## $4 \frac{\text { Command }}{\text { GSMFI }}$



## Table of Contents


About Us .....  4
A Reliable Partner Offering .....  4
Solutions for All Drilling Environments Your One Stop Shop for All Products .....  5
from the Rig Floor to the BHA
Applications .....  6
Onshore Drilling ..... 6
Sour Service Environments .....
Geothermal Drilling .....  8
Grades .....  9
Sour Service Grades .....  9
Drill Pipe ..... 11
Drill Pipe ..... 11
Heavy Weight Drill Pipe ..... 13
Heavy Weight Drill Pipe ..... 13
Heavy Weight Drill Pipe ..... 16
Manufacturing Flow Chart
Heavy Weight Drill Pipe Data ..... 18
HWDP Data - Sour Service ..... 24
HWDP Performance Datasheet ..... 28
Drill Collars ..... 29
Drill Collars. ..... 29
Drill Collar Manufacturing Flow Chart ..... 32
Drill Collar Data ..... 34
Drill Collar Performance Datasheet ..... 38

## Table of Contents (continued)



Accessories ................................ 39
Kelly Cock Valves . . . . . . . . . . . . . . . . . . . . . . . 39
Inside Blowout Preventer (I-BOP) . . . . . . . . . . . 43
Retrievable Drop in Check Valve (RDCV). . . . . . 46
Rotary Substitutes (Subs) . . . . . . . . . . . . . . . . . . 50
Pup Joints . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 52
Stabilizers ....................................... . . . 53

Options........................................ . 54
Client Specs. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 54
Hardbanding . . . . . . . . . . . . . . . . . . . . . . . . . . . . 55
Coating . ....................................... . . . . 56
Make and Break. . . . . . . . . . . . . . . . . . . . . . . . . . 57
Thread Protectors . . . . . . . . . . . . . . . . . . . . . . . 58

Contacts....................................... . 59

The data provided in this catalog is for general information only. While every
effort has been made to ensure the accuracy of all data and information contained herein, COMMAND SMFI assumes no responsibility or liability for loss, damage or injury resulting from the use of this material. All uses of the information presented in this catalog are at the user's oun risk and responsibility.© 2018 COMMAND SMFI. Unless othemise specified, COMMAND SMFI and its subsidaries are sole owners of all content induding and without limitation, all patents, trademarks, copynights and other intellectual property rights thereta.

## A Reliable Partner Offering Solutions for All Drilling Environments

With the days of easily accessible oil \& gas fields becoming numbered, exploration and production is moving to even harsher environments. Drillers today contend with tougher operating conditions, greater technological challenges and increased risks. All the more reason to choose a partner with a proven track record of providing innovative solution packages that secure reliable operation and availability day in and day out, even under the most challenging conditions.

With experience in the world's most complex wells, COMMAND SMFI solutions to meet challenges head on in: $\rightarrow$ Offshore environments with products capable of drilling:
$>$ in water depths exceeding $12,000 \mathrm{ft}(3,700 \mathrm{~m})$
> on platforms, jackups, drillships, and semisubmersibles $>$ in extended reach, deviated, and deep wells
$>$ despite unexpected pressure variations and low pressures in reservoir
$>$ while withstanding corrosion, storms, high seas, and strong currents
$\rightarrow$ Conventional and unconventional onshore environments with products that either provide resistance or mitigate risks associated to:
> excessive drill string buckling
> high side forces
> high drag and low torque
> reduced rate of penetration
$>$ lost circulation
> ineffective hole cleaning
> excessive pipe belly wear
> vibrations and stick-slip
> short tubular life
> difficulty getting weight on bit
$\rightarrow$ Sour Service environments with specially designed drill pipe and BHA grades guaranteeing the necessary resistance to $\mathrm{H}_{2} \mathrm{~S}$.

Whatever the environment, COMMAND SMFI has the solutions to guarantee exceptional performance.


## Your One Stop Shop for All Products from the Rig Floor to the BHA

COMMAND SMFI offers the following standard product lines:

## Drill Pipe

$2-3 / 8$ " to $6-5 / 8$ " OD, Range 2 and 3

## Heavy Weight

2-7/8" to 6-5/8" OD, welded or integral

## Drill Collars

2-7/8" to 11" OD, slick or spiral

## API and High-Performance Connections

> API connections
> Proprietary connections upon request

## Steel Grades

API, Sour Service, high strength and non-mag material grades.

## Drill Stem Accessories

Square or hexagonal kellys, RDCV, Kelly Cocks, I-BOP, valve repair kits, valve spare parts, pup joints, crossovers, bit subs, lifting subs, saver subs, pump-in subs, side entry subs, and circulating subs.

COMMAND SMFI is more than a manufacturer of drilling tubulars, supplying a complete range of proprietary drill stem products. We also design and provide tailormade solutions to help clients succeed in increasingly challenging well profiles and drilling programs.


## Onshore Drilling

## Application

Onshore or land base drilling is defined as drilling with rigs that are moved in by ground transportation and the drilling site is not over water. Many of these wells are now being drilled using a technique called pad drilling where multiple wells are drilled from the same site in very close proximity of each other by shifting the rig slightly. Typically, these are mature fields, pushing the drilling envelope farther to more challenging well formations like new shale fields or very deep wells.

## Challenges

Onshore drilling has many different challenges related to industry economics, equipment used, location of the field, well profile and formations.
>Rig day rates make running a rig expensive, which means that the speed of rigging down, moving and rigging up is crucial to guarantee project success. Drilling equipment has to be reliable and easy to handle on the rig floor.
> The physical location of the well site sets limits on the size and type of drilling equipment and sometimes the drill string. Well sites in Arctic areas, for example, have surface equipment and downhole equipment that are exposed to extreme surface temperatures for long periods before use, which can impact their performance.
> Well profiles and formations determine drill string requirements:

- $\mathrm{H}_{2} \mathrm{~S}$ wells require use of special steels to resist Sulfide Stress Cracking.
- ERD or deep wells require the drill pipe in the upper part of the string to have high tensile strength.
- Extended reach wells and ultra-extended reach wells can be difficult to drill because they may be limited by the increased torque and drag of the drill string.
- Small clearance wells will drive Equivalent Circulating Density (ECD) higher, put additional stress on formations and increase circulation pressures.


## Products \& Solutions

COMMAND SMFI offers custom drill strings to meet onshore challenges head-on:
> High performance proprietary connections that can be matched with ODs and IDs to provide optimized torque, tensile and hydraulic impact for the particular program.

## > Multiple grades and weights

## > Drill string products for $\mathrm{H}_{2} \mathrm{~S}$ environments

## Sour Service Environments

## Application

"Sour Service" refers to a well environment containing Hydrogen Sulfide ( $\mathrm{H}_{2} \mathrm{~S}$ ), which can significantly impact steel drilling tubular performance. It is also well known that $\mathrm{H}_{2} \mathrm{~S}$ is hazardous to human health, living organisms and generally to the environment.

Historically, this is the reason wells found with Sour gas were often carefully plugged and abandoned. With the increasing demand for domestic gas worldwide, some major Sour fields are now being explored and developed.

## Challenges

The physical phenomenon associated with Sour Service environments and affecting steel based products under applied or residual stress is known as $\mathrm{H}_{2} \mathrm{~S}$ embrittlement or more specifically as Sulfide Stress Cracking (SSC).
$\mathrm{H}_{2} \mathrm{~S}$ in combination with water and low pH will react with pipe surface, releasing free hydrogen, which can be absorbed through the steel's surface. At this point, hydrogen particles diffuse further into the steel matrix and interact with the steel itself, making it brittle.

The key factors leading to SSC are elevated $\mathrm{H}_{2} \mathrm{~S}$ content, low temperatures, low pH , and the high stress state of the material (tensile stress). When these factors are combined, a crack can initiate in the material and propagate until catastrophic failure, even when stresses are substantially inferior to the yield limit of the material.

Specially designed grades are essential to guarantee the necessary $\mathrm{H}_{2} \mathrm{~S}$ resistance and to ensure the safety of those working in such harsh environments.

## Products \& Solutions

COMMAND SMFI's Sour Service proprietary grades are renowned for their performance.Our extensive research, development facilities, and our internationally recognized expertise have combined to produce outstanding critical service material.

Today, COMMAND SMFI is able to guarantee the superior performance of its material in the toughest sour environments around the world. Due to the astringency of the Sour environment, particular attention needs to be paid when selecting and characterizing adapted Sour Service steel grades. Controlling critical manufacturing parameters is also a requirement to ensure superior product performance. Steel microstructure, chemical composition, cleanliness, and heat treatment process controls are essential for high sulfide stress cracking resistance.

## Geothermal Drilling

## Application

Geothermal energy uses the earth's thermal energy generated and stored in the earth's geology from the core to the surface. Steam, hot water and minerals are some of the most important direct products of geothermal resources. Convenient access to this energy source is concentrated at the margins of the earth's tectonic plates where conventional drilling techniques and equipment can best be exploited. Geothermal drilling is used to access this stored energy through a process of creating boreholes in the earth to extract the earth's heat. Most of today's geothermal drilling projects are located in continental Europe, the Philippines, Indonesia, New Zealand, and the Americas.

## Challenges

Geothermal well profiles are characterized as challenging. Hydrogen sulphide, high torsion, high temperatures and punishing wear are a few of the extreme conditions, which may be experienced during geothermal drilling. The extremely hard and abrasive rock formations found in geothermal wells result in torsion levels and equipment wear which may be higher than those found in oil and gas drilling.

## Products \& Solutions

COMMAND SMFI offers custom drill strings to meet geothermal challenges head-on:
> high performance connections high torque double shoulder connections offered upon request.
> Hardbanding products are applied to tool joints and upsets/wear pads as a hard and extremely abrasion-resistant sacrificial layer. We offer alloy steel and tungsten carbide hardband products to suit the drilling conditions and specific client requirements from our portfolio of proprietary hardband products and specialist manufacturers.


## Sour Service Grades

## Operational Challenges

The physical phenomenon associated with Sour Service environments and affecting steel based products under applied or residual stress is known as $\mathrm{H}_{2} \mathrm{~S}$ embrittlement or more specifically as Sulfide Stress Cracking (SSC). $\mathrm{H}_{2} \mathrm{~S}$ in combination with water and low pH will react with pipe surface, releasing free hydrogen, which can be absorbed through the steel's surface. At this point, hydrogen particles diffuse further into the steel matrix and interact with the steel itself, which becomes brittle. The key factors leading to SSC are elevated $\mathrm{H}_{2} \mathrm{~S}$ content, low temperatures, low pH , and the high stress state of material (tensile stress). When these factors are combined, a crack can initiate in the material and propagate causing catastrophic failure, even when stresses are substantially inferior to the yield limit of the material.

Specially designed grades are essential to guaranteeing the necessary $\mathrm{H}_{2} \mathrm{~S}$ resistance within the steel and to ensure the safety of those working in such harsh environments.

## The Solution: Specific Drill String Components Providing Higher Performance and Safety Margins

COMMAND SMFI's Sour Service proprietary grades are renowned for their performance. Our extensive research and development facilities, and our internationally recognized expertise combine to produce outstanding critical service material. We are able to guarantee the superior performance of our material in the toughest sour environments around the world.

Due to the astringency of sour environments, particular attention needs to be paid when selecting and characterizing adapted Sour Service steel grades. Controlling critical manufacturing parameters is also a requirement to ensure superior product performance. Steel microstructure, chemical composition, cleanliness, and heat treatment process controls are essential for high sulfide stress cracking resistance. Such proprietary grades largely exceed the resistance of API grades to SSC, and are being manufactured according to several industry standards such as NACE TM0177 and IRP 1.8.


Our Sour Service HWDP is compliant with API specifications and is more resistant to $\mathrm{H}_{2} \mathrm{~S}$ than standard grade HWDP.

|  | Construction | $\begin{gathered} \text { Ys Min } \\ \text { KSI } \end{gathered}$ | $\begin{aligned} & \text { UTI Min } \\ & \text { KSI } \end{aligned}$ | Hardness Single Max HRC | Min Single Impact Charpy Test ft-bs@+20C | Material Type | NACE Test |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| HWDP-65 HW MS | Welded | 65 | 95 | 22 | 24 | $\mathrm{H}_{2} \mathrm{~S}$ resistant | No |
|  |  | 110 | 140 | 36 | 48 | $\mathrm{H}_{2} \mathrm{~S}$ resistant | No |
| HWDP-110 HW MS | Integral | 110 | 140 | 36 | 48 | $\mathrm{H}_{2} \mathrm{~S}$ resistant | No |

COMMAND SMFI can maximize safety margins in $\mathrm{H}_{2} \mathrm{~S}$ environments with Sour Service drill collars, pup joints and accessories using ASCOWELL C material.

|  | Construction | YS Min <br> KSI | UTI Min <br> KSI | Hardness <br> Single Max HRC | Min Single Impact <br> Charpy Test ft-los@+20C | Material Type | NACE Test |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| PJ -110 PUP S | Integral | 110 | 140 | 36 | 48 | $H_{2}$ S resistant | No |
| Dill collars and accessories | Integral | 110 | 140 | 36 | 48 | $H_{2}$ S resistant | No |



## Drill Pipe

## The Solution: Drill Pipe Designed to Go Deep

COMMAND SMFI, through its mother company Command Tubular Products located in Houston (US) is able to supply Drill Dipes designed to provide superior technical performance and a service lifetime exceeding most current industry standards.

Drill Pipe are in conformance with API 5DP, 7-1 \& 7-2 specifications:
> Pipe body OD from 2-3/8" to $6-5 / 8$ "
> Range 2 and 3 lengths
> And a variety of steel grades:
> API: E-75, X-95, G-105, S-135, Sour Service Connections
> API
> Proprietary high torque double shoulder connections (CET, CDS \& others upon request)
Drill pipes are available with:
> Pipe body OD from 2-3/8" to 6-5/8"
> 87.5 or $95 \%$ minimum wall
> All tubes/Grades full length ultrasonic inspected (flut)
> All tool joints exceed API requirements
> Connection threading is performed to API Spec 7-2
> Tool joint markings are applied to customer or API RP7G specifications
> Factory 3 cycle make and break
> Internal Plastic Coating (upon request)
> High quality hardbanding solutions upon request
> Full documentation packages provided
> Phosphate-coated threads
> NS-1, DS-1 specifications

COMMAND SMFI also has its own tool joint manufacturing capabilities and our tool joints meet or exceed API specifications and tolerance requirements. Each joint is inspected to guarantee visual and dimensional properties and tested to ensure proper mechanical characteristics.

All our tool joints are:
> 100\% magnetic-particle inspected
> Phosphate-coated (anti-galling treatment)
> Hardness-tested

## Operational Benefits

Drill Pipe Internal and External Upset Profile


One of the most critical sections in welded drill pipe is the transition zone between the tool joint and the pipe body. A smooth, gradual transition linked to the superior nature of the purity of our steel ensures minimum stress concentration and greatly improves the fatigue life of the pipe.

## Heavy Weight Drill Pipe

## The Solution: Transitional and Compressive Load Member

COMMAND SMFI's Heavy Weight Drill Pipe (HWDP) features a tool joint pin and box and a thick-walled tube with a raised central section for wellbore protection of the tube. The central section comes in various designs; slick, spiral, full spiral, or tri-spiral. HWDP can be manufactured as a welded assembly or machined integral from bars.

HWDP in the bottom-hole assembly (BHA) provide a gradual transition between drill pipe and drill collars. Its main function is to transfer surface weight-on-bit (WOB) and pipe rotation to the drilling assembly. It also mitigates drill string fatigue and provides directional control of the BHA. In addition, Heavy Weight Drill Pipe can be used to push or force liners/screens down hole during drilling operations.

## Applications

## Vertical Drilling

> Weight-on-bit and compressive load member
> Transitional and fatigue resistant member
> Replacement of drill collars

## Directional, Horizontal, and Extended Reach Drilling

$>$ Weight-on-bit and compressive load member
> Differential sticking and drill string lock-up prevention
> Directional control of BHA

## Remedial Operations

> Provide the weight required for milling, under-reaming, and hole-opening operations


COMMAND SMFI's HWDP conforms to API Spec 7-1 (ISO 10424-1) and API Spec 7-2 (ISO 10424-2).


## Heavy Weight Spiral Drill Pipe (HWSP)

COMMAND SMFI 's Heavy Weight Spiral Drill Pipe (HWSP) is designed to address differential sticking in vertical and directional drilling environments. Different central upset designs and spiraling configurations are available (spiral, full spiral and tri-spiral) to reduce buckling, risks of differential sticking, improve hole cleaning, and BHA stiffness.

## Materials

COMMAND SMFI provides HWDP in standard, Sour Service, or non-magnetic grades.
Standard heavy weight drill pipe (HWDP) is supplied with AISI 1340 steel or equivalent in the pipe body and AISI 4145 H or AISI 4140 H -modified tool joints. The welded assembly is the standard offer whereas the integral version is considered optional due to plant availability.

