NOV is a world class partner for measurement services and solutions appealing to rig designers, drilling operations managers, and operations managers who are dissatisfied with the loss of time and money associated with providers whose products fail under harsh conditions. Our measurement offerings provide the accuracy you need along with unparalleled service from a lifelong solutions partner. Measurement professionals can help you accomplish the most challenging of force measurement tasks by leveraging solutions that are oilfield tough with proven reliability under the harshest of conditions.

The Dynamic Drilling Solutions (DDS) business unit offers base instrumentation, which is a key element in any measurement package, and we provide many system integration packages using an array of instrumentation. Our current technologies range from hydraulic products to strain gauge and electronic signal indication devices. The DDS business unit has assembled a total product and service solution that includes certified sensors and displays backed by a global network of service personnel who are ready to serve you.

Table of Contents

- **Auxiliary Products**
  - Standardized Consoles...
  - Spectrum...
- **Electronic Indicators**
  - Multifunction Display...
  - SPM Pump Speed Indicator...
  - RPM Rotary Speed Indicator...
- **Electronic Instruments**
  - Load Pins...
  - Compression Cells...
  - Triple Bridge Sensor...
  - TCE-Series Line Tension Transducer...
  - Ultrasonic Mud Tank Level Sensor 40224300-Series...
  - Electronic Pit Level Probe Assembly 272819-Series...
  - Electronic Flow Line Sensor 40223750-Series...
  - Strain Gauge Pressure Sensor 221145-Series...
  - StringSense Multi-variable Measurement System...
- **Electronic Systems**
  - Mud Watch...
  - Drill Watch...
  - Rigsite Closed-Circuit Television System (CCTV)...
- **Force Measurement**
  - Load Pins...
  - Compression Load Cells...
  - Load Pin / T-Link...
  - TCE-Series Line Tension Transducer...
  - Strain Gauge Pressure Sensor 221145-Series...
  - StringSense Multi-variable Measurement System...
- **Hydraulic Indicators**
  - Anchor Type Weight Indicators...
  - TRU-VUE Untitzed Pressure Gauge...
  - Single Pointer Indicators...
  - Single Pointer Indicators with 1:1 GM1000A-Series, bracket mount...
  - Compound Pointer Indicators...
  - 1:1 Piston Separator Pressure Transmitter P10038A-Series...
- **Hydraulic Systems**
  - Diaphragm Protector Hydraulic Pressure Transmitter E17-Series...
  - Electric Rotary Torque (ERT)...
  - Pressure Debooster Systems...
  - Hydro-Mech Rotary Torque...
  - Tong Line Pull Indicating System...
  - Tong Torque Indicating System...
Auxiliary Products

Standardized Consoles

The NOV line of standardized driller’s consoles includes single, double and triple bay arrangements. Instrumentation can be selected in a variety of configurations using proven NOV gauges to measure critical rig site weight, force, pressure, and speed parameters. Advanced MudWatch® Spectrum® and RigSense™ system displays are offered for those requiring expanded information monitoring and analysis. Choose from a broad selection of configurations to help measure, monitor, and manage your drilling process. Configuration options include:

- Bit and hook weight, rate of penetration and depth
- Rotary revolutions per minute and torque
- Pump pressure and speed
- Mud gain/less and flow
- Mud temperature and density
- Total hydrocarbon gas, as well as many other important rig parameters

NOV offers “configure-to-order” (CTO) standard console designs using many off-the-shelf components selected for the specific application’s requirements. Production and delivery lead times are dramatically reduced. Some CTO consoles can be delivered in as little as 2 to 3 weeks.

We take quality seriously. Regularly scheduled inspections and comprehensive final testing ensure that your console will perform as specified. Be it a standard driller’s console or a comprehensive interface, NOV is uniquely positioned to provide and comprehensive final testing ensure that your console will perform as specified. Be it a standard driller’s console or a comprehensive interface, NOV is uniquely positioned to provide and comprehensive final testing ensure that your console will perform as specified. Be it a standard driller’s console or a comprehensive interface, NOV is uniquely positioned to provide and comprehensive final testing ensure that your console will perform as specified. Be it a standard driller’s console or a comprehensive interface, NOV is uniquely positioned to provide and comprehensive final testing ensure that your console will perform as specified. Be it a standard driller’s console or a comprehensive interface, NOV is uniquely positioned to provide and comprehensive final testing ensure that your console will perform as specified. Be it a standard driller’s console or a comprehensive interface, NOV is uniquely positioned to provide

Electronic Indicators

Spectrum®

Large-scale liquid crystal displays present drilling parameter data in both digital and analog formats. This highly efficient, space saving alternative to conventional analog hydraulic and electronic display systems is certified intrinsically safe for use in Class I, Division 3 Groups C and D hazardous locations. It can be configured to meet numerous input parameter requirements.

Spectrum technology offers complete integration of all important drilling parameters into a compact driller’s display panel.

Flexibility is designed into the Spectrum display system. Should changes in operating conditions necessitate a change in the mix of monitored parameters, a simple lens change and software upgrade enable the display to accommodate different sensor data received from the Data Acquisition Unit (DAQ). The driller has full control over all alarm set points as well as channel scaling through the numeric keypad. Displays can be specified with backlighting should operating conditions require.

