,184   |
|       |                        | 9 1/2    |  |  | 88,582   | 83,992   | 80,991   | 76,706   | 72,102   | 67,184   |
|       | API NC70               | 9        |  |  | *75,781  | *75,781  | *75,781  | *75,781  | *75,781  | *75,781  |
|       |                        | 9 1/4    |  |  | *88,802  | *88,802  | *88,802  | *88,802  | *88,802  | *88,802  |
|       |                        | 9 1/2    |  |  | *102,354 | *102,354 | *102,354 | 101,107  | 96,214   | 90,984   |
|       |                        | 9 3/4    |  |  | 113,710  | 108,841  | 105,657  | 101,107  | 96,214   | 90,984   |
|       |                        | 10       |  |  | 113,710  | 108,841  | 105,657  | 101,107  | 96,214   | 90,984   |
|       |                        | 10 1/4   |  |  | 113,710  | 108,841  | 105,657  | 101,107  | 96,214   | 90,984   |
|       | API NC77               | 10       |  |  | *108,194 | *108,194 | *108,194 | *108,194 | *108,194 | *108,194 |
|       |                        | 10 1/4   |  |  | *124,051 | *124,051 | *124,051 | *124,051 | *124,051 | *124,051 |
|       |                        | 10 1/2   |  |  | *140,491 | *140,491 | *140,491 | 140,488  | 135,119  | 129,375  |
|       |                        | 10 3/4   |  |  | 154,297  | 148,965  | 145,476  | 140,488  | 135,119  | 129,375  |
|       |                        | 11       |  |  | 154,297  | 148,965  | 145,476  | 140,488  | 135,119  | 129,375  |
| 7     | H-90 <sup>4</sup>      | 8        |  |  | *53,454  | *53,454  | *53,454  | *53,454  | *53,454  | *53,454  |
|       |                        | 8 1/4    |  |  | *63,738  | *63,738  | *63,738  | *63,738  | 60,971   | 56,382   |
|       |                        | 8 1/2    |  |  | *74,478  | 72,066   | 69,265   | 65,267   | 60,971   | 56,382   |
| 7 5/8 | API Regular            | 8 1/2    |  |  | *60,402  | *60,402  | *60,402  | *60,402  | *60,402  | *60,402  |
|       |                        | 8 3/4    |  |  | *72,169  | *72,169  | *72,169  | *72,169  | *72,169  | *72,169  |
|       |                        | 9        |  |  | *84,442  | *84,442  | *84,442  | 84,221   | 79,536   | 74,529   |
|       |                        | 9 1/4    |  |  | 96,301   | 91,633   | 88,580   | 84,221   | 79,536   | 74,529   |
|       |                        | 9 1/2    |  |  | 96,301   | 91,633   | 88,580   | 84,221   | 79,536   | 74,529   |
| 7 5/8 | H-90 <sup>4</sup>      | 9        |  |  | *73,017  | *73,017  | *73,017  | *73,017  | *73,017  | *73,017  |
|       |                        | 9 1/4    |  |  | *86,006  | *86,006  | *86,006  | *86,006  | *86,006  | *86,006  |
|       |                        | 9 1/2    |  |  | *99,508  | *99,508  | *99,508  | *99,508  | *99,508  | 96,285   |
| 8 5/8 | API Regular            | 10       |  |  | *109,345 | *109,345 | *109,345 | *109,345 | *109,345 | *109,345 |
|       |                        | 10 1/4   |  |  | *125,263 | *125,263 | *125,263 | *125,263 | *125,263 | 125,034  |
|       |                        | 10 1/2   |  |  | *141,767 | *141,767 | 141,134  | 136,146  | 130,777  | 125,034  |
| 8 5/8 | H-90 <sup>4</sup>      | 10 1/4   |  |  | *113,482 | *113,482 | *113,482 | *113,482 | *113,482 | *113,482 |
|       |                        | 10 1/2   |  |  | *130,063 | *130,063 | *130,063 | *130,063 | *130,063 | *130,063 |
| 7     | H-90 <sup>4</sup>      | 8 3/4    |  |  |          | *68,061  | *68,061  | 67,257   | 62,845   | 58,131   |
|       | (with low torque face) | 9        |  |  |          | 74,235   | 71,361   | 67,257   | 62,845   | 58,131   |
| 7 5/8 | API Regular            | 9 1/4    |  |  |          |          | *73,099  | *73,099  | *73,099  | *73,099  |
|       | (with low torque face) | 9 1/2    |  |  |          |          | *86,463  | *86,463  | 82,457   | 77,289   |
|       |                        | 9 3/4    |  |  |          |          | 91,789   | 87,292   | 82,457   | 77,289   |
|       |                        | 10       |  |  |          |          | 91,789   | 87,292   | 82,457   | 77,289   |
| 7 5/8 | H-90 <sup>4</sup>      | 9 3/4    |  |  |          | *91,667  | *91,667  | *91,667  | *91,667  | *91,667  |
|       | (with low torque face) | 10       |  |  |          | *106,260 | *106,260 | *106,260 | 104,171  | 98,804   |
|       |                        | 10 1/4   |  |  |          | 117,112  | 113,851  | 109,188  | 104,171  | 98,804   |
|       |                        | 10 1/2   |  |  |          | 117,112  | 113,851  | 109,188  | 104,171  | 98,804   |