ASCOWELL C steel bar grade has been developed to provide resistance to Sulfide Stress Cracking (SSC) for BHA products improving impact strength and fracture toughness. The resistance to sulfide stress cracking significantly surpasses the resistance of AISI 4145 H -modified/4140H-modified steel as shown in NACE test TM0177. The ASCOWELL C HWDP provides superior performance in Sour Service applications and continues to be used around the world.

Integral non-magnetic HWDP made of Amagnit $^{\text {TM }} 501$ is also offered for directional drilling applications.

| Application | Material | Size | Yield Strength | Ultimate Strength | Hardness (Brinell) | Elongation | Reduction of Area | Min Charpy |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Min (KS) | Win (KSS) | (HiB) | (A\%) | (\%) | (it-libs ©+20 ${ }^{\circ} \mathrm{C}$ ) |
| Standard Integral \& NS-1 | AISI 4145H-modified | All | 110 | 140 | 285 to 340 | 13 | 45 | 40 |
| Standard welded (central part) | AISI 1340-modified | All | 65 | 95 | 235 (max) | 18 | N/A | 30 |
| NS-1 welded (central part) | AISI 4140H-modified | All | 120 | 140 | 285 to 340 | 13 | 45 | 40 |
| Standard welded \& NS-1 (tool joint) | AISI 4140H-modified | Up to $71 / 4$ " | 120 | 140 | 285 to 340 | 13 | 45 | 40 |
|  | ASCOWELL C | Above $71 / 4$ " | 100 | 135 |  |  |  | 0 |
| HWDP-110 HW MS |  | Up to $63 / 4$ " | 110 | 140 | 285 to 340 | 13 | 45 | 55 |
|  |  | Above $63 / 4$ " (up to $81 / 4$ ) | 100 | 135 |  |  |  |  |
| HWDP-65 HW MS (tool joint) | ASCOWELL C | Up to $63 / 4$ " | 110 | 140 | 285 to 340 | 13 | 45 | 55 |
|  |  | Above $63 / 4$ " (up to $81 / 4$ ) | 100 | 135 |  |  |  |  |
| HWDP-65 HW MS (central part) | AISI 1340-modified | All | 65 | 95 | 235 (max) | 18 | N/A | 30 |

## Operational Benefits

COMMAND SMFI has been producing high quality Heavy Weight Drill Pipe for over 60 years and is one of the few global suppliers that can offer both HWDP products manufactured from solid bars or assembled from tubes. Our quality standards, manufacturing processes, internal sourcing of green tubes and tool joints, premium connections and product traceability guarantee product performance and reliability.

# Heavy Weight Drill Pipe Manufacturing Flow Chart 

## Central Body

Tool Joint



Heavy weight drill pipe is manufactured to customer requirements and, where applicable, to specifications such as API, ISO, NS1, DS1, etc.

Heavy Weight Drill Pipe Data

| Pipe Body |  |  |  |  |  |  | Tool Joint |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Tube OD | Construction | Tube ID | Central Upset $\varnothing$ | Tube Yield | Torsional Strength | Tensile Strength | Connection | $\begin{aligned} & \text { TJ } \\ & \text { OD } \end{aligned}$ | $\begin{aligned} & \text { TJ } \\ & \text { ID } \end{aligned}$ | TJ Yield |
| in |  | in | in | ksi | ft -\|bs | Ibs |  | in | in | ksi |
| 2-7/8 | Integral | 1-1/2 | 3-3/8 | 110 | 22,900 | 520,000 | $27 / 8$ PAC | 3-1/8 | 1-1/2 | 110 |
| 2-7/8 | Integral | 1-1/2 | 3-3/8 | 110 | 22,900 | 520,000 | NC26 | 3-5/8 | 1-1/2 | 110 |
| 2-7/8 | Integral | 2-1/16 | 3-3/8 | 110 | 18,100 | 347,000 | NC31 | 4-1/8 | 2-1/16 | 110 |
| 2-7/8 | Integral | 2-1/8 | 3-3/8 | 110 | 17,300 | 324,000 | $27 / 80 \mathrm{H}$ | 3-7/8 | 2-1/8 | 110 |
| $27 / 8$ | Integral | 2-1/8 | 3-3/8 | 110 | 17,300 | 324,000 | $27 / 8$ SLH-90 | 4 | 2-1/8 | 110 |
| 2-7/8 | Integral | 2-1/8 | 3-3/8 | 110 | 17,300 | 324,000 | $27 / 8$ SLH-90 | 4-1/8 | 2-1/8 | 110 |
| 2-7/8 | Integral | 2-1/8 | 3-3/8 | 110 | 17,300 | 324,000 | NC31 | 4-1/8 | 2-1/8 | 110 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC31 | 4-1/8 | 2-1/16 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 4-3/4 | 2-11/16 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 4-3/4 | 2-1/16 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 4-3/4 | 2-1/8 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 4-3/4 | 2-3/16 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 4-3/4 | 2-1/4 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 4-3/4 | 2-5/16 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 4-3/4 | 2-3/8 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 4-3/4 | 2-7/16 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 4-3/4 | 2-9/16 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 5 | 2-7/16 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 5 | 2-1/4 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 5 | 2-1/8 | 120 |
| 3-1/2 | Welded | 2-1/16 | 4 | 55 | 19,600 | 345,000 | NC38 | 5 | 2-1/16 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC31 | 4-1/8 | 2-1/16 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 4-3/4 | 2-11/16 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 4-3/4 | 2-1/16 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 4-3/4 | 2-1/8 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 4-3/4 | 2-3/16 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 4-3/4 | 2-1/4 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 4-3/4 | 2-5/16 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 4-3/4 | 2-3/8 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 4-3/4 | 2-7/16 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 4-3/4 | 2-9/16 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 5 | 2-7/16 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 5 | 2-1/4 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 5 | 2-1/8 | 120 |
| 3-1/2 | Welded | 2-1/4 | 4 | 55 | 18,500 | 310,000 | NC38 | 5 | 2-1/16 | 120 |


| Tool Joint |  |  |  |  | Slick |  |  | Spiraled |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Recommended Make-Up | Torsional Strength | Tensile Strength | Box Length | Pin Length | Central Upset | Total Weight | Weight per foot | Unspiraled Upset | Total Weight | Weight per foot |
| ft -lbs | ft -lbs | Ibs | in | in | in | Ibs | $\mathrm{lbs} / \mathrm{ft}$ | in | Ibs | lbs/ft |
| 4,150 | 5,220 | 250,000 | 21 | 27 | 24 | 532 | 17.26 | 25 | 634 | 20.60 |
| 4,670 | 8,220 | 358,000 | 21 | 27 | 24 | 565 | 18.38 | 25 | 668 | 21.72 |
| 6,500 | 11,400 | 432,000 | 21 | 27 | 24 | 440 | 14.33 | 25 | 543 | 17.68 |
| 4,690 | 8,260 | 328,000 | 21 | 27 | 24 | 399 | 12.98 | 25 | 502 | 16.32 |
| 6,050 | 10,600 | 362,000 | 21 | 27 | 24 | 409 | 13.31 | 25 | 512 | 16.65 |
| 6,050 | 10,600 | 362,000 | 21 | 27 | 24 | 420 | 13.66 | 25 | 523 | 17.00 |
| 6,140 | 10,800 | 410,000 | 21 | 27 | 24 | 419 | 13.63 | 25 | 521 | 16.98 |
| 7,490 | 12,500 | 472,000 | 21 | 27 | 24 | 729 | 23.75 | 25 | 859 | 27.98 |
| 10,800 | 18,100 | 587,000 | 21 | 27 | 24 | 785 | 25.60 | 25 | 915 | 29.83 |
| 11,500 | 19,200 | 867,000 | 21 | 27 | 24 | 785 | 25.60 | 25 | 915 | 29.83 |
| 11,500 | 19,200 | 842,000 | 21 | 27 | 24 | 785 | 25.60 | 25 | 915 | 29.83 |
| 11,500 | 19,200 | 817,000 | 21 | 27 | 24 | 785 | 25.60 | 25 | 915 | 29.83 |
| 11,500 | 19,200 | 791,000 | 21 | 27 | 24 | 785 | 25.60 | 25 | 915 | 29.83 |
| 11,500 | 19,200 | 764,000 | 21 | 27 | 24 | 785 | 25.60 | 25 | 915 | 29.83 |
| 11,500 | 19,200 | 736,000 | 21 | 27 | 24 | 785 | 25.60 | 25 | 915 | 29.83 |
| 11,500 | 19,200 | 708,000 | 21 | 27 | 24 | 785 | 25.60 | 25 | 915 | 29.83 |
| 11,500 | 19,200 | 649,000 | 21 | 27 | 24 | 785 | 25.60 | 25 | 915 | 29.83 |
| 13,200 | 22,000 | 708,000 | 21 | 27 | 24 | 811 | 26.44 | 25 | 941 | 30.67 |
| 14,900 | 24,800 | 791,000 | 21 | 27 | 24 | 811 | 26.44 | 25 | 941 | 30.67 |
| 15,900 | 26,500 | 842,000 | 21 | 27 | 24 | 811 | 26.44 | 25 | 941 | 30.67 |
| 16,100 | 26,800 | 867,000 | 21 | 27 | 24 | 811 | 26.44 | 25 | 941 | 30.67 |
| 7,490 | 12,500 | 472,000 | 21 | 27 | 24 | 663 | 21.60 | 25 | 793 | 25.82 |
| 10,800 | 18,100 | 587,000 | 21 | 27 | 24 | 719 | 23.44 | 25 | 849 | 27.67 |
| 11,500 | 19,200 | 867,000 | 21 | 27 | 24 | 719 | 23.44 | 25 | 849 | 27.67 |
| 11,500 | 19,200 | 842,000 | 21 | 27 | 24 | 719 | 23.44 | 25 | 849 | 27.67 |
| 11,500 | 19,200 | 817,000 | 21 | 27 | 24 | 719 | 23.44 | 25 | 849 | 27.67 |
| 11,500 | 19,200 | 791,000 | 21 | 27 | 24 | 719 | 23.44 | 25 | 849 | 27.67 |
| 11,500 | 19,200 | 764,000 | 21 | 27 | 24 | 719 | 23.44 | 25 | 849 | 27.67 |
| 11,500 | 19,200 | 736,000 | 21 | 27 | 24 | 719 | 23.44 | 25 | 849 | 27.67 |
| 11,500 | 19,200 | 708,000 | 21 | 27 | 24 | 719 | 23.44 | 25 | 849 | 27.67 |
| 11,500 | 19,200 | 649,000 | 21 | 27 | 24 | 719 | 23.44 | 25 | 849 | 27.67 |
| 13,200 | 22,000 | 708,000 | 21 | 27 | 24 | 745 | 24.28 | 25 | 874 | 28.51 |
| 14,900 | 24,800 | 791,000 | 21 | 27 | 24 | 745 | 24.28 | 25 | 874 | 28.51 |
| 15,900 | 26,500 | 842,000 | 21 | 27 | 24 | 745 | 24.28 | 25 | 874 | 28.51 |
| 16,100 | 26,800 | 867,000 | 21 | 27 | 24 | 745 | 24.28 | 25 | 874 | 28.51 |

Heavy Weight Drill Pipe Data

| Pipe Body |  |  |  |  |  |  | Tool Joint |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Tube OD | Construction | Tube ID | Central Upset Ø | Tube Yield | Torsional Strength | Tensile Strength | Connection | $\begin{aligned} & \text { TJ } \\ & \text { OD } \end{aligned}$ | TJ | TJ Yield |
| in |  | in | in | ksi | ft-lbs | Ibs |  | in | in | ksi |
| 4 | Welded | 2-1/2 | 4-1/2 | 55 | 28,200 | 421,000 | NC38 | 4-3/4 | 2-9/16 | 120 |
| 4 | Welded | 2-1/2 | 4-1/2 | 55 | 28,200 | 421,000 | NC38 | 4-7/8 | 2-9/16 | 120 |
| 4 | Welded | 2-1/2 | 4-1/2 | 55 | 28,200 | 421,000 | NC38 | 5 | 2-9/16 | 120 |
| 4 | Welded | 2-1/2 | 4-1/2 | 55 | 28,200 | 421,000 | NC38 | 4-7/8 | 2-7/16 | 120 |
| 4 | Welded | 2-1/2 | 4-1/2 | 55 | 28,200 | 421,000 | NC38 | 5 | 2-7/16 | 120 |
| 4 | Welded | 2-1/2 | 4-1/2 | 55 | 28,200 | 421,000 | NC38 | 5 | 2-1/4 | 120 |
| 4 | Welded | 2-1/2 | 4-1/2 | 55 | 28,200 | 421,000 | NC40 | 5-1/2 | 2-7/16 | 120 |
| 4 | Welded | 2-1/2 | 4-1/2 | 55 | 28,200 | 421,000 | NC46 | 6 | 3-1/4 | 120 |
| 4 | Welded | 2-1/2 | 4-1/2 | 55 | 28,200 | 421,000 | NC46 | 6 | 3 | 120 |
| 4 | Welded | 2-9/16 | 4-1/2 | 55 | 27,600 | 408,000 | NC38 | 4-3/4 | 2-9/16 | 120 |
| 4 | Welded | 2-9/16 | 4-1/2 | 55 | 27,600 | 408,000 | NC38 | 4-7/8 | 2-9/16 | 120 |
| 4 | Welded | 2-9/16 | 4-1/2 | 55 | 27,600 | 408,000 | NC38 | 5 | 2-9/16 | 120 |
| 4-1/2 | Welded | 2-1/2 | 5 | 55 | 42,800 | 605,000 | NC40 | 5-1/2 | 2-13/16 | 120 |
| 4-1/2 | Welded | 2-1/2 | 5 | 55 | 42,800 | 605,000 | NC46 | 6-1/4 | 3-1/4 | 120 |
| 4-1/2 | Welded | 2-1/2 | 5 | 55 | 42,800 | 605,000 | NC50 | 6-5/8 | 3-3/4 | 120 |
| 4-1/2 | Welded | 2-1/2 | 5 | 55 | 42,800 | 605,000 | NC46 | 6-1/4 | 3 | 120 |
| 4-1/2 | Welded | 2-1/2 | 5 | 55 | 42,800 | 605,000 | NC46 | 6-1/4 | 2-7/8 | 120 |
| 4-1/2 | Welded | 2-1/2 | 5 | 55 | 42,800 | 605,000 | NC46 | 6-1/4 | 2-13/16 | 120 |
| 4-1/2 | Welded | 2-1/2 | 5 | 55 | 42,800 | 605,000 | NC46 | 6-1/4 | 2-3/4 | 120 |
| 4-1/2 | Welded | 2-1/2 | 5 | 55 | 42,800 | 605,000 | NC50 | 6-5/8 | 3-1/2 | 120 |
| 4-1/2 | Welded | 2-1/2 | 5 | 55 | 42,800 | 605,000 | NC46 | 6-1/4 | 2-1/2 | 120 |
| 4-1/2 | Welded | 2-1/2 | 5 | 55 | 42,800 | 605,000 | NC46 | 6-1/4 | 2-1/4 | 120 |
| 4-1/2 | Welded | 2-1/2 | 5 | 55 | 42,800 | 605,000 | NC50 | 6-5/8 | 3 | 120 |
| 4-1/2 | Welded | 2-13/16 | 5 | 55 | 40,100 | 533,000 | NC40 | 5-1/2 | 2-13/16 | 120 |
| 4-1/2 | Welded | 2-13/16 | 5 | 55 | 40,100 | 533,000 | NC50 | 6-5/8 | 3-3/4 | 120 |
| 4-1/2 | Welded | 2-13/16 | 5 | 55 | 40,100 | 533,000 | NC46 | 6-1/4 | 3 | 120 |
| 4-1/2 | Welded | 2-13/16 | 5 | 55 | 40,100 | 533,000 | NC46 | 6-1/4 | 2-13/16 | 120 |
| 4-1/2 | Welded | 2-13/16 | 5 | 55 | 40,100 | 533,000 | NC46 | 6-1/4 | 2-3/4 | 120 |
| 4-1/2 | Welded | 2-13/16 | 5 | 55 | 40,100 | 533,000 | NC50 | 6-5/8 | 3-1/2 | 120 |
| 4-1/2 | Welded | 2-13/16 | 5 | 55 | 40,100 | 533,000 | NC50 | 6-5/8 | 3 | 120 |
| 5 | Welded | 3 | 5-1/2 | 55 | 56,500 | 691,000 | NC50 | 6-5/8 | 3 | 120 |
| 5 | Welded | 3 | 5-1/2 | 55 | 56,500 | 691,000 | $51 / 2 \mathrm{FH}$ | 7 | 3-3/4 | 120 |
| 5 | Welded | 3 | 5-1/2 | 55 | 56,500 | 691,000 | NC50 | 6-5/8 | 2-3/4 | 120 |
| 5 | Welded | 3 | 5-1/2 | 55 | 56,500 | 691,000 | $51 / 2 \mathrm{FH}$ | 7-1/4 | 3-1/2 | 120 |