Features

- Five fully sealed push buttons within a heavy-duty stainless-steel front panel
- Easy-to-follow English language menu for sensor calibration, input/output (I/O) channel configuration, alarm settings, network settings, and screen layout
- Bright 320 x 240 electroluminescent display
- 160° readability in all light conditions
- Four strain gauge input channels (20 mV or 100 mV) and four analog output channels
- Serial networking capabilities; USB and Ethernet ports
- Internal CompactFlash drive
- Accepts inputs from a range of tension and payout sensors
- Waterproof front panel (with available watertight mount and enclosure)
- Certified in Class I, Division 2, Groups A, B, C, and D hazardous locations
- Thin-film transistor

Multifunction Display

The MD Totco multifunction display is a new, next-generation multi-variable controller that improves upon our previous display with a host of new features. The multifunction display offers intuitive, easy-to-access information about critical settings right at your fingertips. Tension, speed, and payout signals from engineering units are displayed with unmatched readability in various working conditions. The multifunction selection display instrument’s networking capabilities eliminate the need for external modules and provide flexibility in line monitoring, weighing, or supervisory control and data acquisition (SCADA) applications. On-board data logging reduces the amount of inert data, and remotely linking displays enable the creation of a rig/ship-wide monitoring network. Various sensors display parameters in different locations and resolutions, enabling as many as six different alarms and utilizing a broad array of communication technologies.

Features

- One button brings up diagnostic screen
- Multiple serial protocols supported
- Switch units at any time, no recalibration required
- Inert data, and remotely linking displays enable the creation of a rig/ship-wide monitoring network. Various sensors display parameters in different locations and resolutions, enabling as many as six different alarms and utilizing a broad array of communication technologies.

Operating temperature
- Temperature range is -40°C to 75°C

Front panel construction
- Stainless steel
- Glass-coated Lexan, epoxy lamination assembly

Pushbutton construction
- Fully sealed stainless-steel push buttons

Input voltage range
- 9 to 36 VDC

Display viewing angle
- Electroluminescent, more than 160°

Display pixel density
- Electroluminescent pixel density 320 x 240

Input modes
- Up to four analog inputs, 4 to 20 mA, 0 to 5 VDC

Menu structure
- Easy-to-use English language menus

Units of measure
- Switch units at any time, no recalibration required

Serial ports
- RS-485, RS-232, USB and Ethernet ports

Serial protocols
- Multiple serial protocols supported

Diagnostics
- One button brings up diagnostic screen

Calibration
- Calibration units are actual sensor units

www.nov.com | Dynamic Drilling Solutions
NOV is a world class partner for measurement services and solutions appealing to rig designers, drilling operations managers, and force measurement specialists who are dissatisfied with the loss of time and money associated with providers whose products fail under harsh conditions. Our measurement offerings provide the accuracy you need along with unparalleled service from a lifelong solutions partner. Our measurement professionals can help you accomplish the most challenging of force measurement tasks by leveraging solutions that are oil field tough with proven reliability under the harshest of conditions.

Unlike our imitators who require you to keep an increased number of spares while waiting for service, NOV has assembled a total product and service solution which includes certified sensors and displays backed by a global network of service personnel who are ready to serve you.

NOV has been manufacturing electronic sensors for the oil and gas and industrial industries for twenty five years. During this time we have developed unique processes and procedures for manufacturing the highest quality and most robust sensors in the market today. Our seal-welded sensors protect our internal strain gauges and signal conditioner boards from harsh environments. The signal conditioner board that has been developed will operate from 8 to 30 volts supply and has an onboard temperature sensor that provides self-linearization of the 4-20mA output over a temperature range of -40° C to + 60° C. Other outputs also available are 0-5 Volts, mV/V and voltage out.

Custom designs are a large part of our sensor strengths. We have designed for:

- NASA
- Department of Defense
- Military applications
- Medical industry applications
- Crane manufacturers
- Boeing® aircraft

NOV designs and manufactures strain gauge-based force, load and pressure sensors from the highest quality traceable materials in house and tests them on our certified test stands. Testing methods and equipment are traceable to National Institute of Standards & Technology and test data is captured electronically and stored in our database in accordance with our ISO 9001 quality manual. Sensors are certified for use in hazardous locations throughout the oil and gas industry and industrial markets both domestically and internationally. Features include ATEX, UL, and IECEx certifications for most sensor products.

**Comprehensive Electronic Sensor Suite Includes:**

- Load pins
- Position transducers
- Compression cells
- Line tension transducers
- System 2000
- Tensiometers
- Ultrasonic mud tank level sensors
- Electronic pit level probe assemblies
- Electronic flow line sensors
- Strain gauge pressure sensors
- Pressure transmitters

**Digitally Controlled Signal Conditioning**

NOV introduces an advancement in signal conditioning technology utilizing an on-board microprocessor. This advanced technology provides finer resolution using an analog circuit instead of the conventional “analog-to-digital-to-analog” controller. It monitors ambient temperature and provides continuous corrections to the gain and offset values, as determined by a table developed during calibration of the device. This approach provides the high precision and bandwidth of an analog circuit along with the extreme flexibility of digital technology.