| Size  | Type                   | OD<br>in |  |  | 2 1/2 | 2 13/16 | 3        | 3 1/4    | 3 1/2    | 3 3/4    |
|-------|------------------------|----------|--|--|-------|---------|----------|----------|----------|----------|
| 8 5/8 | API Regular            | 10 3/4   |  |  |       |         | *112,883 | *112,883 | *112,883 | *112,883 |
|       | (with low torque face) | 11       |  |  |       |         | *130,672 | *130,672 | *130,672 | *130,672 |
|       |                        | 11 1/4   |  |  |       |         | 147,616  | 142,430  | 136,846  | 130,871  |
| 8 5/8 | H-90 <sup>†</sup>      | 10 3/4   |  |  |       |         | *92,960  | *92,960  | *92,960  | *92,960  |
|       | (with low torque face) | 11       |  |  |       |         | *110,781 | *110,781 | *110,781 | *110,781 |
|       |                        | 11 1/4   |  |  |       |         | *129,203 | *129,203 | *129,203 | *129,203 |

† Recommended Make-Up Torque<sup>1</sup> For Rotary Shouldered Drill Collar Connections

Notes:

- 1 Torque figures preceded by an asterisk (\*) indicate that the weaker member for the corresponding outside diameter (OD) and bore is the BOX; For all other torque values the weaker member is the PIN.
- 2 In each connection size and type group, torque values apply to all connection types in the group, when used with the same drill collar outside diameter and bore, i.e. 2 3/8 API IF, API NC26, and 2 7/8 Slim Hole connections used with 3 1/2 x 1 1/4 drill collars all have the same minimum make-up torque of 4,600 ft.lb., and The BOX is the weaker member.
- 3 Stress-relief features are disregarded for make-up torque.

Footnotes:

- 1 Basis of calculations for recommended make-up torque assumed the use of a thread compound containing 40-60% by weight of finely powered metallic zinc or 60% by weight of finely powered metallic lead, with not more than 0.3% total active sulfur applied thoroughly to all threads and shoulders and using the modified screw jack formula in API RP7G (16th edition) Appendix A, paragraph A.8, and a unit stress of 62,500 psi in the box or pin, whichever is weaker.
- 2 Normal torque range is tabulated value plus 10%. Higher torque values may be used under extreme conditions.
- 3 Make-up torque for 2 7/8 PAC connection is based on 87,500 psi stress and other factors listed in footnote 1.
- 4 Make-up torque for H-90 connection is based on 56,200 psi stress and other factors listed in footnote 1.