|  | Tool Joint |  |  |  |  | Slick |  |  | Spiraled |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Recommended Make-Up Torque ft -Ibs | Torsional Strength | Tensile Strength | Box Length | Pin Length | Central <br> Upset <br> Length in | Total Weight | Weight per foot | Unspiraled Upset Length in | Total Weight | Weight per foot |
|  |  | ft -lbs | Ibs | in | in |  | Ibs | lbs/ft |  | Ibs | lbs/ft |
| 4 | 11,500 | 19,200 | 649,000 | 21 | 27 | 24 | 893 | 29.13 | 25 | 1,045 | 34.07 |
| 4 | 12,100 | 20,100 | 649,000 | 21 | 27 | 24 | 906 | 29.53 | 25 | 1,057 | 34.47 |
| 4 | 12,100 | 20,100 | 649,000 | 21 | 27 | 24 | 918 | 29.94 | 25 | 1,070 | 34.88 |
| 4 | 13,200 | 22,000 | 708,000 | 21 | 27 | 24 | 906 | 29.53 | 25 | 1,057 | 34.47 |
| 4 | 13,200 | 22,000 | 708,000 | 21 | 27 | 24 | 918 | 29.94 | 25 | 1,070 | 34.88 |
| 4 | 14,900 | 24,800 | 791,000 | 21 | 27 | 24 | 918 | 29.94 | 25 | 1,070 | 34.88 |
| 4 | 17,900 | 29,800 | 897,000 | 21 | 27 | 24 | 971 | 31.69 | 25 | 1,122 | 36.64 |
| 4 | 19,900 | 33,200 | 901,000 | 21 | 27 | 24 | 1,032 | 33.69 | 25 | 1,183 | 38.64 |
| 4 | 23,400 | 39,000 | 1,050,000 | 21 | 27 | 24 | 1,032 | 33.69 | 25 | 1,183 | 38.64 |
| 4 | 11,500 | 19,200 | 649,000 | 21 | 27 | 24 | 867 | 28.28 | 25 | 1,019 | 33.22 |
| 4 | 12,100 | 20,100 | 649,000 | 21 | 27 | 24 | 880 | 28.68 | 25 | 1,031 | 33.62 |
| 4 | 12,100 | 20,100 | 649,000 | 21 | 27 | 24 | 892 | 29.10 | 25 | 1,044 | 34.04 |
| 4-1/2 | 14,000 | 23,300 | 712,000 | 21 | 27 | 24 | 1,277 | 41.70 | 25 | 1,451 | 47.37 |
| 4-1/2 | 19,900 | 33,200 | 901,000 | 21 | 27 | 24 | 1,369 | 44.71 | 25 | 1,543 | 50.38 |
| 4-1/2 | 22,400 | 37,300 | 939,000 | 21 | 27 | 24 | 1,421 | 46.40 | 25 | 1,595 | 52.07 |
| 4-1/2 | 23,400 | 39,000 | 1,050,000 | 21 | 27 | 24 | 1,369 | 44.71 | 25 | 1,543 | 50.38 |
| 4-1/2 | 25,000 | 41,700 | 1,120,000 | 21 | 27 | 24 | 1,369 | 44.71 | 25 | 1,543 | 50.38 |
| 4-1/2 | 25,800 | 43,100 | 1,150,000 | 21 | 27 | 24 | 1,369 | 44.71 | 25 | 1,543 | 50.38 |
| 4-1/2 | 26,600 | 44,400 | 1,180,000 | 21 | 27 | 24 | 1,369 | 44.71 | 25 | 1,543 | 50.38 |
| 4-1/2 | 26,700 | 44,500 | 1,110,000 | 21 | 27 | 24 | 1,421 | 46.40 | 25 | 1,595 | 52.07 |
| 4-1/2 | 29,600 | 49,300 | 1,310,000 | 21 | 27 | 24 | 1,369 | 44.71 | 25 | 1,543 | 50.38 |
| 4-1/2 | 32,300 | 53,800 | 1,420,000 | 21 | 27 | 24 | 1,369 | 44.71 | 25 | 1,543 | 50.38 |
| 4-1/2 | 34,500 | 57,500 | 1,420,000 | 21 | 27 | 24 | 1,421 | 46.40 | 25 | 1,595 | 52.07 |
| 4-1/2 | 14,000 | 23,300 | 712,000 | 21 | 27 | 24 | 1,141 | 37.27 | 25 | 1,315 | 42.94 |
| 4-1/2 | 22,400 | 37,300 | 939,000 | 21 | 27 | 24 | 1,285 | 41.97 | 25 | 1,459 | 47.64 |
| 4-1/2 | 23,400 | 39,000 | 1,050,000 | 21 | 27 | 24 | 1,233 | 40.28 | 25 | 1,407 | 45.94 |
| 4-1/2 | 25,800 | 43,100 | 1,150,000 | 21 | 27 | 24 | 1,233 | 40.28 | 25 | 1,407 | 45.94 |
| 4-1/2 | 26,600 | 44,400 | 1,180,000 | 21 | 27 | 24 | 1,233 | 40.28 | 25 | 1,407 | 45.94 |
| 4-1/2 | 26,700 | 44,500 | 1,110,000 | 21 | 27 | 24 | 1,285 | 41.97 | 25 | 1,459 | 47.64 |
| 4-1/2 | 34,500 | 57,500 | 1,420,000 | 21 | 27 | 24 | 1,285 | 41.97 | 25 | 1,459 | 47.64 |
| 5 | 34,500 | 57,500 | 1,420,000 | 21 | 27 | 24 | 1,536 | 50.17 | 25 | 1,732 | 56.56 |
| 5 | 37,700 | 62,900 | 1,450,000 | 21 | 27 | 24 | 1,587 | 51.88 | 25 | 1,782 | 58.28 |
| 5 | 38,000 | 63,400 | 1,550,000 | 21 | 27 | 24 | 1,536 | 50.17 | 25 | 1,732 | 56.56 |
| 5 | 43,300 | 72,200 | 1,620,000 | 21 | 27 | 24 | 1,625 | 53.13 | 25 | 1,821 | 59.53 |

## Heavy Weight Drill Pipe Data

| Pipe Body |  |  |  |  |  |  | Tool Joint |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Tube OD | Construction | Tube ID | Central Upset $\varnothing$ | Tube Yield | Torsional Strength | Tensile Strength | Connection | $\begin{aligned} & \text { TJ } \\ & \text { OD } \end{aligned}$ | $\begin{aligned} & \text { TJ } \\ & \text { ID } \end{aligned}$ | TJ Yield |
| in |  | in | in | ksi | ft-Ibs | lbs |  | in | in | ksi |
| 5-1/2 | Welded | 3-5/8 | 6 | 55 | 70,100 | 739,000 | $51 / 2 \mathrm{FH}$ | 7-1/4 | 3-1/2 | 120 |
| 5-1/2 | Welded | 3-5/8 | 6 | 55 | 70,100 | 739,000 | $51 / 2 \mathrm{FH}$ | 7-1/2 | 3 | 120 |
| 5-1/2 | Welded | 3-7/8 | 6 | 55 | 65,100 | 658,000 | $51 / 2 \mathrm{FH}$ | 7-1/4 | 3-1/2 | 120 |
| 5-1/2 | Welded | 3-7/8 | 6 | 55 | 65,100 | 658,000 | $51 / 2 \mathrm{FH}$ | 7-1/2 | 3 | 120 |
| 6-5/8 | Welded | 5 | 7 | 55 | 102,000 | 816,000 | $65 / 8 \mathrm{FH}$ | 8-1/4 | 4-3/4 | 120 |
| 6-5/8 | Welded | 5 | 7 | 55 | 102,000 | 816,000 | $65 / 8 \mathrm{FH}$ | 8-1/2 | 4-1/4 | 120 |

## 5-1/2" - 6-5/8"

| Tool Joint |  |  |  |  | Slick |  |  | Spiraled |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Recommended Make-Up | Torsional Strength | Tensile Strength | $\begin{aligned} & \text { Box } \\ & \text { Length } \end{aligned}$ | $\begin{gathered} \text { Pin } \\ \text { Length } \end{gathered}$ | Central Upset <br> Length | Total Weight | Weight per foot | Unspiraled Upset Length in | Total Weight | Weight per foot |
| ft-Ibs | ft -Ibs | Ibs | in | in |  | Ibs | $\mathrm{lbs} / \mathrm{ft}$ |  | Ibs | lbs/ft |
| 43,300 | 72,200 | 1,620,000 | 21 | 27 | 24 | 1,662 | 54.34 | 25 | 1,880 | 61.47 |
| 52,100 | 86,800 | 1,930,000 | 21 | 27 | 24 | 1,701 | 55.62 | 25 | 1,919 | 62.75 |
| 43,300 | 72,200 | 1,620,000 | 21 | 27 | 24 | 1,509 | 49.33 | 25 | 1,727 | 56.47 |
| 52,100 | 86,800 | 1,930,000 | 21 | 27 | 24 | 1,548 | 50.61 | 25 | 1,766 | 57.75 |
| 51,300 | 85,500 | 1,680,000 | 21 | 27 | 24 | 1,822 | 59.58 | 25 | 2,031 | 66.40 |
| 65,000 | 108,000 | 2,100,000 | 21 | 27 | 24 | 1,866 | 61.03 | 25 | 2,075 | 67.85 |

Heavy Weight Drill Pipe Data Sour Service

| Pipe Body |  |  |  |  |  |  | Tool Joint |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Tube OD | Construction | Tube ID | Central Upset $\varnothing$ | Tube Yield | Torsional Strength | Tensile Strength | Connection | $\begin{aligned} & \text { TJ } \\ & \text { OD } \end{aligned}$ | $\begin{aligned} & \text { TJ } \\ & \text { ID } \end{aligned}$ | TJ Yield |
| in |  | in | in | ksi | ft-Ibs | Ibs |  | in | in | ksi |
| 3-1/2 | HWDP-110 HW MS | 2-3/16 | 4 | 110 | 37,700 | 645,000 | NC38 | 4-3/4 | 2-3/16 | 110 |
| 3-1/2 | HWDP-110 HW MS | 2-1/16 | 4 | 110 | 39,200 | 691,000 | NC38 | 4-3/4 | 2-1/16 | 110 |
| 3-1/2 | HWDP-110 HW MS | 2-1/16 | 4 | 110 | 39,200 | 691,000 | NC38 | 5 | 2-1/16 | 110 |
| 4-1/2 | HWDP-110 HW MS | 2-13/16 | 5 | 110 | 80,200 | 1,070,000 | NC46 | 6-1/4 | 2-13/16 | 110 |
| 5 | HWDP-110 HW MS | 3 | 5-1/2 | 110 | 113,000 | 1,380,000 | NC50 | 6-1/2 | 3 | 110 |
| 5 | HWDP-110 HW MS | 3 | 5-1/2 | 110 | 113,000 | 1,380,000 | NC50 | 6-5/8 | 3 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/16 | 4 | 65 | 23,100 | 408,000 | NC38 | 4-3/4 | 2-1/16 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/16 | 4 | 65 | 23,100 | 408,000 | NC38 | 4-3/4 | 2-1/8 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/16 | 4 | 65 | 23,100 | 408,000 | NC38 | 4-3/4 | 2-3/16 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-3/16 | 4 | 65 | 22,300 | 381,000 | NC38 | 4-3/4 | 2-3/16 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/4 | 4 | 65 | 21,800 | 367,000 | NC38 | 4-3/4 | 2-3/16 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/16 | 4 | 65 | 23,100 | 408,000 | NC38 | 4-3/4 | 2-1/4 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/4 | 4 | 65 | 21,800 | 367,000 | NC38 | 4-3/4 | 2-1/4 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/16 | 4 | 65 | 23,100 | 408,000 | NC38 | 4-3/4 | 2-5/16 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/16 | 4 | 65 | 23,100 | 408,000 | NC38 | 4-3/4 | 2-3/8 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/4 | 4 | 65 | 21,800 | 367,000 | NC38 | 4-3/4 | 2-3/8 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-3/8 | 4 | 65 | 20,700 | 337,000 | NC38 | 4-3/4 | 2-3/8 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/16 | 4 | 65 | 23,100 | 408,000 | NC38 | 4-7/8 | 2-1/16 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/4 | 4 | 65 | 21,800 | 367,000 | NC38 | 4-7/8 | 2-1/4 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/4 | 4 | 65 | 21,800 | 367,000 | NC38 | 4-7/8 | 2-5/16 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/16 | 4 | 65 | 23,100 | 408,000 | NC38 | 5 | 2-1/16 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-3/16 | 4 | 65 | 22,300 | 381,000 | NC38 | 5 | 2-3/16 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/4 | 4 | 65 | 21,800 | 367,000 | NC38 | 5 | 2-3/16 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/16 | 4 | 65 | 23,100 | 408,000 | NC38 | 5 | 2-1/4 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/4 | 4 | 65 | 21,800 | 367,000 | NC38 | 5 | 2-1/4 | 110 |
| 3-1/2 | HWDP-65 HW MS | 2-1/16 | 4 | 65 | 23,100 | 408,000 | NC38 | 5 | 2-7/16 | 110 |
| 4 | HWDP-65 HW MS | 2-1/2 | 4-1/2 | 65 | 33,300 | 498,000 | NC38 | 5 | 2-9/16 | 110 |
| 4 | HWDP-65 HW MS | 2-1/2 | 4-1/2 | 65 | 33,300 | 498,000 | NC40 | 5-1/4 | 2-1/2 | 110 |
| 4-1/2 | HWDP-65 HW MS | 2-13/16 | 5 | 65 | 47,400 | 630,000 | NC46 | 6-1/4 | 2-13/16 | 110 |
| 4-1/2 | HWDP-65 HW MS | 2-3/4 | 5 | 65 | 48,100 | 648,000 | NC46 | 6-1/4 | 2-7/8 | 110 |
| 4-1/2 | HWDP-65 HW MS | 2-13/16 | 5 | 65 | 47,400 | 630,000 | NC46 | 6-1/2 | 2-13/16 | 110 |
| 5 | HWDP-65 HW MS | 3 | 5-1/2 | 65 | 66,800 | 817,000 | NC50 | 6-1/2 | 3 | 110 |
| 5 | HWDP-65 HW MS | 3 | 5-1/2 | 65 | 66,800 | 817,000 | NC50 | 6-1/2 | 3-1/16 | 110 |
| 5 | HWDP-65 HW MS | 3 | 5-1/2 | 65 | 66,800 | 817,000 | NC50 | 6-1/2 | 3-1/8 | 110 |
| 5 | HWDP-65 HW MS | 3-1/8 | 5-1/2 | 65 | 65,000 | 778,000 | NC50 | 6-1/2 | 3-1/8 | 110 |
| 5 | HWDP-65 HW MS | 3 | 5-1/2 | 65 | 66,800 | 817,000 | NC50 | 6-1/2 | 3-1/8 | 110 |
| 5 | HWDP-65 HW MS | 2-3/4 | 5-1/2 | 65 | 69,700 | 890,000 | NC50 | 6-5/8 | 2-3/4 | 110 |
| 5 | HWDP-65 HW MS | 2-13/16 | 5-1/2 | 65 | 69,000 | 872,000 | NC50 | 6-5/8 | 2-13/16 | 110 |
| 5 | HWDP-65 HW MS | 3 | 5-1/2 | 65 | 66,800 | 817,000 | NC50 | 6-5/8 | 3 | 110 |
| 5 | HWDP-65 HW MS | 3 | 5-1/2 | 65 | 66,800 | 817,000 | NC50 | 6-5/8 | 3-1/16 | 110 |
| 5 | HWDP-65 HW MS | 3-1/16 | 5-1/2 | 65 | 65,900 | 797,000 | NC50 | 6-5/8 | 3-1/16 | 110 |
| 5 | HWDP-65 HW MS | 3 | 5-1/2 | 65 | 66,800 | 817,000 | NC50 | 6-5/8 | 3-1/8 | 110 |
| 5 | HWDP-65 HW MS | 3 | 5-1/2 | 65 | 66,800 | 817,000 | NC50 | 6-5/8 | 3-1/4 | 110 |