**Electronic Instruments**

**SPM Pump Speed Indicator**

- Measures pump speed, shows pump or hole trouble at a glance, information not indicated on mud pressure gauge.
- System self powered by generator (supplied), which can operate any number of meters.
- Needs no outside power or batteries.
- Generators have explosion proof ratings.
- Generators easily mounted with direct connection to pump pinion shaft, piston rod oiler, or as an idler wheel to the V-belt driving the oiler.
- Available in capacities from 0-100 to 0-500 SPM.

**RPM Rotary Speed Indicator**

- Helps driller to select optimum speed for faster penetration.
- Generator can be directly coupled to any shaft turning in direct proportion to the rotary table or V-belt driven.
- Systems available for either panel or box mounted meters.

**Tachometers**

- Measures pump speed, shows pump or hole trouble at a glance, information not indicated on mud pressure gauge.
- System self powered by generator (supplied), which can operate any number of meters.
- Needs no outside power or batteries.
- Generators have explosion proof ratings.
- Generators easily mounted with direct connection to pump pinion shaft, piston rod oiler, or as an idler wheel to the V-belt driving the oiler.
- Available in capacities from 0-100 to 0-500 SPM.
Electronic Instruments

Load Pins

Load pins can be installed in shackles for line tension, sheaves for anchor line or drill line tension, clevises for hook load or tow forces, rollers for roller forces and numerous other applications.

- Mooring line tension
- Towline tension
- Forklift load
- Conveyor belts and rollers
- Many other applications

3500 Compression Load Cell

NOV’s Model 3500 compression load cell utilizes the most stable geometric form. Unlike columnar or ring/stem type geometry, the Model 3500 does not require guidance to prevent errors due to bending.

The stability of the 3500 series geometry is complemented by a unique eight-gauge bridge which helps to cancel errors due to nonparallel loading. The “thru-hole” body design facilitates mounting in any application and may be mounted over a stud or other fixture arrangement. The standard corrosion resistant stainless steel core and case permit usage in hostile environments ranging from food processing to aerospace applications. A variety of cases may be custom designed to meet requirements ranging from underwater to deep space, as well as needs associated with internally housed signal conditioners. The load cell’s temperature compensation circuit, designed as an integral part of the bridge, permits maximum performance and the highest accuracies under changing environmental conditions.

Load ranges are available from 1,000 to 2,000,000 pounds. We specialize in difficult and custom applications and provide customized solutions to meet customer requirements.

Compression Load Cells

When the loads are not carried through a pin, compression load cells are often an excellent means of measuring critical loads.

- Hook load
- Anchor tension
- Bulk mud weight
- Bulk cement weight
- Many other applications

Load Pin / T-Link

NOV supplies very accurate and reliable sensors, such as load pins and column style tension links. The sensors are manufactured with the highest quality, mill traceable material, such as 17-4 PH stainless steel for standard applications. We have a fully staffed engineering department with an understanding of exotic materials for custom applications. Strain gauge bridge outputs and 4-20mA outputs utilizing our Digitally Controlled Signal Conditioner (DCSC) provide the highest reliability offered in the sensor industry.

Electronic Instruments

Triple Bridge Sensor

NOV’s triple bridge sensors provide our customers with the high accuracy of our compression load cells multiplied by three. It operates with three independent internal bridges and signal conditioners, which is equivalent to having separate load cells incorporated into one unit. This allows for multiple outputs to be utilized by the customer’s control systems. It provides the ability, with a ratio metric software package, to be used as comparison for control of your applications and avoid cost associated with redundant sensors.

Position Transducer Line

NOV’s Position Transducer solutions address displacement measurement problems with a device whose history spans thirty-five years. From the very first design to the latest, the original position transducer has led the way to become the industry standard.

The Position Transducer Line is designed with performance in mind. All components are carefully designed for precision and long life service. The hybrid conductive plastic potentiometer provides infinite resolution and linearity of better than 0.1% of full scale as standard and optional linearity of better than 0.05%. The standard A circuit configuration is a voltage divider, which provides a high level output in volts. The optional B circuit provides a low-level differential output in millivolts for compatibility when used with other differential transducers.

NOV’s calibration certificates are traceable to the National Institute of Standards and Technology (NIST). NOV’s Position Transducer solutions are also in compliance with the United States Government Military Standards MIL-45208, for inspection systems, and MIL-STD-45662, for calibration systems.
Electronic Instruments

TC-E-Series Line Tension Transducer

- 100,000 lbs (45,360 kg) capacity.
- Accurate strain gauge measurement achieves 0.2% repeatability.
- Designed for all deadline tension electronic sensing applications.
- Simple clamp on design requires no deadline anchor.
- Operating temperature: -40° to +180° F (-40° to 82° C).
- Certified model: -40° to 140° F (-40° to 60° C)
- Temperature compensated to within .01% per degree Fahrenheit.
- Easy to use, weighs only 17 lbs.
- Installs on wire rope sizes 7/8” through 2” diameter without modification.
- Standard 4-20 mA output, 2-wire loop powered.
- Electronics are protected against surges and reverse wire hook up.
- Replaceable wear parts made of 316 corrosion resistant steel.
- UL/ATEX/IECEX certified as Intrinsically Safe.

