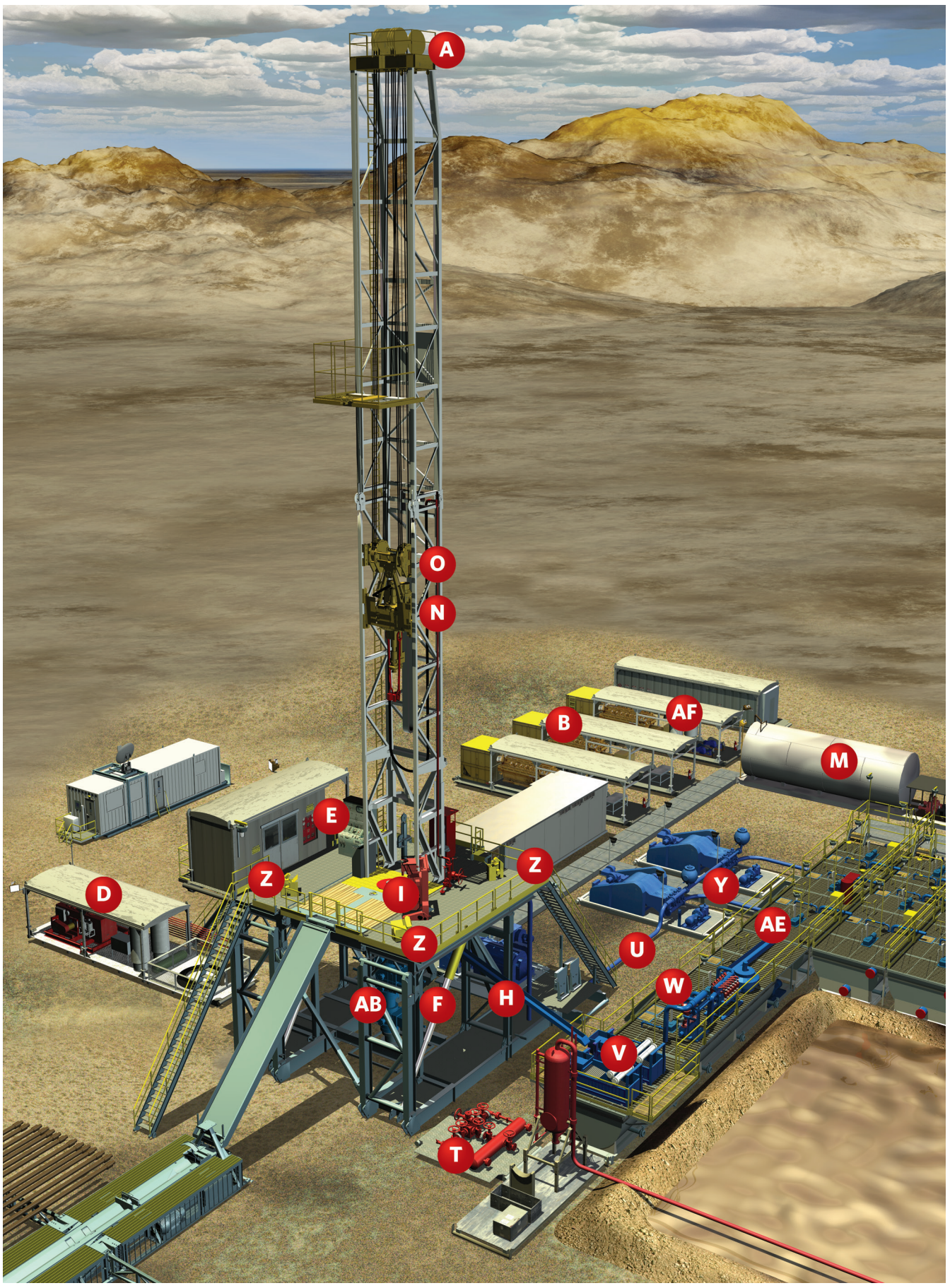
Sensors and Switches in Oil Rig Applications