| Tool Joint |  |  |  |  | Slick |  |  | Spiraled |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Recommended Make-Up | Torsional Strength | Tensile Strength | Box Length | $\begin{aligned} & \text { Pin } \\ & \text { Length } \end{aligned}$ | Central <br> Upset | Total Weight | Weight per foot | Unspiraled Upset | Total Weight | Weight per foot |
| ft-lbs | ft -lbs | Ibs | in | in | in | Ibs | Ibs/ft | in | Ibs | lbs/ft |
| 9,990 | 17,600 | 749,000 | 21 | 27 | 25 | 742 | 24.19 | 25 | 871 | 28.41 |
| 9,990 | 17,600 | 795,000 | 21 | 27 | 25 | 785 | 25.60 | 25 | 915 | 29.83 |
| 13,900 | 24,600 | 795,000 | 21 | 27 | 25 | 811 | 26.44 | 25 | 941 | 30.67 |
| 22,400 | 39,500 | 1,050,000 | 21 | 27 | 25 | 1,233 | 40.28 | 25 | 1,407 | 45.94 |
| 29,700 | 52,200 | 1,300,000 | 21 | 27 | 25 | 1,519 | 49.60 | 25 | 1,715 | 56.00 |
| 30,000 | 52,700 | 1,300,000 | 21 | 27 | 25 | 1,536 | 50.17 | 25 | 1,732 | 56.56 |
| 9,990 | 17,600 | 795,000 | 21 | 27 | 25 | 785 | 25.60 | 25 | 915 | 29.83 |
| 9,990 | 17,600 | 772,000 | 21 | 27 | 25 | 785 | 25.60 | 25 | 915 | 29.83 |
| 9,990 | 17,600 | 749,000 | 21 | 27 | 25 | 785 | 25.60 | 25 | 915 | 29.83 |
| 9,990 | 17,600 | 749,000 | 21 | 27 | 25 | 742 | 24.19 | 25 | 871 | 28.41 |
| 9,990 | 17,600 | 749,000 | 21 | 27 | 25 | 719 | 23.44 | 25 | 849 | 27.67 |
| 9,990 | 17,600 | 725,000 | 21 | 27 | 25 | 785 | 25.60 | 25 | 915 | 29.83 |
| 9,990 | 17,600 | 725,000 | 21 | 27 | 25 | 719 | 23.44 | 25 | 849 | 27.67 |
| 9,990 | 17,600 | 700,000 | 21 | 27 | 25 | 785 | 25.60 | 25 | 915 | 29.83 |
| 9,990 | 17,600 | 675,000 | 21 | 27 | 25 | 785 | 25.60 | 25 | 915 | 29.83 |
| 9,990 | 17,600 | 675,000 | 21 | 27 | 25 | 719 | 23.44 | 25 | 849 | 27.67 |
| 9,990 | 17,600 | 675,000 | 21 | 27 | 25 | 672 | 21.90 | 25 | 801 | 26.13 |
| 11,900 | 21,000 | 795,000 | 21 | 27 | 25 | 798 | 26.02 | 25 | 927 | 30.24 |
| 11,900 | 21,000 | 725,000 | 21 | 27 | 25 | 732 | 23.86 | 25 | 861 | 28.08 |
| 11,900 | 21,000 | 700,000 | 21 | 27 | 25 | 732 | 23.86 | 25 | 861 | 28.08 |
| 13,900 | 24,600 | 795,000 | 21 | 27 | 25 | 811 | 26.44 | 25 | 941 | 30.67 |
| 13,400 | 23,500 | 749,000 | 21 | 27 | 25 | 767 | 25.02 | 25 | 897 | 29.25 |
| 13,400 | 23,500 | 749,000 | 21 | 27 | 25 | 745 | 24.28 | 25 | 874 | 28.51 |
| 12,900 | 22,700 | 725,000 | 21 | 27 | 25 | 811 | 26.44 | 25 | 941 | 30.67 |
| 12,900 | 22,700 | 725,000 | 21 | 27 | 25 | 745 | 24.28 | 25 | 874 | 28.51 |
| 11,500 | 20,200 | 649,000 | 21 | 27 | 25 | 811 | 26.44 | 25 | 941 | 30.67 |
| 10,500 | 18,400 | 595,000 | 21 | 27 | 25 | 918 | 29.94 | 25 | 1,070 | 34.88 |
| 15,000 | 26,300 | 796,000 | 21 | 27 | 25 | 943 | 30.78 | 25 | 1,094 | 35.73 |
| 22,400 | 39,500 | 1,050,000 | 21 | 27 | 25 | 1,233 | 40.28 | 25 | 1,407 | 45.94 |
| 21,700 | 38,300 | 1,020,000 | 21 | 27 | 25 | 1,262 | 41.20 | 25 | 1,435 | 46.87 |
| 22,400 | 39,500 | 1,050,000 | 21 | 27 | 25 | 1,268 | 41.39 | 25 | 1,441 | 47.06 |
| 29,700 | 52,200 | 1,300,000 | 21 | 27 | 25 | 1,519 | 49.60 | 25 | 1,715 | 56.00 |
| 29,200 | 51,300 | 1,270,000 | 21 | 27 | 25 | 1,519 | 49.60 | 25 | 1,715 | 56.00 |
| 28,300 | 49,900 | 1,230,000 | 21 | 27 | 25 | 1,519 | 49.60 | 25 | 1,715 | 56.00 |
| 28,300 | 49,900 | 1,230,000 | 21 | 27 | 25 | 1,456 | 47.56 | 25 | 1,652 | 53.95 |
| 28,300 | 49,900 | 1,230,000 | 21 | 27 | 25 | 1,519 | 49.60 | 25 | 1,715 | 56.00 |
| 33,000 | 58,100 | 1,420,000 | 21 | 27 | 25 | 1,654 | 54.00 | 25 | 1,850 | 60.40 |
| 32,300 | 56,800 | 1,390,000 | 21 | 27 | 25 | 1,625 | 53.08 | 25 | 1,821 | 59.47 |
| 30,000 | 52,700 | 1,300,000 | 21 | 27 | 25 | 1,536 | 50.17 | 25 | 1,732 | 56.56 |
| 29,200 | 51,300 | 1,270,000 | 21 | 27 | 25 | 1,536 | 50.17 | 25 | 1,732 | 56.56 |
| 29,200 | 51,300 | 1,270,000 | 21 | 27 | 25 | 1,505 | 49.15 | 25 | 1,701 | 55.55 |
| 28,300 | 49,900 | 1,230,000 | 21 | 27 | 25 | 1,536 | 50.17 | 25 | 1,732 | 56.56 |
| 26,700 | 46,900 | 1,160,000 | 21 | 27 | 25 | 1,536 | 50.17 | 25 | 1,732 | 56.56 |

Heavy Weight Drill Pipe Data Sour Service

| Pipe Body |  |  |  |  |  |  | Tool Joint |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Tube OD | Construction | Tube ID | Central Upset $\varnothing$ | Tube Yield | Torsional Strength | Tensile Strength | Connection | $\begin{aligned} & \text { TJ } \\ & \text { OD } \end{aligned}$ | $\begin{aligned} & \text { TJ } \\ & \text { ID } \end{aligned}$ | TJ Yield |
| in |  | in | in | ksi | ft-lbs | Ibs |  | in | in | ksi |
| 5-1/2 | HWDP-65 HW MS | 3-1/8 | 6 | 65 | 91,500 | 1,050,000 | NC50 | 6-7/8 | 3-1/4 | 110 |
| 5-1/2 | HWDP-65 HW MS | 3-1/2 | 6 | 65 | 85,400 | 919,000 | $51 / 2 \mathrm{FH}$ | 7 | 3-1/2 | 110 |
| 5-1/2 | HWDP-65 HW MS | 3-5/8 | 6 | 65 | 82,800 | 873,000 | $51 / 2 \mathrm{FH}$ | 7 | 3-5/8 | 110 |
| 5-1/2 | HWDP-65 HW MS | 3-7/8 | 6 | 65 | 76,900 | 778,000 | $51 / 2 \mathrm{FH}$ | 7 | 3-5/8 | 110 |
| 5-1/2 | HWDP-65 HW MS | 3-7/8 | 6 | 65 | 76,900 | 778,000 | $51 / 2 \mathrm{FH}$ | 7 | 3-7/8 | 110 |
| 5-1/2 | HWDP-65 HW MS | 3-1/4 | 6 | 65 | 89,700 | 1,010,000 | $51 / 2 \mathrm{FH}$ | 7-1/4 | 3-1/4 | 100 |
| 5-1/2 | HWDP-65 HW MS | 3-1/4 | 6 | 65 | 89,700 | 1,010,000 | $51 / 2 \mathrm{FH}$ | 7-1/4 | 3-5/16 | 100 |
| 5-1/2 | HWDP-65 HW MS | 3-1/4 | 6 | 65 | 89,700 | 1,010,000 | $51 / 2 \mathrm{FH}$ | 7-1/4 | 3-1/2 | 100 |
| 5-1/2 | HWDP-65 HW MS | 3-1/2 | 6 | 65 | 85,400 | 919,000 | $51 / 2 \mathrm{FH}$ | 7-1/4 | 3-1/2 | 100 |
| 5-1/2 | HWDP-65 HW MS | 3-7/8 | 6 | 65 | 76,900 | 778,000 | $51 / 2 \mathrm{FH}$ | 7-1/4 | 3-1/2 | 100 |
| 5-1/2 | HWDP-65 HW MS | 3-5/8 | 6 | 65 | 82,800 | 873,000 | $51 / 2 \mathrm{FH}$ | 7-1/4 | 3-5/8 | 100 |
| 5-1/2 | HWDP-65 HW MS | 3-7/8 | 6 | 65 | 76,900 | 778,000 | $51 / 2 \mathrm{FH}$ | 7-1/4 | 3-7/8 | 100 |
| 5-1/2 | HWDP-65 HW MS | 3-7/8 | 6 | 65 | 76,900 | 778,000 | $51 / 2 \mathrm{FH}$ | 7-1/4 | 3-7/8 | 100 |
| 5-1/2 | HWDP-65 HW MS | 3-7/8 | 6 | 65 | 76,900 | 778,000 | $51 / 2 \mathrm{FH}$ | 7-1/2 | 3-1/4 | 100 |
| 5-1/2 | HWDP-65 HW MS | 3-1/2 | 6 | 65 | 85,400 | 919,000 | $51 / 2 \mathrm{FH}$ | 7-1/2 | 3-1/2 | 100 |
| 5-1/2 | HWDP-65 HW MS | 3-7/8 | 6 | 65 | 76,900 | 778,000 | $51 / 2 \mathrm{FH}$ | 7-1/2 | 3-7/8 | 100 |
| 6-5/8 | HWDP-65 HW MS | 4 | 7-1/8 | 65 | 155,000 | 1,420,000 | $65 / 8 \mathrm{FH}$ | 8 | 4 | 100 |
| 6-5/8 | HWDP-65 HW MS | 4 | 7-1/8 | 65 | 155,000 | 1,420,000 | 6 5/8 REG | 8 | 4 | 100 |
| 6-5/8 | HWDP-65 HW MS | 4-1/2 | 7-1/8 | 65 | 140,000 | 1,210,000 | $65 / 8 \mathrm{FH}$ | 8 | 4-1/2 | 100 |
| 6-5/8 | HWDP-65 HW MS | 5 | 7-1/8 | 65 | 121,000 | 964,000 | $65 / 8 \mathrm{FH}$ | 8 | 4-3/4 | 100 |
| 6-5/8 | HWDP-65 HW MS | 5 | 7-1/8 | 65 | 121,000 | 964,000 | $65 / 8 \mathrm{FH}$ | 8 | 5 | 100 |
| 6-5/8 | HWDP-65 HW MS | 4-1/2 | 7-1/8 | 65 | 140,000 | 1,210,000 | $65 / 8 \mathrm{FH}$ | 8-1/4 | 3-1/2 | 100 |
| 6-5/8 | HWDP-65 HW MS | 5 | 7-1/8 | 65 | 121,000 | 964,000 | $65 / 8 \mathrm{FH}$ | 8-1/4 | 4-1/2 | 100 |
| 6-5/8 | HWDP-65 HW MS | 5 | 7-1/8 | 65 | 121,000 | 964,000 | $65 / 8 \mathrm{FH}$ | 8-1/4 | 5 | 100 |
| 6-5/8 | HWDP-65 HW MS | 4 | 7-1/8 | 65 | 155,000 | 1,420,000 | $65 / 8 \mathrm{FH}$ | 8-1/2 | 4 | 100 |
| 6-5/8 | HWDP-65 HW MS | 5 | 7-1/8 | 65 | 121,000 | 964,000 | $65 / 8 \mathrm{FH}$ | 8-1/2 | 4 | 100 |
| 6-5/8 | HWDP-65 HW MS | 4-1/4 | 7-1/8 | 65 | 148,000 | 1,320,000 | $65 / 8 \mathrm{FH}$ | 8-1/2 | 4-1/4 | 100 |
| 6-5/8 | HWDP-65 HW MS | 5 | 7-1/8 | 65 | 121,000 | 964,000 | $65 / 8 \mathrm{FH}$ | 8-1/2 | 4-1/4 | 100 |
| 6-5/8 | HWDP-65 HW MS | 5 | 7-1/8 | 65 | 121,000 | 964,000 | $65 / 8 \mathrm{FH}$ | 8-1/2 | 4-1/2 | 100 |
| 6-5/8 | HWDP-65 HW MS | 5 | 7-1/8 | 65 | 121,000 | 964,000 | $65 / 8 \mathrm{FH}$ | 8-1/2 | 5 | 100 |


| Tool Joint |  |  |  |  | Slick |  |  | Spiraled |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Recommended Make-Up | Torsional Strength | Tensile Strength | Box Length | Pin Length | Central Upset | Tota Weight | Weight per foot | Unspiraled Upset | Total Weight | Weight per foot |
| ft-Ibs | ft -Ibs | Ibs | in | in | in | Ibs | lbs/ft | in | Ibs | lbs/ft |
| 26,700 | 46,900 | 1,160,000 | 21 | 27 | 25 | 1,886 | 61.59 | 25 | 2,104 | 68.72 |
| 32,800 | 57,700 | 1,480,000 | 21 | 27 | 25 | 1,697 | 55.49 | 25 | 1,915 | 62.63 |
| 32,800 | 57,700 | 1,410,000 | 21 | 27 | 25 | 1,624 | 53.11 | 25 | 1,843 | 60.25 |
| 32,800 | 57,700 | 1,410,000 | 21 | 27 | 25 | 1,471 | 48.11 | 25 | 1,690 | 55.25 |
| 31,200 | 55,000 | 1,250,000 | 21 | 27 | 25 | 1,471 | 48.11 | 25 | 1,690 | 55.25 |
| 41,000 | 65,600 | 1,480,000 | 21 | 27 | 25 | 1,872 | 61.22 | 25 | 2,091 | 68.36 |
| 40,600 | 64,900 | 1,450,000 | 21 | 27 | 25 | 1,872 | 61.22 | 25 | 2,091 | 68.36 |
| 37,600 | 60,200 | 1,350,000 | 21 | 27 | 25 | 1,872 | 61.22 | 25 | 2,091 | 68.36 |
| 37,600 | 60,200 | 1,350,000 | 21 | 27 | 25 | 1,735 | 56.71 | 25 | 1,953 | 63.85 |
| 37,600 | 60,200 | 1,350,000 | 21 | 27 | 25 | 1,509 | 49.33 | 25 | 1,727 | 56.47 |
| 35,600 | 56,900 | 1,280,000 | 21 | 27 | 25 | 1,662 | 54.34 | 25 | 1,880 | 61.47 |
| 31,200 | 50,000 | 1,130,000 | 21 | 27 | 25 | 1,509 | 49.33 | 25 | 1,727 | 56.47 |
| 31,200 | 50,000 | 1,130,000 | 21 | 27 | 25 | 1,509 | 49.33 | 25 | 1,727 | 56.47 |
| 41,500 | 66,500 | 1,480,000 | 21 | 27 | 25 | 1,548 | 50.61 | 25 | 1,766 | 57.75 |
| 37,600 | 60,200 | 1,350,000 | 21 | 27 | 25 | 1,774 | 58.00 | 25 | 1,992 | 65.13 |
| 31,200 | 50,000 | 1,130,000 | 21 | 27 | 25 | 1,548 | 50.61 | 25 | 1,766 | 57.75 |
| 45,800 | 73,200 | 1,910,000 | 21 | 27 | 25 | 2,525 | 82.58 | 25 | 2,795 | 91.38 |
| 34,000 | 54,400 | 1,200,000 | 21 | 27 | 25 | 2,525 | 82.58 | 25 | 2,795 | 91.38 |
| 45,800 | 73,200 | 1,580,000 | 21 | 27 | 25 | 2,178 | 71.23 | 25 | 2,448 | 80.03 |
| 44,500 | 71,200 | 1,400,000 | 21 | 27 | 25 | 1,791 | 58.55 | 25 | 2,060 | 67.35 |
| 38,100 | 61,000 | 1,210,000 | 21 | 27 | 25 | 1,791 | 58.55 | 25 | 2,060 | 67.35 |
| 56,500 | 90,400 | 2,210,000 | 21 | 27 | 25 | 2,221 | 72.61 | 25 | 2,490 | 81.42 |
| 50,600 | 81,000 | 1,580,000 | 21 | 27 | 25 | 1,833 | 59.93 | 25 | 2,102 | 68.74 |
| 38,100 | 61,000 | 1,210,000 | 21 | 27 | 25 | 1,833 | 59.93 | 25 | 2,102 | 68.74 |
| 62,000 | 99,100 | 1,910,000 | 21 | 27 | 25 | 2,612 | 85.41 | 25 | 2,881 | 94.21 |
| 62,000 | 99,100 | 1,910,000 | 21 | 27 | 25 | 1,877 | 61.38 | 25 | 2,146 | 70.18 |
| 56,400 | 90,300 | 1,750,000 | 21 | 27 | 25 | 2,444 | 79.90 | 25 | 2,713 | 88.71 |
| 56,400 | 90,300 | 1,750,000 | 21 | 27 | 25 | 1,877 | 61.38 | 25 | 2,146 | 70.18 |
| 50,600 | 81,000 | 1,580,000 | 21 | 27 | 25 | 1,877 | 61.38 | 25 | 2,146 | 70.18 |
| 38,100 | 61,000 | 1,210,000 | 21 | 27 | 25 | 1,877 | 61.38 | 25 | 2,146 | 70.18 |

## Heavy Weight Drill Pipe Performance Datasheet

## Overview

The Heavy Weight Drill Pipe Performance Datasheet is an easy-to-use document summarizing the performances and other technical characteristics of HWDPs manufactured by COMMAND SMFI. This document provides key performance characteristics such as tensile strength, torsional strength and make-up torque range, as well as other product-specific performance data.