Ultrasonic Mud Tank Level Sensor 40224300-Series

This pit level sensor has a 30 foot range and offers easy set-up and automatic adjustment for internal obstructions. In addition, measurements on level, distance, volume, or open channel flow easy to configure.

- Measurement range
  9.6” to 16’, 4.8” (0.25 to 5 m)
- Included Angle of Sonic Beam
  10° at -3 dB boundary
- Power
  12-28 VDC
- Output
  4-20 mA
- Resolution
  0.125” (3 mm)
- Temperature
  -40° to +158° F (-40° to +70° C)
- Enclosure
  Tefzel® (flouropolymer)
- Enclosure Rating
  Type 4X, NEMA 4X/IP65
- Mounting
  2” NPT
  2 optional flanges
  (standard application and high corrosion application)

Electronic Instruments

Electronic Flow Line Sensor 40223750-Series

Available in four pipe diameters:
- 8 - 10”
- 10 - 12”
- 12 - 14”
- 16 - 18”
- 14-30 VDC operating voltage with 4-20 mA output.

Strain Gauge Pressure Sensor 221145-Series

- Accurate and reliable strain gauge technology
- Hermetically sealed stainless steel construction withstands shock and vibration.
- Used with Fig. 1502 hammer union nut and flanged, threaded, or weld-on subs.
- Electrical connection options include cable gland with pigtail, 4 pin TURCK and 6 pin bayonet style connectors.
- Conforms to NACE MR0175-97 for H2S service.
- Certified IS, UL, ATEX, and IECEx.
- R-Cal feature available.
- Integral DCSC is standard.
- Calibration certificates provided.

- Maximum Working Pressure
  15,000 psi
- Overload
  150% of capacity without damage, 300% without burst rupture failure
- Output
  4-20 mA, loop powered
- Excitation
  8-28 VDC
- Calibration error
  <0.25% of full scale output (nominal), including hysteresis, repeatability and nonlinearity (based on straight line fit)
- Temperature range
  -40° to +140° F (-40° to +60° C)
- Temperature effects
  <±0.01% of capacity sensitivity shift per °F
Electronic Instruments

StringSense Integrated Drillstring Measurement System

NOV's StringSense™ integrated drillstring measurement system provides a means of making surface measurements directly on the drillstring and using that data to develop a complete picture of the drilling process from downhole to surface. As a patented instrumented internal blowout preventer (IBOP), the StringSense system delivers more accurate and dependable surface drilling data and allows you to extend the operating envelope when drilling near the technical limits of the well.

The StringSense system provides measurements for direct drilling tension and compression, drillstring torque, RPM, bending moment, and internal pressure immediately below the topdrive’s main shaft, transmitting the data wirelessly to a surface receiver system. Using accurate drilling tension and torque data via direct measurements, you can reduce the risk of parting strings, extend drilling envelopes through improved torque and drag models, and improve your drilling equipment efficiency.

The StringSense system uses the latest strain gauge technology and has the advantage of being physically located in the direct load path of the drillstring, which eliminates many components of measurement error due to friction in the hoisting system and other forms of mechanical interference in conventional drilling measurement devices. The system’s valve geometry is identical to original IBOP features, and OEM components are used to ensure the same high-quality seal as a standard NOV valve assembly. Battery life ranges from two-to-six weeks, depending on signal transmission frequency settings, and batteries can be safely replaced one at a time over well center to maintain a continuous data stream. Three proprietary patch antennas provide 360° coverage from the drill floor to the top of the derrick.

Features and Benefits

- Accurate mechanical work measurement for topdrive
  - Provides the necessary data for improved torque and drag modeling
  - Facilitates decreased nonproductive time
- Same form factor and operation as existing upper IBOP for drop-in replacement
  - Requires no change from original installation procedures
- Direct measurement of multiple variables at the drillstring
  - Eliminates external elements that would affect accuracy of measurements
- Driller can adjust quickly to correct many issues
  - Reduces wear on the topdrive and drillstring

Electronic Systems

Mud Watch®

NOV's standard mud monitoring system provides accurate, up-to-the-minute information on critical drilling fluid parameters during drilling, tripping, and other mud-sensitive rig activities. The Mud Watch system supplies rig personnel with important circulation system values and relative alarm point settings in a rugged, compact display unit designed for use on the rig floor. The system’s large-scale LCDs allow easy viewing of information in all light conditions. Using the integral keypad, alarm points, alarm acknowledgment and display operation parameters such as active pits and pumps can be easily set or modified when drilling conditions or rig operations change.

The Mud Watch monitoring system replaces conventional mud volume, mud flow, trip tank and E-Mud systems. It saves space, reduces rig-up expense and eliminates the need for complicated, costly purging equipment.