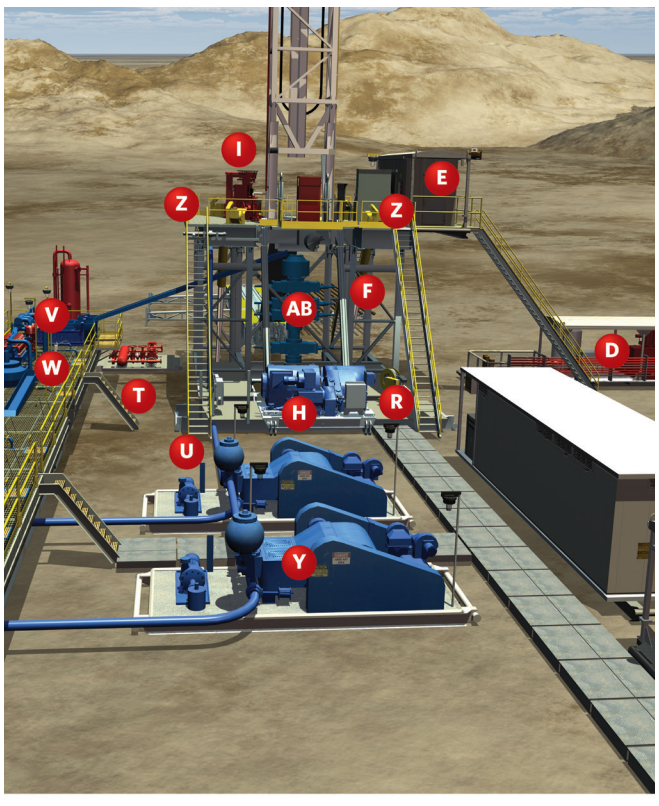
Honeywell

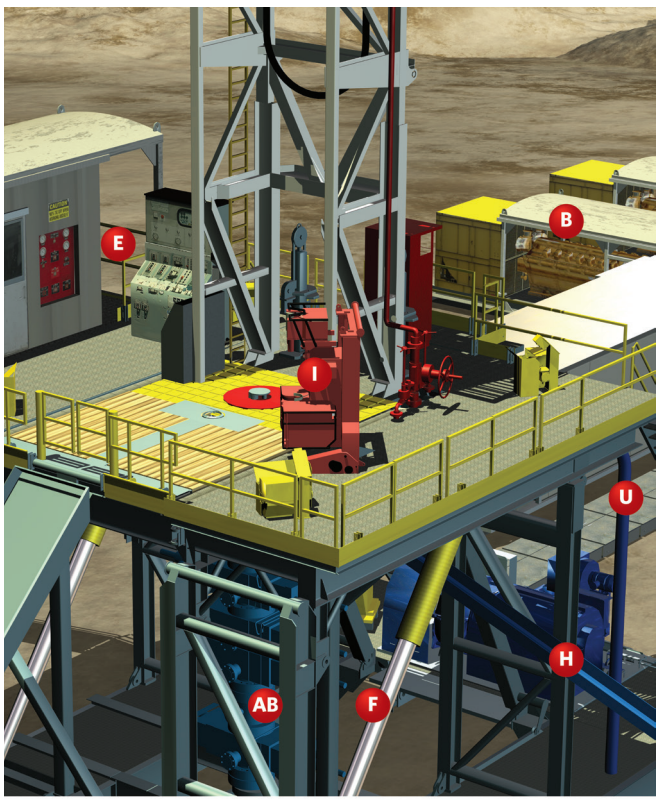
A Crown Block	Measure weight on drill line via cable tension **Load cells:** 41, RM
B Power Generation Unit	Measure oil, water, and hydraulic fluid pressure **Pressure sensors:** FP2000, MLH, IP IS, PX2, PX3, SPT Emergency shutdown **Switches for ESD:** WOI
D Accumulator Unit	Measure inlet/outlet pressure with high accuracy **Pressure sensors:** FP2000, STJE
E Drilling Cab	Control/monitor operations activity **MICRO SWITCH basic switches:** BZ, V7, V15W, SX **MICRO SWITCH toggle switches:** TL, NT, TS, TW, ET, AT **Key, rotary, and e-stop switches:** custom **Limitless™ operator interface:** WOI
F Rig Hydraulic Lift	Measure hydraulic pressure, weight, force/strain or movement, monitor raising or lowering deck for directional drilling **Pressure sensors:** FP2000, IP IS **Load cells:** 41
H Drawworks	Measure torque, load/weight/position while guiding pipe into position **Load cells:** 41, RM **MICRO SWITCH switches:** BX, LSX
I Iron Roughneck	Measure torque while attaching pipe using hydraulic pressure or load measurements **Load cells:** 41 **Pressure sensors:** FP2000, IP IS
M Water/ Storage Tank	Measure tank liquid levels **Switches:** HDLS, WLS non-contact **Pressure sensors:** MLH, LL-V, SPT, PX2
N Top Drive	Monitor torque/twisting movement to ensure right amount of force is applied **Torque sensors:** custom Measure weight on drill bit **Load cells:** 41 Measure hydraulic pressure and feed information into control system **Pressure sensors:** FP2000, 811FM On/off control and operator alerts to enhance safety **Limitless™ operator interface:** WOI
O Traveling Block	Measure weight on the drill line via cable tension **Load cells:** 41
R Deadline Anchor	Measure tension on deadline/drilling line cable **Load cells:** 41, RM
T Choke Manifold	Measure valve position/choke valves **MICRO SWITCH hazardous area switch:** CX, VPX
U Mud Return Line	Measure drilling mud pressure to monitor and control mud flow **Wing Union sensors:** 434, 435, 437
V Mud Shaker	Position sensing or on/off applications **Switches:** HDLS, WLS, WOI
W Mud Cleaner	Position sensing or on/off applications **Limit switches:** HDLS, WLS, WOI
Y Mud Pump	Measure pressure and flow of mud media **Wing Union sensors:** 434, 435, 437 On/off or emergency start/stop applications **Limitless™ operator interface:** WOI Mud pump stroke count, position sensing, or on/off applications **MICRO SWITCH limits:** EX, BX, HDLS