An overview of some additional information available in the HWDP Performance Datasheet is shown below. Useful datasheet definitions:
> Torsional Ratio: The ratio of the connection torsional strength divided by the pipe body torsional strength. API recommends a ratio of 0.80 or larger.
> Balance OD: The tool joint OD where the yield of the box is equal to the yield of the pin for a given tool joint ID.
> Bending Strength Ratio (BSR): This bending criteria is defined in the API spec RP7G as an inertia ratio between pin and box connection. A rotary shouldered connection that has a BSR of 2.5 (or 2.5:1) is generally accepted as an average balanced connection.
> Combined Load Chart: Chart used to determine the operation zone for tool joint in tension and torque.
> Wear Chart: Chart used to determine the recommended make-up torque for worn products.


## Drill Collars

## The Solution: Transitional and Compressive Load Member

COMMAND SMFI drill collars are thick-walled tubulars machined from solid steel bars and manufactured to specifications to meet and/or exceed API or NS-1 requirements. The quality of the heat treatment is critical in the production of raw materials and must be uniform and deep enough through the thickness of the bar to ensure the mechanical properties.

Drill collars are used as a component of the bottom-hole assembly (BHA) and provide the following:
$>$ Drilling weight-on-bit (WOB)
$>$ BHA directional control
$>$ Hole size integrity
> Stiffness to maintain hole straightness
$>$ Clearance for the drill string
$>$ Compressive and torsional loads
> Mitigate differential sticking and stuck pipe thanks to spiraled grooves


## Product Performance

Drill collars come in slick and spiral-grooved designs with additional features for safe surface-handling and trouble-free operations. We provide the full range of collars manufactured in AISI 4145H-modified steel with mechanical properties guaranteed 1 inch below steel surface at ambient temperature.

## Product range and features

## Standard

$>$ ODs from 2-7/8" to 11"
> API Specification 7.1 \& 7.2
$>$ Slick
> API connections
> Enhanced fatigue resistance with thread cold rolling
> Phosphate or zinc coated threads
> Slip and elevator recess
> API stress-relief on pin and box bore back
> Pressed steel thread protectors

## Options

> Spiral
>Hardbanding
> Internal plastic coating with ODs <6 1/2"
> High-performance double shoulder connections upon request
>Customized elevator and slip recess
$>$ NS-1 or DS-1 or customers specifications
> Premium grades and materials: Sour Service and non-magnetic alloys
$>$ Range 2 and 3

## Spiral Design

In order to reduce differential pressure sticking and wellbore contact, the surface of Drill Collars can be spiral-grooved. Spiral Drill Collars are the perfect solution for deep, directional or deviated drilling. Cross sections of the drill collars reduce the contact area with the wall of the hole.


Slip \& Elevator Recess
Slip and elevator recesses improve handling efficiency and safety. These features are machined in accordance with API standard RP7G. The upper radius of the elevator recess is cold rolled to increase the product service life. Slip and elevator recesses can be manufactured together or separately.


Drill Collar Material Table

| Connection | API | NS1 |  | DS1 common / DS1 critioal |
| :---: | :---: | :---: | :---: | :---: |
| API | All | $\mathbf{O D}<\mathbf{9 1 / 2 "}$ | $\mathbf{O D}>=\mathbf{9 1 / 2 "}$ | All |
|  | 4145 H "-modified | 4145 H -modified | 4145 H -modified | 4145 H -modified |
|  | 110 KSI | 110 KSI | 100 KSI | 110 KSI |


| Connection | Sour Service |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| API | $\begin{gathered} <=\mathbf{6 3 / 4 " O D} \\ \text { (with NACE test 45\% SMYS) } \end{gathered}$ | > 63/4"OD <br> (with NACE test 45\% SMYS) 45\% SMYS guaranteed) | $\begin{gathered} <=\mathbf{6 3 / 4 " O D} \\ \text { (No NACE test } \\ 45 \% \text { SMYS guaranteed) } \end{gathered}$ | $>63 / 4 \text { " OD }$ <br> (No NACE test |
|  | $\begin{gathered} \text { ASCOWELL C } \\ 110 \mathrm{KSI} \end{gathered}$ | ASCOWELL C 100 KSI | $\begin{gathered} \text { ASCOWELL C } \\ 110 \mathrm{KSI} \end{gathered}$ | $\begin{gathered} \text { ASCOWELL C } \\ 100 \mathrm{KSI} \end{gathered}$ |



## Operational Benefits

COMMAND SMFI has been producing high quality drill collars for over 60 years and we were the first company to manufacture small diameter drill collars from solid bars. Bars are trepanned in-house using specialty equipment to guarantee product performance and reliability. Our experience in material specification, mechanical properties, heat treatment, machining connections, and inspection are reflected in our product performance.

## Drill Collar Manufacturing Flow Chart




Drill collars are manufactured to customer requirements and, where applicable, to specifications such as API, ISO, NS1, DS1, etc.

## Drill Collar Data

|  |  | Pipe Body |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| OD | ID | Connection | Bevel Diameter | Overall Length | Recommended Make-Up Torque* |
| (in) | (in) |  | (in) | (ft) | (ft-\|bs) |
| 2-7/8 | 1-1/2 | $23 / 8$ PAC | 2-45/64 | 31 | 2,070 |
| 3-1/8 | 1 | $23 / 8$ REG | 3-1/64 | 31 | 3,030 |
| 3-1/8 | 1-1/8 | $23 / 8$ REG | 3-1/64 | 31 | 3,030 |
| 3-1/8 | 1-1/4 | NC23 | 3 | 31 | 3,330 |
| 3-1/8 | 1-1/4 | $23 / 8$ REG | 3-1/64 | 31 | 3,030 |
| 3-1/8 | 1-1/4 | NC26 | 3 | 31 | 1,690 |
| 3-3/8 | 1-1/2 | NC26 | 3-21/64 | 31 | 3,580 |
| 3-1/2 | 1-1/2 | NC26 | 3-21/64 | 31 | 4,610 |
| 3-3/4 | 1-1/2 | NC26 | 3-29/64 | 31 | 4,670 |
| 4-1/8 | 2 | NC31 | 3-61/64 | 31 | 6,850 |
| 4-1/4 | 1-3/4 | NC31 | 3-61/64 | 31 | 8,160 |
| 4-1/4 | 2 | NC31 | 3-61/64 | 31 | 6,850 |
| 4-3/4 | 1-3/4 | NC38 | 4-41/64 | 31 | 9,990 |
| 4-3/4 | 2 | NC35 | 4-33/64 | 31 | 10,800 |
| 4-3/4 | 2 | NC38 | 4-41/64 | 31 | 9,990 |
| 4-3/4 | 2-1/4 | NC38 | 4-41/64 | 31 | 9,990 |
| 4-3/4 | 2-1/4 | NC35 | 4-33/64 | 31 | 9,200 |
| 4-3/4 | 2-1/2 | NC38 | 4-41/64 | 31 | 9,990 |
| 4-7/8 | 2-1/4 | NC38 | 4-41/64 | 31 | 11,900 |
| 5 | 2-1/4 | NC38 | 4-49/64 | 31 | 12,900 |
| 5-1/4 | 2-1/4 | NC38 | 4-61/64 | 31 | 12,900 |
| 5-3/4 | 2-1/4 | NC46 | 5-5/8 | 31 | 17,700 |
| 5-3/4 | 2-1/4 | NC40 | 5-25/64 | 31 | 17,000 |
| 6 | 2-1/4 | NC46 | 5-23/32 | 31 | 23,400 |
| 6 | 2-13/16 | NC46 | 5-23/32 | 31 | 22,400 |
| 6-1/4 | 2-1/4 | $41 / 2 \mathrm{H}-90$ | 6 | 31 | 28,700 |
| 6-1/4 | 2-1/4 | NC46 | 5-29/32 | 31 | 28,000 |
| 6-1/4 | 2-1/2 | NC46 | 5-29/32 | 31 | 25,700 |
| 6-1/4 | 2-3/4 | NC46 | 5-29/32 | 31 | 23,100 |
| 6-1/4 | 2-13/16 | NC46 | 5-29/32 | 31 | 22,400 |
| 6-1/4 | 2-13/16 | NC50 | 6-1/16 | 31 | 23,000 |
| 6-1/4 | 3 | NC46 | 5-29/32 | 31 | 20,300 |
| 6-1/2 | 2-1/4 | NC46 | 6-3/32 | 31 | 28,000 |
| 6-1/2 | 2-1/4 | $41 / 2 \mathrm{H}-90$ | 6 | 31 | 28,700 |
| 6-1/2 | 2-1/4 | NC50 | 6-11/32 | 31 | 29,700 |
| 6-1/2 | 2-1/2 | NC46 | 6-3/32 | 31 | 25,700 |
| 6-1/2 | 2-13/16 | NC46 | 6-3/32 | 31 | 22,400 |
| 6-1/2 | 2-13/16 | NC50 | 6-11/32 | 31 | 29,700 |
| 6-1/2 | 2-7/8 | NC50 | 6-11/32 | 31 | 29,700 |
| 6-1/2 | 3 | $41 / 2 \mathrm{H}-90$ | 6 | 31 | 21,100 |
| 6-3/4 | 2-1/4 | NC50 | 6-11/32 | 31 | 36,700 |
| 6-3/4 | 2-1/2 | NC50 | 6-11/32 | 31 | 35,800 |
| 6-3/4 | 2-1/2 | NC46 | 6-11/32 | 31 | 25,700 |
| 6-3/4 | 2-13/16 | NC50 | 6-11/32 | 31 | 32,300 |
| 6-3/4 | 2-7/8 | NC50 | 6-11/32 | 31 | 31,500 |
| 6-3/4 | 3 | NC50 | 6-11/32 | 31 | 30,000 |

*Performances calculated for products manufactured as per API.

| Pipe Body |  |  |  | Slick |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Torsional <br> Strength* | Sending <br> Strength Ratio | Total Weight <br> Slick | Weight/Foot <br> Slick | Total Weight <br> Spiral | Weight/Foot <br> Spiral |
| (ft-lbs) |  | (lbs) | (lbs/ft) | (lbs) | (lbs/ft) |

## Drill Collar Data

|  |  | Pipe Body |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| OD | ID | Connection | Bevel Diameter | Overall Length | Recommended Make-Up Torque* |
| (in) | (in) |  | (in) | (ft) | (ft-Ibs) |
| 7 | 2-1/4 | NC50 | 6-31/64 | 31 | 38,400 |
| 7 | 2-1/2 | NC50 | 6-31/64 | 31 | 35,800 |
| 7 | 2-13/16 | NC50 | 6-31/64 | 31 | 32,300 |
| 7 | 2-13/16 | $51 / 2 \mathrm{H}-90$ | 6-5/8 | 31 | 36,500 |
| 7 | 2-13/16 | $51 / 2 \mathrm{H}-90$ | 6-5/8 | 31 | 36,500 |
| 7 | 2-13/16 | $51 / 2 \mathrm{FH}$ | 6-23/32 | 31 | 32,800 |
| 8 | 2-1/4 | $65 / 8$ REG | 7-33/64 | 31 | 60,300 |
| 8 | 2-1/2 | $65 / 8$ REG | 7-33/64 | 31 | 57,400 |
| 8 | 2-13/16 | $65 / 8$ REG | 7-33/64 | 31 | 53,300 |
| 8 | 2-13/16 | NC56 | 7-31/64 | 31 | 48,200 |
| 8 | 3 | $65 / 8$ REG | 7-33/64 | 31 | 50,700 |
| 8 | 3 | $65 / 8 \mathrm{H}-90$ | 7-1/2 | 31 | 53,600 |
| 8 | 3-1/4 | $65 / 8$ REG | 7-33/64 | 31 | 46,900 |
| 8 | 3-3/8 | $65 / 8$ REG | 7-33/64 | 31 | 44,900 |
| 8-1/4 | 2-13/16 | $65 / 8$ REG | 7-45/64 | 31 | 53,300 |
| 8-1/4 | 3 | $65 / 8$ REG | 7-45/64 | 31 | 50,700 |
| 8-1/4 | 3-3/16 | $65 / 8$ REG | 7-45/64 | 31 | 47,900 |
| 8-1/4 | 3-1/4 | $65 / 8$ REG | 7-45/64 | 31 | 46,900 |
| 8-1/2 | 2-13/16 | $65 / 8$ REG | 7-45/64 | 31 | 53,300 |
| 8-1/2 | 2-13/16 | NC61 | 8 | 31 | 68,400 |
| 8-1/2 | 3 | $65 / 8$ REG | 7-45/64 | 31 | 50,700 |
| 8-1/2 | 3-1/4 | $65 / 8$ REG | 7-45/64 | 31 | 46,900 |
| 9 | 2-13/16 | $75 / 8$ REG | 8-1/2 | 31 | 84,400 |
| 9 | 2-13/16 | $65 / 8 \mathrm{FH}$ | 8-29/64 | 31 | 84,000 |
| 9 | 3 | $75 / 8$ REG | 8-1/2 | 31 | 84,400 |
| 9 | 3 | $65 / 8 \mathrm{FH}$ | 8-29/64 | 31 | 81,000 |
| 9 | 3-1/2 | $65 / 8 \mathrm{FH}$ | 8-29/64 | 31 | 72,100 |
| 9-1/2 | 2-3/4 | $75 / 8$ REG | 8-13/16 | 31 | 92,600 |
| 9-1/2 | 2-13/16 | $75 / 8$ REG | 8-13/16 | 31 | 91,600 |
| 9-1/2 | 3 | 7 5/8 REG | 8-13/16 | 31 | 88,600 |
| 9-1/2 | 3 | NC70 | 8-31/32 | 31 | 102,000 |
| 9-1/2 | 3-1/16 | 7 5/8 REG | 8-13/16 | 31 | 87,500 |
| 9-1/2 | 3-1/2 | $75 / 8$ REG | 8-13/16 | 31 | 79,500 |
| 9-3/4 | 3 | $75 / 8$ REG LT | 9-1/4 | 31 | 91,800 |
| 10 | 3 | $85 / 8$ REG | 9-23/32 | 31 | 109,000 |
| 10 | 3 | $75 / 8$ REG LT | 9-1/4 | 31 | 91,800 |
| 11 | 3 | $85 / 8$ REG LT | 10-1/2 | 31 | 131,000 |

*Performances calculated for products manufactured as per API.

| Pipe Body |  | STick |  | Spiraled |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Torsional Strength* | Bending Strength Ratio | Total Weight Slick | Weight/Foot Slick | Total Weight Spiral | Weight/Foot Spiral | OD |
| (ft-lbs) |  | (lbs) | (lbs/ft) | (lbs) | (lbs/ft) | (in) |
| 61,400 | 2.54 | 3,590 | 117 | 3,380 | 110 |  |
| 57,300 | 2.61 | 3,500 | 114 | 3,290 | 107 |  |
| 51,600 | 2.73 | 3,360 | 110 | 3,150 | 103 |  |
| 64,900 | 2.40 | 3,360 | 110 | 3,150 | 103 |  |
| 64,900 | 2.40 | 3,360 | 110 | 3,150 | 103 |  |
| 52,400 | 1.72 | 3,360 | 110 | 3,150 | 103 |  |
| 96,500 | 2.50 | 4,810 | 157 | 4,560 | 149 |  |
| 91,800 | 2.54 | 4,720 | 154 | 4,460 | 146 |  |
| 85,400 | 2.60 | 4,580 | 150 | 4,330 | 142 |  |
| 77,200 | 3.02 | 4,580 | 150 | 4,330 | 142 |  |
| 81,100 | 2.66 | 4,490 | 147 | 4,240 | 139 |  |
| 95,400 | 2.50 | 4,490 | 147 | 4,240 | 139 |  |
| 75,100 | 2.75 | 4,360 | 143 | 4,110 | 134 |  |
| 71,900 | 2.81 | 4,300 | 140 | 4,040 | 132 |  |
| 85,400 | 2.93 | 4,910 | 161 | 4,630 | 151 |  |
| 81,100 | 2.99 | 4,820 | 158 | 4,540 | 148 |  |
| 76,600 | 3.07 | 4,730 | 155 | 4,440 | 145 |  |
| 75,100 | 3.10 | 4,700 | 154 | 4,410 | 144 |  |
| 85,400 | 3.27 | 5,250 | 172 | 4,960 | 162 |  |
| 109,000 | 2.59 | 5,250 | 172 | 4,960 | 162 |  |
| 81,100 | 3.34 | 5,160 | 169 | 4,870 | 159 |  |
| 75,100 | 3.46 | 5,040 | 165 | 4,750 | 155 |  |
| 135,000 | 2.28 | 5,960 | 195 | 5,430 | 178 |  |
| 134,000 | 2.41 | 5,970 | 195 | 5,440 | 178 |  |
| 135,000 | 2.31 | 5,880 | 192 | 5,340 | 175 |  |
| 130,000 | 2.44 | 5,880 | 192 | 5,350 | 175 |  |
| 115,000 | 2.56 | 5,610 | 184 | 5,080 | 166 |  |
| 148,000 | 2.78 | 6,750 | 221 | 6,200 | 203 |  |
| 147,000 | 2.78 | 6,720 | 220 | 6,170 | 202 |  |
| 142,000 | 2.81 | 6,630 | 217 | 6,080 | 199 |  |
| 164,000 | 2.34 | 6,620 | 217 | 6,070 | 199 |  |
| 140,000 | 2.83 | 6,600 | 216 | 6,050 | 198 |  |
| 127,000 | 2.93 | 6,370 | 208 | 5,820 | 190 |  |
| 147,000 | 3.09 | 7,020 | 230 | 6,470 | 212 |  |
| 175,000 | 1.98 | 7,420 | 243 | 6,800 | 222 |  |
| 147,000 | 3.38 | 7,430 | 243 | 6,800 | 222 |  |
| 209,000 | 2.84 | 9,140 | 299 | 8,410 | 275 |  |

## Drill Collar Performance Datasheet

## Overview

The Drill Collar Performance Datasheet is an easy-to-use document summarizing the performances and other technical characteristics of drill collars manufactured by COMMAND SMFI.