The Mud Watch system monitors hook load and bit weight, standpipe pressure, revolutions per minute and torque, depth of hole, total active mud volume, gain/loss, individual and totalized strokes per minute from three pumps, and return flow from a variety of sensor input types, including voltage, current, and pulse. Signals are processed by a data acquisition unit and transmitted on the communication network to the display. If desired, information can be interfaced to a personal computer for remote-viewing, archiving and printing.

The Mud Watch system display panel makes it ideal for harsh environments and can easily be integrated into a console or panel containing other instrumentation or control systems.

Features

- System displays all of the primary drilling parameters
- Simple operator interface
- Full audio and visual alarm points set by driller
- Large LCDs with backlighting for all viewing conditions
- Display certified Intrinsically Safe for use in Class I Div 1 hazardous areas

Drill Watch®

NOV's Drill Watch system is a rugged hazardous area solution which provides accurate information on critical drilling and fluid parameters during drilling, tripping, and other sensitive rig activities. Utilizing large-scale, easily readable liquid crystal displays (LCDs), the Drill Watch system supplies rig personnel with important drilling and circulation system values and relative alarm point settings in a rugged, compact, stainless steel display unit designed for use on the rig floor. Backlit LCDs allow easy viewing of information in all light conditions. Using the keypad, alarm points, alarm acknowledgment, and display operation parameters such as active tanks, lines strung, gain/loss, top drive/rotary table gear select, trip mode and rate of penetration status can easily be set or modified when drilling conditions or rig operations change.

The Drill Watch system monitors hook load and bit weight, standpipe pressure, revolutions per minute and torque, depth of hole, total active mud volume, gain/loss, individual and totalized strokes per minute from three pumps, and return flow from a variety of sensor input types, including voltage, current, and pulse. The Drill Watch mud monitoring system signals are processed by the DAQ, then transmitted through a communication network to the display. Information can be interfaced to various computers for remote display, archiving and printing.

Mud Watch®

Drill Watch panels are easily integrated to driller console designs.
Electronic Systems

Rigsite Closed-Circuit Television System (CCTV)

NOVs closed-circuit television (CCTV) system can remotely monitor rig operations from your on-site office. The system can be tailored to specific operational needs, providing a comprehensive, real-time view of the rig floor and other areas while waiting on critical operations to take place. The system’s ability to monitor events from one central location provides more eyes on the operation, allowing you to take care of other business and increase efficiency.

The CCTV system helps quickly recognize and deal with situations as they develop. It can improve safety and reduce the need for personnel in hazardous or noisy areas. The system provides safe, remote operation of camera equipment with the added benefit of recording events for conducting safety analyses, enhancing procedures, and training purposes.

The CCTV system’s camera placement can help you identify and eliminate potential problems in areas such as:

- Top drive and derrick during connections and tripping pipe
- Shaker systems for cuttings, fluid levels, and potential spills
- Pumping equipment for leaks and unwanted drilling fluid discharges
- Rig floor and pipe rack for safe, efficient operations
- Rigsite entrance for visitors and/or the rigsite perimeter

The NOV CCTV system features high-definition (HD) cameras with either fixed housings or pan-and-tilt zoom housings—both housings have weather- and explosion-proof enclosures. LCD flat screen monitors provide clear resolution and optional viewing and recording based on the number of cameras, frame rate, and video resolution. We use a digital video recorder (DVR) for reviewing, controlling, and recording the video. The HD DVR can store video for a week or as long as a month, depending on the number of cameras and the recording resolution. The video can also be viewed and exported to a memory device.

NOV offers rental and purchase options for our CCTV systems, and we provide unmatched support for installation and service needs.

Features and Benefits

- Observe multiple operations from a single location
- Increase efficiency and safety
- Mitigate potentially hazardous situations
- Camera placement in dangerous or unmanned locations
- Reduce the need for personnel in unsafe, noisy areas
- Remotely operate equipment
- Record and store video for up to a month
- Conduct safety analyses and develop training

Force Measurement

Load Pins

Load pins can be installed in shackles for line tension, sheaves for anchor line or drill line tension, clevises for hook load or tow forces, rollers for roller forces and numerous other applications.

- Mooring line tension
- Towline tension
- Forklift load
- Conveyor belts and rollers
- Many other applications

Compression Load Cells

When the loads are not carried through a pin, compression load cells are often an excellent means of measuring critical loads.

- Hook load
- Anchor tension
- Bulk mud weight
- Bulk cement weight
- Many other applications

3500 Compression Load Cell

NOV’s Model 3500 compression load cell utilizes the most stable geometric form. Unlike columnar or ring/stem type geometry, the Model 3500 does not require guidance to prevent errors due to bending.

Features and Benefits

- Observe multiple operations from a single location
- Increase efficiency and safety
- Mitigate potentially hazardous situations
- Camera placement in dangerous or unmanned locations
- Reduce the need for personnel in unsafe, noisy areas
- Remotely operate equipment
- Record and store video for up to a month
- Conduct safety analyses and develop training

We have installed column style tension links for NASA, which weigh the space shuttle fuel tanks with combined accuracies of less than 1%. We have designs ranging up to 2,000,000 pounds capacity on load links, compression cells, and on load pins. Our sensors are designed utilizing the latest engineering software such as Pro-É®, AutoCad®, MathCAD®, and Pro Mechanica® FEA modeling. Our 4-20mA sensors offer hazardous area location UL®/ATEX/IECEx certification for use in applications worldwide.

The stability of the 3500 series geometry is complemented by a unique eight-gauge bridge which helps to cancel errors due to nonparallel loading. The “thru-hole” body design facilitates mounting in any application and may be mounted over a stud or other fixture arrangement. The standard corrosion resistant stainless steel core and case permit usage in hostile environments ranging from food processing to aerospace applications. A variety of cases may be custom designed to meet requirements ranging from underwater to deep space, as well as needs associated with internally housed signal conditioners.

The load cell’s temperature compensation circuit, designed as an integral part of the bridge, permits maximum performance and the highest accuracies under changing environmental conditions.

Load ranges are available from 1,000 to 2,000,000 pounds. We specialize in difficult and custom applications and provide customized solutions to meet customer requirements.
Force Measurement

TCE-Series Line Tension Transducer

- 100,000 lbs (45,360 kg) capacity
- Accurate strain gauge measurement achieves 0.2% repeatability.
- Designed for all deadline tension electronic sensing applications.
- Simple clamp on design requires no deadline anchor.
- Operating temperature: -40°F to +180°F (-40°C to 82°C).
- Certified model: -40°F to 140°F (-40°C to 60°C).
- Temperature compensated to within 0.1% per degree Fahrenheit.
- Easy to use, weighs only 17 lbs.
- Installs on wire rope sizes 3/8” through 2” diameter without modification.
- Standard 4-20 mA output, 2-wire loop powered.
- Electronics are protected against surges and reverse wire hook up.
- Replaceable wear parts made of 316 corrosion resistant steel.
- UL/ATEX/IECEx certified as Intrinsically Safe.

Strain Gauge Pressure Sensor 221145-Series

- Accurate and reliable strain gauge technology
  - Hermetically sealed stainless steel construction withstands shock and vibration.
  - Used with Fig. 1502 hammer union nut and flanged, threaded, or weld-on subs.
  - Electrical connection options include cable gland with pigtail, 4 pin TURCK and 6 pin bayonet style connectors.
  - Conforms to NACE MR0175-97 for H2S service.
  - Certified IS, UL, ATEX, and IECEx.
  - R-Cal feature available.
  - Integral DCSC is standard.
  - Calibration certificates provided.

Maximum Working Pressure
- 15,000 psi

Overload
- 150% of capacity without damage, 300% without burst rupture failure

Output
- 4-20 mA, loop powered

Excitation
- 8-28 VDC

Calibration error
- <0.25% of full scale output (nominal), including hysteresis, repeatability and nonlinearity (based on straight line fit)

Temperature range
- -40°F to +140°F (-40°C to +60°C)

Temperature effects
- <±0.01% of capacity sensitivity shift per °F

NOV’s Electronic Deadline Sensor.

Force Measurement

StringSense Integrated Drilstring Measurement System

NOV’s StringSense integrated drillstring measurement system provides a means of making surface measurements directly on the drillstring and using that data to develop a complete picture of the drilling process from downhole to surface. As a patented instrumented internal blowout preventer (IIBOP), the StringSense system delivers more accurate and dependable surface drilling data and allows you to extend the operating envelope when drilling near the technical limits of the well.

The StringSense system provides measurements for direct drillstring tension and compression, drillstring torque, RPM, bending moment, and internal pressure immediately below the topdrive’s main shaft, transmitting the data wirelessly to a surface receiver system. Using accurate drillstring tension and torque data via direct measurements, you can reduce the risk of parting strings, extend drillstring envelopes through improved torque and drag models, and improve your drilling equipment efficiency.

The StringSense system uses the latest strain gauge technology and has the advantage of being physically located in the direct load path of the drillstring, which eliminates many components of measurement error due to friction in the hoisting system and other forms of mechanical interference in conventional drillstring measurement devices. The system’s valve geometry is identical to original IIBOP features, and OEM components are used to ensure the same high-quality seal as a standard NOV valve assembly. Battery life ranges from two-to-six weeks, depending on signal transmission frequency settings, and batteries can be safely replaced one at a time over well center to maintain a continuous data stream. The system’s valve geometry is identical to original IIBOP features, and OEM components are used to ensure the same high-quality seal as a standard NOV valve assembly. Battery life ranges from two-to-six weeks, depending on signal transmission frequency settings, and batteries can be safely replaced one at a time over well center to maintain a continuous data stream. Three proprietary patch antennas provide 360° coverage from the drill floor to the top of the derrick.

Features and Benefits

- Accurate mechanical work measurement for topdrive
- Provides the necessary data for improved torque and drag modeling
- Facilitates decreased nonproductive time
- Same form factor and operation as existing upper IIBOP for drop-in replacement
- Requires no change from original installation procedures
- Direct measurement of multiple variables at the drillstring
- Eliminates external elements that would affect accuracy of measurements
- Driller can adjust quickly to correct many issues
- Reduces wear on the topdrive and drillstring
Hydraulic Indicators

Anchor Type Weight Indicators

Accurate and reliable indications of hook load and weight on bit are essential to drillers for the efficient control of ROP and hole direction. The hydraulic deadline anchor type weight indicator is a standard of the industry, and NOV weight indicators set the standards for quality, accuracy, and reliability against which all others are judged.