This document provides key performance characteristics such as tensile strength, torsional strength, and make-up torque range, as well as other product specific performance data.

An overview of some additional information available in the Drill Collar Performance Datasheet is shown below.
Useful datasheet definition:
> Bending Strength Ratio (BSR): This bending criteria is defined in the API spec RP7G as an inertia ratio between pin and box connection. A rotary shouldered connection that has a BSR of 2.5 (or $2.5: 1$ ) is generally accepted as an average balanced connection.


## Kelly Cock Valves

## Application and General Use

Kelly Cock Valves are devices that allow for shutting the internal bore of the drill string keeping the mud column in the top drive or the Kelly when disconnecting from the drill string. It controls the flow of the mud during normal drilling operations and is operated from the rig floor. Standard configurations include two Kelly Cock Valves; an upper Kelly Valve and lower Kelly Valve.

## Product Description

The Kelly Cock Valve is designed and manufactured as a one-piece or a two-piece Kelly Valve for free-passage and maximum circulation of the drilling fluid minimizing pressure loss.

Kelly Cock Valves are supplied with either API or proprietary connections upon request.
All Kelly Cock Valves are manufactured according to the latest edition of the API 7-1 or NS1 specification.
KC2S Kelly Valves are available in either standard or $\mathrm{H}_{2} \mathrm{~S}$ resistant versions and are supplied according to Class 1 construction.

## Main Features

>Simple construction for trouble-free operations and easy servicing
>Sealed lubrication packing
> 10,000 or $15,000 \mathrm{PSI}$ working pressure (testing pressure 15,000 and 22,500 PSI respectively)
> KC2S Kelly Valves are delivered with an operating wrench and disassembly tool
Other configurations available upon request, subject to engineering department approval.

The KC2S product range is available in 9 different series allowing the following passage IDs:

| SERIES | ID (IN) |
| :---: | :---: |
| 201 | $1-1 / 4$ |
| 202 | $1-3 / 4$ |
| 203 | $2-1 / 8$ |
| 204 | $2-1 / 4$ |
| 205 | $2-7 / 16$ |
| 206 | $2-13 / 16$ |
| 207 | $3-1 / 16$ |
| 208 | $3-1 / 4$ |
| 209 | $4-1 / 4$ |

## Hydraulic Testing

Each Kelly Valve is hydraulically bench tested according to API spec 7-1 (latest edition) and delivered with its individual pressure test records.

The tests are carried out in two steps:
> SHELL TESTING during which the valve is pressurized to the test pressure for 3 minutes, then depressurized and pressurized again for at least 10 minutes.
> SEAT TESTING during which the valve is pressurized from the pin end to its working pressure for at least 5 minutes.

During the pressure-holding period timing starts when pressure stabilization is achieved. No visually detectable leakage is permitted during the test time period and the pressure drop shall be no greater than maximum $1 \%$ of the pressure test value with a zero leak rate.

## Valve Compatibility

In case the Retrievable Drop-in Check Valve (RDCV) has to be dropped into the drill string, the compatibility of RDCV OD and KC2S free ID passage is a critical factor. The table to the right shows shows the compatibility between KC2S Kelly Cocks and Drop-in Check Valves.

## One Piece Kelly Cock Valve



Figure 1 - Kelly Cock Cutaway View

| KELLY COCK REQUIRED |  | RDCV |
| :---: | :---: | :---: |
| KC2S SERIES | ID (IN.) | SERIES |
| 202 | $1-3 / 4$ ID | 901 |
| 203 | $2-1 / 8$ ID | 902 |
| 204 | $2-1 / 4$ ID | 903 |
| $204 / 205$ | $2-1 / 4 / 2-7 / 16$ ID | 904 |
| 206 | $2-13 / 16$ ID | 905 |
| 207 | $3-1 / 16$ ID | 906 |
| 207 | $3-1 / 16 ~ I D$ | 907 |
| 208 | $3-1 / 4 ~ I D$ | 908 |



Figure 2 - Kelly Cock
Exploded View

One Piece Kelly Cock

| One Piece Kelly Cock |  |  |  |
| :---: | :---: | :---: | :---: |
| TYPE OF KIT | DESCRIPTION | STANDARD VERSION | H2S TRIM VERSION |
| Seal Kit | Includes all parts needed for replacement each time the Valve is disassembled; i.e. 0 -Ring Seals, Springs, Knob Plate and Snap Ring or Screw Set. | Items 2, 6, 8, 9, 11, 13 \& 14 | Items 6, 8, 9, 11, 13, 14 \& 17 |
| Complete Repair Kit with Tooling | Includes all inside Valve components plus its Operating Wrench and Disassembling Tool. | Items 2 to 16 | Items 3 to 14 \&17 |
| Complete Repair Kit without Tooling | Includes all KC2S Inside Valve components. | Items 2 to 14 | Items 3 to 17 |

## Two Piece Kelly Cock Valve



Figure 1 - Kelly Cock Cutaway View


Figure 2 - Kelly Cock
Exploded View

## Two Piece Kelly Cock

| Two Piece Kelly Cock |  |  |  |
| :---: | :---: | :---: | :---: |
| TYPE OF KIT | DESCRIPTION | STANDARD VERSION | H2S TRIM VERSION |
| Seal Kit | Includes all parts needed for replacement each time the Valve is disassembled; i.e. 0 -Ring Seals, Springs, Knob Plate and Snap Ring or Screw Set. | Items 2, 6, 8, 9, 11, 13, 14 \& 18 | Items 6, 8, 9, 11, 13, 14,17 \&18 |
| Complete Repair Kit with Tooling | Includes all internal parts plus Operating Wrench and Disassembling Tool. | Items 2 to 16 \& 18 | Items 3 to 14 \& 17-18 |
| Complete Repair Kit without Tooling | Includes all internal parts. | Items 2 to 14 \& 18 | Items 3 to 18 |

Spare Parts and References

| Standard Repair Kit |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ITEM | 201 | 202 | 203 | 204 | $\begin{gathered} \text { SERIES } \\ 205 \end{gathered}$ | 206 | 207 | 208 | 209 |
| Seal kit for One Piece Kelly Cock | KCK201S021 | KCK202S021 | KCK203S021 | KCK204S021 | KCK205S021 | KCK206S021 | KCK207S021 | KCK208S021 | KCK209S021 |
| Seal kit for Two Piece Kelly Cock | KCK201S106 | KCK202S103 | KCK203S106 | KCK204S102 | KCK205S104 | KCK206S103 | KCK207S136 | KCK208S104 | KCK209S100 |
| Complete repair kit without tooling for One Piece Kelly Cock | KCK201S023 | $\begin{aligned} & \text { KCK202S025 } \\ & \text { Valve } 0 D<41 / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK203S102 } \\ & \text { Valve } 0 \mathrm{DD}<53 / 8 \end{aligned}$ | $\begin{gathered} \text { KCK204S100 } \\ \text { Valve } 0 \mathrm{D}<6 \end{gathered}$ | KCK205S023 | KCK206S023 | $\begin{aligned} & \text { KCK207S125 } \\ & \text { Valve } 00<73 / 8 \end{aligned}$ | KCK208S023 | KCK209S023 |
|  |  | $\begin{aligned} & \text { KCK2O2SO23 } \\ & \text { Valve } 0 \mathrm{D}>=41 / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK203SO23 } \\ & \text { Valve } 0 D>=53 / 8 \end{aligned}$ | $\begin{aligned} & \text { KCK204SO23 } \\ & \text { Valve } 0 \mathrm{D}>=6 \end{aligned}$ |  |  | $\begin{aligned} & \text { KCK207S023 } \\ & \text { Valve } 0 \mathrm{D}>=73 / 8 \end{aligned}$ |  |  |
| Complete repair kit without tooling for Two Piece Kelly Cock | KCK201S108 | KCK202S1111 | $\begin{aligned} & \text { KCK203S108 } \\ & \text { Valve } 0 \mathrm{D}<53 / 8 \end{aligned}$ | $\begin{gathered} \text { KCK204S103 } \\ \text { Valve } 00<6 \end{gathered}$ | KCK205S105 | KCK206S105 | $\begin{aligned} & \text { KCK207S138 } \\ & \text { Valve } 00<73 / 8 \end{aligned}$ | KCK208S105 | KCK209S101 |
|  |  | $\begin{aligned} & \text { KCK202S105 } \\ & \text { Valve } 0 \mathrm{D}>=41 / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK203S110 } \\ & \text { Valve } 0 D>=53 / 8 \end{aligned}$ | $\begin{aligned} & \text { KCK204S104 } \\ & \text { Valve } 0 \mathrm{D}>=6 \end{aligned}$ |  |  | $\begin{aligned} & \text { KCK207S140 } \\ & \text { Valve 0D }>=73 / 8 \end{aligned}$ |  |  |
| Complete repair kit with tooling for One Piece Kelly Cock | $\begin{aligned} & \text { KCK201S022 } \\ & \text { Valve } 0 D<43 / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK2O2SO24 } \\ & \text { Valve } 0 D<41 / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK203S101 } \\ & \text { Vave } 00<53 / 8 \end{aligned}$ | $\underset{\text { VCKlve } 00<6}{\text { KCK204S101 }}$ | KCK205S022 | KCK206S022 | $\begin{aligned} & \text { KCK207S124 } \\ & \text { Valve } 00<73 / 8 \end{aligned}$ | KCK208S022 | KCK209S022 |
|  |  | $\begin{gathered} \text { KCK202SO22 } \\ 41 / 4=<\text { Valve 0D } \\ <61 / 4 \end{gathered}$ | $\begin{gathered} \text { KCK203SO22 } \\ 53 / 8=<\text { Valve } 0 \mathrm{D} \\ <57 / 8 \end{gathered}$ |  |  |  |  |  |  |
|  | KCK201S109 <br> Valve 0 D $>=43 / 4$ | $\begin{aligned} & \text { KCK202S } 112 \\ & \text { Valve } 0 \mathrm{D}>=6 \\ & \hline 1 / 4 \end{aligned}$ | KCK203S100 Valve OD >=57/8 | $\begin{gathered} \text { KCK204SO22 } \\ \text { Valve } 0 \mathrm{D}>=6 \end{gathered}$ |  |  | KCK207S022 <br> Valve $0 \mathrm{D}>=73 / 8$ |  |  |
| Complete repair kit with tooling for Two Piece Kelly Cock | $\begin{aligned} & \text { KCK201S107 } \\ & \text { Valve } 0 D<43 / 4 \end{aligned}$ | KCK202S113 <br> Valve 0 < $<41 / 4$ | KCK203S107 Vave $0 \mathrm{D}<53 / 8$ | $\underset{\text { KCK204S105 } 00<6}{\text { Valve } 0<1}$ | KCK205S106 | KCK206S104 | KCK207S137 <br> Valve $0 \mathrm{D}<73 / 8$ | KCK208S106 | KCK209S102 |
|  |  | $\begin{aligned} & \text { KCK202S104 } \\ & 41 / 4=<\text { Valve OD } \\ &<61 / 4 \end{aligned}$ | KCK203S109 <br> $53 / 8=<$ Valve OD <br> <57/8 |  |  |  |  |  |  |
|  | KCK201S110 Valve $0 D>=43 / 4$ | $\begin{aligned} & \text { KCK202S114 } \\ & \text { Valve } 0 D>=61 / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK203S110 } \\ & \text { Valve } 0 D>=57 / 8 \end{aligned}$ | $\begin{aligned} & \text { KCK204S106 } \\ & \text { Valve } 0 \mathrm{D}>=6 \end{aligned}$ |  |  | $\begin{aligned} & \text { KCK207S139 } \\ & \text { Valve } 00>=73 / 8 \end{aligned}$ |  |  |


| $\mathrm{H}_{2} \mathrm{~S}$ TRIM Repair Kit |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ITEM | 201 | 202 | 203 | 204 | $\begin{gathered} \text { SERIES } \\ 205 \end{gathered}$ | 206 | 207 | 208 | 209 |
| Seal kit for One Piece Kelly Cock | KCK201H021 | KCK202H021 | KCK203H021 | KCK204H021 |  | KCK206H024 | KCK207H021 | KCK208H024 | Not created |
| Seal kit for Two Piece Kelly Cock | KCK201H101 | KCK202H104 | KCK203H105 | KCK204H100 |  | KCK206H103 | KCK207H104 | KCK208H100 | Not created |
| Complete repair kit without tooling for One Piece Kelly Cock | KCK201H023 | $\begin{aligned} & \text { KCK202H109 } \\ & \text { Valve } 00<41 / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK203H109 } \\ & \text { Valve } 0 \mathrm{D}<53 / 8 \end{aligned}$ | / | KCK205H023 | KCK206H026 | KCK207H112 <br> Valve 0D $<73 / 8$ | KCK208H026 | Not created |
|  |  | $\begin{aligned} & \text { KCK2O2HO23 } \\ & \text { Valve } \mathrm{OD}>=4 \mathrm{~T} / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK2O3H023 } \\ & \text { Valve } 0 \mathrm{D}>=53 / 8 \end{aligned}$ | $\begin{aligned} & \text { KCK2O4HO23 } \\ & \text { Valve } 0 \mathrm{D}>=6 \end{aligned}$ |  |  | $\begin{aligned} & \text { KCK207H023 } \\ & \text { Valve } 0 \mathrm{D}>=73 / 8 \end{aligned}$ |  |  |
| Complete repair kit without tooling for Two Piece Kelly Cock | KCK201H102 | KCK202H108 <br> Valve 0 < $41 / 4$ | KCK203H110 <br> Valve 0 < $53 / 8$ | 1 | KCK205H100 | KCK206H104 | KCK207H106 <br> Valve 0 D $<73 / 8$ | KCK208H101 | Not created |
|  |  | $\begin{aligned} & \text { KCK2O2H105 } \\ & \text { Valve OD }>=41 / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK203H106 } \\ & \text { Valve } 0 \mathrm{D}>=53 / 8 \end{aligned}$ | $\begin{aligned} & \text { KCK204H101 } \\ & \text { Valve } 0 \mathrm{D}>=6 \end{aligned}$ |  |  | $\begin{aligned} & \text { KCK207H109 } \\ & \text { Valve } 0 \mathrm{D}>=73 / 8 \end{aligned}$ |  |  |
| Complete repair kit with tooling for One Piece Kelly Cock | $\begin{aligned} & \text { KCK201H100 } \\ & \text { Valve 0D >= } 43 / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK202H111 } \\ & \text { Valve } 0 \mathrm{D} \text { < } 41 / 4 \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { KCK203H111 } \\ & \text { Valve } 0 \mathrm{D}<53 / 8 \end{aligned}$ | 1 | KCK205H022 | KCK206H025 | KCK207H113$\text { Valve } 0 \mathrm{D}<73 / 8$ | KCK208H025 | Not created |
|  |  | $\begin{aligned} & \text { KCK2O2HO22 } \\ & \text { Valve } 41 / 4=<0 \mathrm{D} \\ & <61 / 4 \end{aligned}$ | $\begin{gathered} \text { KCK2O3H022 } \\ 53 / 8=<\text { Valve } 00 \\ <57 / 8 \end{gathered}$ |  |  |  |  |  |  |
|  | KCK201H100 $\text { Valve } 0 D<43 / 4$ | $\begin{aligned} & \text { KCK2O2H103 } \\ & \text { Valve } 0 \mathrm{D}>=61 / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK203H104 } \\ & \text { Valve } 0 \mathrm{D}>=57 / 8 \end{aligned}$ | $\begin{aligned} & \text { KCK204H022 } \\ & \text { Valve 0D >=6 } \end{aligned}$ |  |  | $\begin{aligned} & \text { KCK207H109 } \\ & \text { Valve } 0 \mathrm{D}>=73 / 8 \end{aligned}$ |  |  |
| Complete repair kit with tooling for Two Piece Kelly Cock | KCK201H103 <br> Valve $0 D>=43 / 4$ | $\begin{aligned} & \text { KCK202H110 } \\ & \text { Valve } 0 \mathrm{D}<41 / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK203H112 } \\ & \text { Valve } 0 \mathrm{D}<53 / 8 \end{aligned}$ | 1 | KCK205H101 | KCK206H105 | $\begin{aligned} & \text { KCK207H105 } \\ & \text { Valve } 00<73 / 8 \end{aligned}$ | KCK208H102 | Not created |
|  |  | $\begin{gathered} \text { KCK202H1O6 } \\ \text { Valve } 41 / 4=<0 \mathrm{D} \\ >61 / 4 \end{gathered}$ | $\begin{gathered} \begin{array}{c} \text { KCK203H107 } \\ \text { Valve } 53 / 8=00 \\ >57 / 8 \end{array} \end{gathered}$ |  |  |  |  |  |  |
|  | KCK201H104 $\text { Valve } 0 D<43 / 4$ | $\begin{aligned} & \text { KCK202H107 } \\ & \text { Valve } 0 \mathrm{D}>=61 / 4 \end{aligned}$ | $\begin{aligned} & \text { KCK203H108 } \\ & \text { Valve OD }>=57 / 8 \end{aligned}$ | $\begin{aligned} & \text { KCK204H102 } \\ & \text { Valve } 0 \mathrm{D}>=6 \end{aligned}$ |  |  | $\begin{aligned} & \text { KCK207H108 } \\ & \text { Valve } 0 \mathrm{D}>=73 / 8 \end{aligned}$ |  |  |