NOV has weight indicator models designed to work in conjunction with all industry-standard deadline anchors using either tension or compression hydraulic load cells. Indicator systems are supplied as either portable box-mount instrument systems or panel-mounted as part of a driller’s console. Each system accurately senses tension in the deadline and uses this to indicate hook load and weight on bit. Many models have separate pointers for both hook load and weight on bit. In addition, integral circular hydraulic recorders are also offered on several models.

Type 200, AWE-Series
• For deadline loads to 200,000 lbs.
• 10, 12, 14 and 16 lines strung.
• E551 compression load cell.
• 16” dial indicator.

Type 150, AWE-Series
• For deadline loads to 150,000 lbs.
• 10, 12, 14 and 16 lines strung.
• E551 compression load cell.
• E551 compression load cell.
• 16” dial indicator.

Type 125, AWE-Series
• For deadline loads to 125,000 lbs.
• 6, 8, 10 and 12 lines strung.
• E551 compression load cell.
• E551 compression load cell.
• 16” dial indicator.

Type D, AW-Series
• For deadline loads to 50,000 lbs.
• 6, 8, 10 and 12 lines strung.
• E543 compression load cell or E80 Sensater® tension load cell.
• 16” dial indicator.

Type FS, AW-Series
• For deadline loads to 40,000 lbs.
• 4, 6 and 8 lines strung.
• E542 compression load cell or E160A Sensater® tension load cell.
• 12” dial indicator with actual bit weight pointer or 8 1/2” fluid filled indicator with target pointer for bit weight.

Type G, AWG-Series
• For deadline loads to 30,000 lbs.
• 4, 6 and 8 lines strung.
• E190A compression load cell.
• 12” dial indicator with target pointer.

TRU-VUE Unitized Pressure Gauge

GM14-Series

Available with optional API type 6BX 2 1/16” - 10 M flange for special applications.

NOV has the only mud pressure gauge that can be read easily from 75 feet and more away.

• Rugged yet precise bourdon tube and movement indicator offers unmatched performance for standpipe and local pressure manifold applications.
• Valuable for blowout prevention and cementing, fracturing, acidizing and gravel packing trucks.
• Integral adjustable damper for eliminating pointer oscillations.
• Fluid filled case for movement lubrication and pointer dampening.

Standard capacities
• 0-1000 psi
• 0-3000 psi
• 0-5000 psi
• 0-6000 psi
• 0-10,000 psi
• 0-15,000 psi
• Metric equivalents in kg/cm2, kPa, MPa and BAR units of measure
Hydraulic Indicators

Single Pointer Indicators

GM6A-Series, bracket mount
GM6AP-Series, panel mount
- Provides quick, accurate checks on mud pump operation; helps detect washout drill pipe or bit nozzle problems.
- Indicator gauges can be mounted in the weight indicator box, driller’s console or locally on the mud pump.
- Full 360° dial calibration for maximum pointer movement; shows the smallest pressure changes.
- Fluid filled gauge has large, easy-to-read 6” dial face and high pressure damper adjust.
- Rugged E17-152 Diaphragm Protector mounts with 2” NPT sub.
- Hose lengths to 50 feet are standard; longer lengths available in some pressure ranges.

Standard capacities
- 3,000, 5,000, 6,000, 10,000 and 15,000 psi
- 210, 350, 420, 700 and 1000 kg/cm²
- 21, 35, 42, 70, 100 MPa

Single Pointer Indicators with 1:1 GM1006A-Series, bracket mount
GM1007A-Series, panel mount
- Accurate reading up to 140 ft – twice the distance of other pressure systems.
- Separator features either weld-on or threaded female sub.
- Lower pressure limits apply to threaded type female thread or to sour gas applications.
- Special seals withstand either granular or acidic pressure conditions.
- Suitable for separation of pressurized gases including nitrogen and CO₂ in scouring applications.

Standard capacities
- 3,000, 5,000, 6,000, 10,000 and 15,000 psi
- 218, 350, 420, 700 and 1000 kg/cm²
- 210, 350, 420, 700, 1000 BAR

Panel mount, side view

Compound Pointer Indicators

GM4-Series, bracket mount
GM4P-Series, panel mount
- Used primarily for checking pump pressures on service trucks engaged in cementing, high-pressure hydraulic fracturing operations or acidizing operations involving stimulation of oil pay formations.
- Primary pointer makes one full 360° revolution to full-scale capacity.
- Secondary pointer offers 4:1 resolution for indicating small pressure changes, making four revolutions for full capacity of gauge.
- Rugged E17-152 Diaphragm Protector mounts with 2” National Pipe Thread sub.