## Operational Benefits

COMMAND SMFI offers KC2S Kelly Valves with PTFE rings inserted in both upper and lower seats, which provide high sealing capability, even at low pressures. KC2S internal parts are made of high grade heat treated stainless steel. The design of the body limits plug rotation to $90^{\circ}$ between open and closed positions. Two KC2S versions are offered to suit drilling environments:
> The standard version for normal drilling conditions with an inside surface treated to enhance mud corrosion resistance and maintenance operations.
> The $\mathrm{H}_{2} \mathrm{~S}$ trim version which has been designed for $\mathrm{H}_{2} \mathrm{~S}$ environments with internal parts made of corrosion resistant materials matching the NACE MR0175 standard (latest edition), fitted in a standard body.
> Full NACE available upon request.

## Inside Blowout Preventer (I-BOP)

## Application and General Use

Wells can at times experience unpredictable pressure differentials causing flow into the well bore that can potentially be catastrophic for the rig and rig personnel, if uncontrolled. Safety Valves are an essential component to maintaining the safety of the well and drilling operations. Safety Valves are configured in the drill string and used on the rig floor and down-hole to manage safe operations while controlling kicks and preventing back flow of the drilling mud during the drilling process.

## Product Description

The Inside Blowout Preventer (I-BOP) Valve is a heavy duty check valve connected to the drill string for use on the rig floor level to protect from kicks at surface. It can be left in the drill string as long as necessary to reestablish well control with over-balanced pressure.

I-BOP valves are supplied with either API or with proprietary connections upon request. All I-BOP valves are manufactured to API 7-1 or NS1 latest edition.
I-BOP valves are available in both standard or $\mathrm{H}_{2} \mathrm{~S}$ resistant versions and supplied according to Class 1 construction.

## Main Features

> OD sizes ranging from $3-3 / 8$ " to $9-1 / 2^{\prime \prime}$
> ID sizes ranging from $1-1 / 2$ " to $2-13 / 16$ "
> 10,000 or $15,000 \mathrm{PSI}$ working pressure (testing pressure 15,000 or 22,500 PSI respectively)

The I-BOP product range comes with 4 sizes corresponding to internal part dimensions as follows:


Other configurations available upon request, subject to engineering department approval.

## Hydraulic Testing

Each I-BOP valve is hydraulically bench tested according to API spec 7-1 (latest edition) and delivered with its individual pressure record sheets.

The pressure test is carried out in two steps:
> SHELL TESTING during which the valve is pressurized to the test pressure for 3 minutes, then depressurized and pressurized again for at least 10 minutes (see figures $1 \& 2$ ).
> SEAT TESTING during which the valve is pressurized from the pin end to its working pressure for at least 5 minutes (see figures $1 \& 2$ ).

During the pressure-holding period, timing starts when pressure stabilization is achieved. No visually detectable leakage is permitted during the test time period and pressure drop shall be no greater than maximum $1 \%$ of the pressure test value with a zero leak rate.

## Operational Benefits

I-BOP body and internal parts are made of high grade heat treated steel. The I-BOP valve sealing is achieved through a PTFE ring inserted in the valve. Two I-BOP construction versions are available:
> The standard version which is suitable for normal drilling conditions. The standard body inner surface is surface treated to improve resistance against mud corrosion and maintenance operations.
> The $\mathrm{H}_{2} \mathrm{~S}$ trim version which has been designed for $\mathrm{H}_{2} \mathrm{~S}$ environments. Internal parts are made of corrosion resistant materials matching NACE MR0175 standard (latest edition) and fitted in a standard body.

## Inside BOP



Figure 1 - Inside BOP Cutaway View


Figure 2 - Inside BOP Exploded View

Spare Parts and References

| Ітем | Standard version |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Trim 1 | Trim 2 | Trim 3 | Trim 4 |
| 1 Valve Release Screw | BVP100S001 | BVP200S001 | BVP200S001 | BVP400S001 |
| 5 Valve Head with Insert | BVP100S005 | BVP200S005 | BVP300S005 | BVP400S005 |
| 6 Valve Seat | BVP100S006 | BVP200S006 | BVP300S006 | BVP400S006 |
| 7 Valve Spring | BVP100S007 | BVP200S007 | BVP300S007 | BVP400S007 |
| 9 Large 0-Ring | JOIN044V01 | JOIN053V01 | JOINR41V01 | JOINR50V01 |
| 10 Small 0-Ring | JOINR33V01 | JOINR36V01 | JOINR36V01 | JOINR41V01 |
| Seal Kit | BVK100S001 | BVK200S001 | BVK300S001 | BVK400S001 |
| Complete Repair Kit | BVK100S002 | BVK200S002 | BVK300S002 | BVK400S002 |


| item | Standard version |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Trim 1 | Trim 2 | Trim 3 | Trim 4 |
| 2 Plug |  |  |  |  |
| 3 Release Rod | Part numbers depend on valve configuration will be supply upon request |  |  |  |
| 8 Lower Valve Body |  |  |  |  |


| ITEM | $\mathrm{H}_{2} \mathrm{~S}$ SERVICE VERSION |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Trim 1 | Trim 2 | Trim 3 | Trim 4 |
| 1 Valve Release Screw | BVP100S001 | BVP200S001 | BVP200S001 | BVP400S001 |
| 5 Valve Head with Insert | BVP100H005 | BVP200H005 | BVP300H005 | BVP400H005 |
| 6 Valve Seat | BVP100H006 | BVP200H006 | BVP300H006 | BVP400H006 |
| 7 Valve Spring | BVP100S007 | BVP200S007 | BVP300S007 | BVP400S007 |
| 9 Large 0-Ring | JOIN044V01 | JOIN053V01 | JOINR41V01 | JOINR50V01 |
| 10 Small 0-Ring | JoinR33V01 | Joinr36V01 | JoinR36V01 | Joink41V01 |
| Seal Kit | BVK100S001 | BVK200S001 | BVK300S001 | BVK400S001 |
| Complete Repair Kit | BVK100H002 | BVK200H002 | BVK300H002 | BVK400H002 |


| item | $\mathrm{H}_{2} \mathrm{~S}$ Service version |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | Trim 1 | Trim 2 | Trim 3 | Trim 4 |
| 2 Plug |  |  |  |  |
| 3 Release Rod | Part numbers depend on valve configuration will be supply upon request |  |  |  |
| 8 Lower Valve Body |  |  |  |  |

## Retrievable Drop in Check Valve (RDCV)

## Product Description

The Retrievable Drop-in Check Valve (RDCV) is used to control back flow from high pressure formations into the well and through the drill string back to the surface. It also allows for downward fluid circulation within the drill string. When the back flow is under control, the Drop-in Check Valve can be retrieved using a wire line.
If a kick or back flow starts while tripping out the pipes, it can be controlled with a drill pipe Safety Valve or Kelly Cock to close the flow through the drill pipe before reconnecting the Kelly and for pumping the RDCV down to its landing sub.
By design, the Check Valve is equipped with a self-locking (under down hole pressure) feature.

## Main Features

> Landing Sub OD ranging from $3-3 / 8^{\prime \prime}$ to $8-1 / 2^{\prime \prime}$
> Check Valve OD sizes ranging from $1-9 / 32$ " to $3-7 / 64^{\prime \prime}$
> Check Valve ID sizes ranging from $3 / 8$ " to $1-11 / 16$ "
> 10,000 or 15,000 PSI working pressure (testing pressure 15,000 or $22,500 \mathrm{PSI}$ respectively)
> Supplied with API or proprietary connections
Other configurations available upon request, subject to engineering department approval.

The RDCV product range has 8 Valve series corresponding to different Check Valve outside diameters (OD):

| SERIES | CHECK VALVE OD (IN) |
| :---: | :---: |
| 901 | $1-9 / 32$ |
| 902 | $1-25 / 32$ |
| 903 | $2-5 / 32$ |
| 904 | $2-15 / 64$ |
| 905 | $2-15 / 32$ |
| 906 | $2-27 / 32$ |
| 907 | $3-3 / 64$ |
| 908 | $3-7 / 64$ |



Figure 1 - Landing Sub Cutaway View


Figure 2 - Landing Sub Exploded View


Figure 6 - Overshot Exploded View

## Hydraulic Testing

Each RDCV is hydraulically bench tested according to API spec 7-1 (latest edition) and delivered with its individual pressure test records.

The tests are carried out in two steps:
>SHELL TESTING during which the valve is pressurized to the test pressure for 3 minutes, then depressurized and pressurized again for at least 10 minutes.
>SEAT TESTING during which the valve is pressurized from the pin end to its working pressure for at least 5 minutes.

During the pressure-holding period, timing shall start when pressure stabilization is achieved. No visually detectable leakage is permitted during the test time period and the pressure drop shall be no greater than maximum $1 \%$ of the pressure test value with a zero leak rate.

## Valve Compatibility

In case the Check Valve has to be dropped into the drill string, the compatibility of Check Valve OD and Kelly Cock Valve free ID passage is a critical factor. The table to the right shows the compatibility between KC2S Kelly Cock Valves and Retrievable Drop-in Check Valves:

| RDCV | KELLY COCK REQUIRED |  |
| :---: | :---: | :---: |
| SERIES | KC2S SERIES | KC2S ID PASSAGE (in.) |
| 901 | 202 | $1-3 / 4$ ID |
| 902 | 203 | $2-1 / 8$ ID |
| 903 | 204 | $2-1 / 4$ ID |
| 904 | $204 / 205$ | $2-1 / 4$ ID |
| 905 | 206 | $2-13 / 16$ ID |
| 906 | 207 | $3-1 / 16$ ID |
| 907 | 207 | $3-1 / 16$ ID |
| 908 | 208 | $3-1 / 4$ ID |

## Operational Data

| Standard Version |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ITEM | SERIES |  |  |  |  |  |  |  |
|  | 901 | 902 | 903 | 904 | 905 | 906 | 907 | 908 |
| Check Valve OD | 19/32 | 125/32 | $25 / 32$ | $215 / 64$ | $215 / 32$ | $227 / 32$ | 3 3/64 | $37 / 64$ |
| Requested Drill String ID | 111/32 | 127/32 | $27 / 32$ | 219/64 | $217 / 32$ | 2 29/32 | $37 / 64$ | $311 / 64$ |
| Check Valve ID | 3/8 | 5/8 | 3/4 | 7/8 | $11 / 8$ | $13 / 8$ | 19/16 | 111/16 |
| Check Valve weight (lbs/kg) | $5.3 / 2.4$ | $6.6 / 3.0$ | 15.4 / 7.0 | 19.0 / 8.6 | 24.4/11.0 | $28.2 / 12.8$ | 32.7 / 14.8 | 38.0 / 15.8 |
| Landing Sub Drift diameter | 17/64 | 129/64 | 127/32 | $27 / 64$ | $21 / 8$ | $233 / 64$ | 211/16 | $225 / 32$ |
| Overshot weight (lbs/kg) | 1.3/0.6 | $3.8 / 1.7$ | $4.8 / 2.2$ | $5.8 / 2.6$ | $8.8 / 4.0$ | 9.3 / 4.2 | 10.1/4.6 | $11.0 / 5.0$ |

## Spare Parts and References

| Standard Version |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ITEM | SERIES |  |  |  |  |  |  |  |
|  | 901 | 902 | 903 | 904 | 905 | 906 | 907 | 908 |
| Overshot | RD0901S001 | RD0902S001 | RD0903S001 | RD0904S001 | RD0905S001 | RD0906S001 | RD0907S001 | RD0908S001 |
| Check Valve | RDV901S001 | RDV902S001 | RDV903S001 | RDV904S001 | RDV905S001 | RDV906S001 | RDV907S001 | RDV908S001 |
| Landing Sub Sleeve Kit includes items L2 to L5 | RDS901S001 | RDS902S001 | RDS903S001 | RDS904S001 | RDS905S001 | RDS906S001 | RDS907S001 | RDS908S001 |
| Seal Kit includes items V6x2, V7x2, V9 | RDK901S001 | RDK902S001 | RDK903S001 | RDK904S001 | RDK905S001 | RDK906S001 | RDK907S001 | RDK908S001 |
| $\mathrm{H}_{2} \mathrm{~S}$ Service Version |  |  |  |  |  |  |  |  |
| ITEM | SERIES |  |  |  |  |  |  |  |
|  | 901 | 902 | 903 | 904 | 905 | 906 | 907 | 908 |
| Overshot | RD0901S001 | RD0902S001 | RD0903S001 | RD0904S001 | RD0905S001 | RD0906S001 | RD0907S001 | RD0908S001 |
| Check Valve | RDV901H001 | RDV902H001 | RDV903H001 | RDV904H001 | RDV905H001 | RDV906H001 | RDV907H001 | RDV908H001 |
| Landing Sub Sleeve Kit includes items L2,L3,L4,L6 | RDS901T001 | RDS902T001 | RDS903T001 | RDS904T001 | RDS905T001 | RDS906T001 | RDS907T001 | RDS908T001 |
| Seal Kit Includes items V6x2, V7x2, V9 | RDK901H001 | RDK902H001 | RDK903H001 | RDK904H001 | RDK905H001 | RDK906H001 | RDK907H001 | RDK908H001 |

## Operational Benefits

RDCVs body and internal parts are made of high grade heat treated steel. Sealing is achieved through a metal to metal contact between a ball and a seat.

Two RDCV versions exist to suit all drilling environments:
> The standard version which is suitable for normal drilling conditions.
> The $\mathrm{H}_{2} \mathrm{~S}$ trim version which has been designed for $\mathrm{H}_{2} \mathrm{~S}$ environments in which the internal parts are made of corrosion resistant materials matching the NACE MR0175 standard (latest edition), fitted in a standard steel landing sub.


## Product Performance

COMMAND SMFI collar-based non-magnetic drilling products are made from Amagnit ${ }^{\text {t" }} 501$, a chrome manganese carbon austenitic alloy. Amagnit'" 501 is specifically designed for extreme service. This alloy ensures nonmagnetic steel, which is resistant to stress corrosion cracking, providing superior mechanical properties with low magnetic permeability, excellent machineability and no tendency for galling. Consistent non-magnetic behavior as well as material that is free of hot spots is essential in this special alloy steel. Laboratory tests and actual field use confirm that Amagnit ${ }^{\text {tm }} 501$ provides very good resistance to stress corrosion cracking in an aggressive chloride environment. For specific downhole applications where higher mechanical properties are required as can often be the case with MWD/LWD housings, a high strength corrosion resistant steel Amagnit ${ }^{\text {t" }} 601$ as well as other specific client alloys are available upon request.


## Operational Benefits

COMMAND SMFI has over 30 years of experience manufacturing non-magnetic tools for the drilling industry. A dedicated plant based in France with state of the art equipment and specialized engineers is able to offer our clients the tools needed for all directional drilling applications.

## Rotary Substitutes (Subs)

The Solution: Rotary Substitutes (Subs)
Subs are generally part of most drill strings and have two main functions:
> To crossover connections
> To extend the life of a more expensive drill stem item and/or as a disposable component

This means that subs have to be manufactured from selected bars of alloy steel, heat-treated to provide the strength and toughness required to carry the entire weight of the drill string or to withstand high torque differentials. Generally, subs exceed API specifications for drill pipe tool joint mechanical properties.


Subs are classified into four main categories:
> Bit subs or crossover subs are used to connect the drill bit to the first piece of BHA equipment or to crossover connections in the drill string. Drill bits are manufactured with a pin, making make-up impossible without a bit sub.
> Lift subs or handling subs are used to lift BHA components from the catwalk to the rig floor.
> Top drive subs or saver subs serve as the sacrificial element between the drill string and the top drive, reducing repair and maintenance costs.
Workover subs or circulating subs are used to limit the allowable fluid-circulation rates.

## Product Performance

Bit subs or crossover subs are manufactured from AISI 4145H-modified alloy, heat-treated to a Brinell Hardness range of 285-341 with a Charpy "V" notch minimum impact strength of $40 \mathrm{ft} / \mathrm{lb}$ at $70^{\circ} \mathrm{F}$ and one inch below the surface. Connections can be cold rolled after machining, if requested. All connections are phosphate coated to impede galling during initial make-up. They are available in standard lengths of 36 " and 48 " with other configurations upon request.

Crossover subs come with a minimum yield strength of 110 KSI and are manufactured integral with the following connections:
$>$ box $x$ pin
> box x box
$>$ pin $x$ pin

Lift subs and lift plugs are made of AISI 4145H-modified steel and manufactured to the same specifications used for drill collars. They are available in sizes from $3-1 / 8$ " to 11".


Lift Plug


Lift Subs


## Operational Benefits

 COMMAND SMFI offers a wide range drill string products and accessories with standard API or proprietary high-performance connections to meet the most demanding drilling requirements.

COMMAND SMFI drill stem subs are available in any size or configuration required.

## Pup Joints

## The Solution: Pup Joints for Easy Surface Handling \& Drilling Practices

Pup Joints are commonly used to adjust the length of the drill string to the elevation of rotary table for easy surface handling and drilling practices. They undergo the same stresses as drill pipe and their performance depends primarily on their superior mechanical properties.
Pup Joints are short drill pipe used to adjust the length of the drill string and are ordered to match all drill pipe dimensions.

## Product Performance

Pup Joints are manufactured from AISI 4145H or 4140H-modified alloy, heat-treated to a Brinell Hardness range of 285-341 with a Charpy "V" notch
 minimum impact strength of $40 \mathrm{ft} / \mathrm{bb}$ at $70^{\circ} \mathrm{F}$ and one inch below the surface. Pup Joints are heat-treated to 110,000 PSI minimum yield. All connections are phosphate coated to impede galling during initial make-up. They are available in standard lengths of $5^{\prime}, 10^{\prime}, 15^{\prime}$ and $20^{\prime}$ with other configurations upon request.

Integral Pup Joints dedicated to Sour Service applications are available. PJ -110 PUP S are Sour Service Pup Joint using ASCOWELL C material providing improved resistance to Sulfide Stress Cracking with high yield strength.

## Operational Benefits

COMMAND SMFI offers a wide range drill string products and accessories with standard API or proprietary highperformance connections to meet the most demanding drilling requirements.


| Nominal Size <br> A (in) | Tool Joint OD <br> B (in) | Tool Joint ID <br> (in) | TJ Pin Tong <br> C (in) | TJ Box Tong <br> D (in) | Connection |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $2-3 / 8$ | $3-3 / 8$ | $1-1 / 2$ | 9 | 12 |  |
| $2-7 / 8$ | $4-1 / 8$ | $2-1 / 8$ | 9 | 11 | NC26 |
| $3-1 / 2$ | $4-3 / 4$ | $2-9 / 16$ | 10 | $12-1 / 2$ | NC31 |
| $3-1 / 2$ | 5 | $2-1 / 8$ | 10 | $12-1 / 2$ | NC38 |
| 4 | $5-1 / 4$ | $2-11 / 16$ | 9 | 12 | NC38 |
| $4-1 / 2$ | $6-1 / 4$ | 3 | 9 | 12 | NC40 |
| 5 | $6-1 / 2$ | $3-1 / 4$ | 9 | 12 | NC46 |
| 5 | $6-5 / 8$ | $2-3 / 4$ | 9 | 12 | NC50 |
| 5 | $6-5 / 8$ | $3-1 / 4$ | 9 | 12 | NC50 |
| $5-1 / 2$ | $7-1 / 4$ | $3-1 / 2$ | 8 | 10 | NC50 |
| $5-1 / 2$ | $7-1 / 2$ | $3-1 / 2$ | 10 | $5-1 / 2$ FH |  |
| $6-5 / 8$ | $8-1 / 2$ | $4-1 / 4$ | 8 | 12 | $5-1 / 2$ FH |
| $6-5 / 8$ | 8 | 5 | 8 | 10 | $6-5 / 8 ~ F H$ |

Sour Service grades and equivalent to G-105 and S-135 are available upon request
Length L(ft): 5; 10; 15; 20
Other configurations are available upon request
All hardbanding and coating options available upon request.

## Stabilizers

The Solution: Preventing Undesirable Deviation with Stabilizers
Stabilizers are used to prevent undesirable deviation of the drill string. Typically, one or two stabilizers are placed in the bottom-hole assembly (BHA) to increase drill string stability. Additional stabilizers can be added to the drill string to further improve BHA solidness and minimize wellbore deviation.


| Dimensions | Fishing Neck |  | Wall Contact | Overall Length |  | Blade Angle |  | Blade Width | Approx Weight |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Hole Size <br> (in) | Length <br> (in) | $\begin{aligned} & \hline \text { OD } \\ & \text { (in) } \end{aligned}$ | Length <br> (in) | Near Bit <br> (in) | String <br> (in) | Open Design | Tight Design $360^{\circ}$ Coverage | $\begin{aligned} & \hline \text { BW } \\ & \text { (in) } \end{aligned}$ | (lbs) |
| 6 | 28 | 4-3/4 | 16 | 69 | 72 | $15^{\circ}$ | $15^{\circ}$ | 2-3/16 | 320 |
| 8-1/2 | 28 | 6-1/2 | 16 | 69 | 73 | $15^{\circ}$ | $23^{\circ}$ | 2-3/8 | 717 |
| 12-1/4 | 30 | 8 | 18 | 77 | 82 | $15^{\circ}$ | $27^{\circ}$ | 3-1/2 | 1,146 |
| 12-1/4 | 30 | 9-1/2 | 18 | 77 | 82 | $15^{\circ}$ | $27^{\circ}$ | 3-1/2 | 1,477 |
| 16 | 30 | 9-1/2 | 18 | 87 | 92 | $15^{\circ}$ | $35^{\circ}$ | 4-1/2 | 2,227 |
| 17-1/2 | 30 | 9-1/2 | 18 | 89 | 93 | $15^{\circ}$ | $38^{\circ}$ | 4-1/2 | 2,315 |
| 26 | 30 | 9-1/2 | 18 | 98 | 103 | $15^{\circ}$ | $43^{\circ}$ | 5 | 3,417 |

## Client Specs

## The Solution: Products Built According to Spec to Guarantee Performance

Specifications are needed to guarantee product performance in the most demanding environments. They are vital in understanding and agreeing upon all product requirements. In addition to COMMAND SMFI design specifications, our products adhere to the most demanding industry standards or individual client specifications and are immediately suitable for use on the rig site upon delivery.

## Performance

Where applicable, COMMAND SMFI manufactures products in compliance with the following API standards:
> API Specification 5DP (ISO 11961:2008)
> API Specifications 7-1 \& 7-2 (ISO 10424-1:2004
\& ISO 10424-2:2007)
> API Recommended Practice 7G (ISO 10407:1993)

COMMAND SMFI products can also be supplied with the following specifications:

```
> NS1
```

> DS1
> IRP 1.8
> Customer supplied specification

When a client requires unique specifications, a team of dedicated engineers reviews the specification to ensure it is feasible and that the manufacturing process is modified accordingly to guarantee client satisfaction.

COMMAND SMFI facilities meet the following quality standards:
>API Specification Q1
> ISO 9001
> ISO 11961

## Benefits

COMMAND SMFI works together with its clients to develop unique specs to answer specific challenges. We ensure that products meet specified requirements every time.


## Hardbanding

## The Solution: Increase Drill String Service Life \& Reduce Casing Wear with Hardband Application

The large diameters of drill string products are susceptible to wear due to the rotation and sliding of the drill string. Various hardband alloys are used to address a variety of issues related to the durability of the products and the protection of the casing.

COMMAND SMFI plants are qualified by wire suppliers and follow application procedures accordingly. Hardbanding is applied by automatic arc-welding methods. The application process is closely monitored and controlled resulting in a uniform, low porosity, wear-resistant surface.

## Performance

Hardbanding is available in raised, semi-raised or flush configurations and in open hole and casing friendly compounds.

COMMAND SMFI is a qualified applicator of the following casing friendly products:
> Duraband NC
> Arnco 100XT, 150XT \& 350XT
> Tuboscope TCS Ti and 8000
> Armacor M Star
> Castolin OTW-12Ti, OTW-13CF
> COMMAND SMFI Procasing*


COMMAND SMFI Procasing is a hard chromium alloy free of tungsten carbide used primarily on the center wear pads of Heavy Weight Drill Pipe.

Additionally, COMMAND SMFI has the following proprietary tungsten carbide products (typically for open hole):
> CF 500 (20-45 mesh) general
> CF 1000 (20-30 mesh) large
> CF 2000 (CF 1000 with metal overlay)

## Standard Application:

$\rightarrow$ Heavy Weight Drill Pipe - COMMAND SMFI offers hardbanding on tool joint pin and box sections and the center wear pad. Special requests for tool joint box elevator taper are also available.Several bands of hardbanding (generally 4" in length) is applied to the pin and box tool joints. An optional band (approximately $3 / 4$ " in length) may be applied to the box elevator taper. Two areas of hardbanding (generally 3 " long each) are applied to the center wear pad.
$\rightarrow$ Drill Collar - Recommendations for the amount and placement of hardband depends upon the geometry of the drill collar. These recommendations may be found in the earlier section on drill collars in this catalog and are designated as Type A, B or C.

## Benefits

Whether for the Drilling Contractor or the Oil Company, hardbanding plays a significant role in extending the service life and improving the performance of the drill string and casing.

## Coating

## The Solution: Pipe ID Protection with Internal Plastic Coating

Internal Plastic Coating (IPC) is an epoxy resin that is applied on the ID of Drill Pipe and Heavy Weight Drill Pipe as a thin layer ( 0.1 to $0.4 \mu \mathrm{~m}$ or 5 to 15 mils). Coating takes place at the end of the manufacturing process. The internal coating plays a key role in protecting against corrosion and improving the hydraulic efficiency of the drill string, lowering operational costs of drilling and extending the life of the drill string.

Corrosion related fatigue failures are known to be the biggest cause of fatigue failures for Drill Pipe, followed by pure and notch fatigue. While external pits on the drill pipe surface are harmless, since they are immediately polished off during downhole operation, internal notches can grow and become stress-concentration points.

Internal Plastic Coating provides a protective barrier against corrosion and extends the useful life of Drill Pipe. It also acts as an effective stress coat giving a reliable visible indicator of an over-torqued connection when IPC is missing from under the pin.

We have identified industry accepted coating suppliers and applicators near all of our manufacturing plants.

## Performance

IPC solutions include:
> NOV Tuboscope - TK-34, TK-34 P, TK-34 XT
> other coating materials are available upon request

These products withstand high temperatures encountered in most drilling environments provided circulation is maintained.

## Benefits

Operational benefits include:

## > Corrosion barrier

> Mechanical and abrasion wear resistance
$>$ Chemical and organic acids resistance
> Improved hydraulics
> Prevention against scale deposits


## Make and Break

## The Solution: Save Time \& Money with Make and Break

Time is money on the drilling rig. It takes about 10 minutes per joint to break-in pipe at the rig site. A 15,000-foot drill string (about 500 joints), takes 5,000 minutes (or 83 hours) of rig and crew time. Non-productive time (NPT) can be avoided by making and breaking connections before they reach the rig floor.

Proper initial make-up is probably the most important factor affecting the life of the tool joint connections. By using controlled initial factory make-up/break-out drill pipe, galling of the threads can be minimized.

Make-up/Break-out Costs At Rig


## Performance

COMMAND SMFI's make-up/break-out is consistently performed using the same procedure for each tool joint, thus avoiding material handling mishaps and the potential variability of procedure used on different rig sites. Should galling occur during the process, it can be immediately addressed and repaired at the plant prior to shipping.

Procedure for make-up/break-out:
> Joints are finish-machined, inspected and phosphate coated prior to operation.
> Threads of each box and pin member are cleaned thoroughly to remove any oil, grease or other matter.
> Box and pin threads are coated with drill pipe thread compound.
> Joints are made-up hand tight and then power-tightened to $100 \%$ of recommended make-up torque and broken-out to hand-tight condition for three successive make and break cycles.
> Joints are finally broken apart, cleaned thoroughly, and inspected to ensure that no galling of the threads and sealing shoulders has occurred.

## Benefits

Factory make-up/break-out at COMMAND SMFI provides insurance against damage to connections and reduces NPT on the rig floor.

## Thread Protectors

## The Solution: Avoid Thread Damage with Thread Protectors

Threads can be subject to damage during transport, storage, and surface handling. These damages can reduce the life expectancy of the drill string. It is a safe and standard practice to place hard plastic thread protectors on every connection of Drill Pipe, BHA and accessories whenever these products are to be transported, stored or submitted to other surface handling.

## Performance

Thread protectors, when properly used, offer a guaranteed thread protection and are available for all standard oilfield connections. COMMAND SMFI products are generally shipped with plastic protectors and are available with pressed steel protectors.

We also offer cast-steel (with lift bail and certification on request) thread protectors.
Cast-steel thread protectors are ideal for safe handling and protecting swivels, drill collars, tool joints, and wear subs. These protectors feature API precision machined shoulders and threads.

We offer all standard oilfield size thread protectors including for proprietary connections.

Pressed Steel Thread Protectors


| Connection | Pin <br> Protector <br> Weight (lbs) | Box <br> Protector <br> Weight (lbs) | Weight <br> per Set <br> (lbs) |
| :---: | :---: | :---: | :---: |
| NC23 | 4 | 6 | 10 |
| 2-2/4 REG | 4 | 6 | 10 |
| NC26 | 4 | 6 | 10 |
| 2-3/8 IF | 4 | 7 | 11 |
| 2-7/8 XH | 7 | 6 | 13 |
| 2-7/8 IF | 7 | 6 | 13 |
| NC31 | 7 | 6 | 13 |
| 3-1/2 REG | 7 | 8 | 15 |
| NC35 | 10 | 9 | 19 |
| 3-1/2 XH | 10 | 9 | 19 |
| NC38 | 10 | 9 | 19 |
| 3-1/2 IF | 10 | 9 | 19 |
| 3-1/2 H-90 | 14 | 11 | 25 |
| NC40 | 14 | 11 | 25 |
| 4 FH | 14 | 11 | 25 |
| 4 H-90 | 17 | 13 | 31 |
| 4-1/2 REG | 17 | 13 | 31 |
| NC44 | 17 | 13 | 31 |
| 4-1/2 FH | 17 | 13 | 31 |
| 4 IF | 18 | 14 | 31 |
| NC46 | 18 | 14 | 31 |
| 4-1/2 H-90 | 18 | 14 | 31 |
| 5 H-90 | 21 | 18 | 39 |
| 5-1/2 REG | 21 | 18 | 39 |
| 5-1/2 H-90 | 21 | 18 | 39 |
| NC50 | 21 | 18 | 39 |
| 4-1/2 IF | 21 | 18 | 39 |
| 5-1/2 FH | 28 | 23 | 51 |
| 6-5/8 REG | 28 | 23 | 51 |
| 6-5/8 H-90 | 28 | 23 | 51 |
| NC56 | 28 | 23 | 51 |
| 7 H-90 | 29 | 25 | 54 |
| NC61 | 29 | 25 | 54 |
| 7-5/8 REG | 35 | 31 | 66 |
| 7-5/8 H-90 | 35 | 31 | 66 |
| NC70 | 35 | 31 | 66 |
| 8-5/8 REG | 55 | 46 | 101 |
| 8-5/8 H-90 | 55 | 46 | 101 |
| 25 |  |  |  |

## Benefits

Far less expensive than the cost of re-cutting threads, COMMAND SMFI thread protectors offer protection against damage during transportation, storage and handling.

## Leader in Drilling Solutions



FOR GENERAL INFORMATION

Email: sales@command-smfi.com

L Command
5 Rue des Guérins 58200 Cosne-Cours-sur-Loire France