Standard capacities
- 4,000, 8,000, 12,000 and 16,000 psi
- 400 and 800 kg/cm²
- 40 and 80 MPa

1:1 Piston Separator Pressure Transmitter P10038A-Series
- One-to-one piston separates working fluid from gauge fluid, transmitting no-lag linear signal to gauge.
- Features temperature compensating device to assure true pressure readings for differences in ambient temperatures of ±100°F.
- Available in standard or H₂S configurations and with either weld-on or threaded female sub.
- Simple design allows field overhaul and seal replacement.
- High fluid capacity compensates for hose expansion associated with extended high pressure runs, maintaining accuracy up to 140°.
Hydraulic Systems

Electric Rotary Torque (ERT)

Essential equipment for all electric motor-driven rotary tables

ERTs split core transducer senses motor current draw.

The NOV solution to measuring rotary torque on electric rigs is accurate, simple and reliable, proving itself over the years in hundreds of installations worldwide. The NOV system displays torque on a rugged panel or box mounted meter calibrated in either foot-pounds or metric equivalents.

Installation is simple. The split core transducer is clamped around the power cable that leads to your rig’s electric motor. This will enable the transducer to sense the current the motor draws, which is proportionate to that required by the rotary table and transmit the signal to the dual output signal conditioner. The conditioner will then convert this signal into an accurate reading on the electric meter. This dual output signal conditioner will also drive an NOV drilling recorder or data acquisition system.

Features

• Simple, no moving parts to wear out.
• Split core transducer measuring electrical current to the motor clamps around power cable; no shunts or direct electrical connections required.
• Signal conditioner unit provides outputs to meters, recorders and other data acquisition devices.
• Multi-scaled meter provides readings for different gear selections.

Hydraulic Systems

Diaphragm Protector Hydraulic Pressure Transmitter E17-Series

Protects measuring or recording device from working fluid while transmitting a no-lag, linear pressure signal.

• Rugged workhorse sensor found in every corner of the world doing every conceivable pressure sensing job.
• Robust, time-proven design allows easy field repair and maintenance.
• Available in flanged, threaded and weld-on female sub configurations.
• Certified models are available.

Hydraulic Systems

Pressure Debooster Systems

DBS107A-Series, bracket mount
DBS112A-Series, panel mount

DBS104A debooster, proof tested to 22,500 psi, for working pressures to 15,000 psi.

DBS106A debooster, proof tested to 30,000 psi, for working pressure to 20,000 psi.

Actual pressure at specially calibrated gauge is only 25% of indicated value.

Reduced output pressures allow longer hose lengths and operator distance from high pressure sources.

Standard capacities

• 10,000, 15,000 and 20,000 psi
• Equivalent values in kg/cm², MPa, BAR

Hydro-Mech Rotary Torque

FA9-Series

Providing reliable and sensitive relative rotary torque indication, the Hydro-Mech assembly is suitable for all mechanical rigs utilizing a chain driven rotary table. The idler assembly is installed under the rotary drive chain, typically within the oil bath environment of the chain guard, where it senses changes in the tightness of the chain that indicate changes in torque.

• 6’ fluid-filled indicator has dial-adjust mechanism to “zero out” drill string for monitoring “torque at the bit.”
• Gauge dampener minimizes pointer oscillations caused by rough drilling and movements in the drill string.
• Helps determine hole conditions and torque patterns, giving the driller an indication of when to change bits.

By indicating stress on the drill pipe, the Hydro-Mech warns the driller of:

• Potential twist off’s.
• Locked cones on the bit.
• Bit trouble.
• Gauge loss or out-of-gauge holes.
• Formation changes.

The Hydro-Mech is a self-contained assembly with a fluid filled gauge for long, trouble free service. The unit includes idler with 2 ft hose and gauge with 15 ft hose. The hoses are connected by a self-sealing coupling.

Idler wheels are available for 1.5” through 4.063” single chain and 1.5” through 3.125” double chain.

The Hydro-Mech is easily connected to any NOV drilling recorder where torque trends can be easily detected.
Hydraulic Systems

**Tong Line Pull Indicating System**

H6E-Series Universal Tong Line Pull Assembly is a necessity for maximum drill string life

- Provides an accurate check on critical makeup or break-out torque for all tool joints, drill collars and drill string components.
- 6" fluid-filled indicator reads directly in line pull.
- Target pointer is set to a line pull value corresponding to the desired torque, taking into account tong handle length and place of load cell attachment.
- Models and capacities to work with all manual tongs.
- Permanent installation models for box or console include 25 ft hose assembly, portable installation models with 5 ft hose mount indicator and cylinder directly on tong handle.
- Capacities to 25,000 pounds line pull with metric equivalents available.
- Some models offer combination dials.

**Tong Torque Indicating System**

H29-Series Tong Torque Assembly for all power tong applications

- Each model designed and calibrated for a specific make and model of power tong.
- Both tension and compression hydraulic load cell assemblies are offered to accommodate any tong design.
- Assures uniform and proper makeup of the string by indicating precise torque applied to each joint when running pipe or casing with power tongs.
- Capacities to 120,000 ft-lbs or metric equivalents.
- Many models are available with dual scales for added versatility.
- Rugged yet simple load cell designs offer extended life and ease of service.