Z Winch	Measure direct and indirect loads **Canister load cells:** MPB, 3130, 3156, 3127
AB BlowOut Preventor	Monitor RAM position via hydraulic volumetric or pressure behind the piston ("pinch offs") **Pressure sensors:** A-105, TJE
AD Drill Bit	Measure pressure or differential pressure at high temperature and pressure ranges **Pressure sensors:** S

AE Fluid Manifold	Measure drilling fluid pressure **Pressure sensors:** FP2000 **Wing Union sensors:** 434, 435, 437 Measure valve position **Limit switches:** CX, WCX, VPX
AF Mud Tank/ Reservoir	Measure tank liquid levels **Pressure sensors:** FP2000, IP IS, SPT Monitor tank valve position **Limit switches:** BX, LSX, HDLS, WLS





Sensors and Switches in Oil Rig Applications

Pressure Sensors

FP2000 Series
- All-welded, stainless steel construction
- Gage, absolute, barometric, vacuum, differential pressure
- Range: 0.5 psi to 10,000 psi
- Accuracy range of 0.1 % or 0.25 %
- Intrinsically safe options available

MLH Series
- All metal wetted parts for use in wide variety of fluid applications
- No internal elastomeric seals mean no o-ring compatibility issues
- Range: 50 psi to 8000 psi (inclusive)
- Accuracy: ±0.25 %FS BFSL
- Rated IP65 or better for protection from harsh environments

IP IS Series
- Rugged, all-welded stainless steel and Hastelloy® wetted parts for durability
- Compatible with a wide variety of media
- Range: 7 bar to 350 bar | 100 psi to 5,000 psi
- Accuracy: ±0.15 %, ±0.25 % BFSL
- Fully configurable

PX2 and PX3 Series
- Cost effective, highly configurable and highly durable
- Compatible with a wide variety of harsh media
- Broad compensated temperature range with industry-leading Total Error Band
- Range: 1 bar to 46 bar | 100 kPa to 4.6 MPa | 15 psi to 667 psi (PX2)
- Range: 1 bar to 46 bar | 15 psi to 667 psi (PX3)
- Accuracy ±0.25 %FSS; TEB ±2 %FSS (-40 °C to 125 °C [-40 °F to 257 °F])

SPT Series
- Rugged, stainless steel in a small size package
- Absolute, gage, sealed gage, vacuum gage
- Range: 0 psi to 3 psi, 0 psi to 5000 psi; ±0.25 % accuracy
- Reliable semiconductor technology, NEMA 4 design
- Calibrated and temperature compensated

Model TJE
- Rugged, all-welded, stainless steel construction
- Built for applications requiring high accuracy and temperature stability
- Unique “true gage” design hermetically sealed against atmospheric contamination
- Range: 1 psig/a to 60000 psig/a; accuracy: ±0.10 %
- Intrinsically safe available

Super TJE Series
- Ultra precision pressure sensors with up to ±0.05 % accuracy
- True gage, absolute and differential (wet/wet)
- Durable, stainless steel for use in rugged environments
- Range: 10 psig to 7500 psig (pressure); 50 psid to 750 psid (differential)
- Intrinsically safe options available

811FM Series
- All-welded, stainless steel construction for use with liquid, gas or corrosive vapors
- Range: 2 psig/a to 10000 psig/a
- Accuracy: ±0.25 %
- Dual pipe thread pressure fitting for easy bulkhead mounting
- Explosion proof

Model S
- Rugged, high-frequency stainless steel
- Extremely small size, fits into tight spaces
- Range: 100 psig to 15,000 psig
- Operating temperature range: -54 °C to 149 °C [-65 °F to 300 °F]
- Accuracy: ±1.0 %

Model A-105
- Rugged, unitized stainless steel design with heavy sidewalls
- Thin diaphragm design able to measure low pressures
- Flush mount design with miniature footprint
- Can be used in corrosive fluid environments
- Range: 100 psig to 15,000 psig; accuracy: ±0.5 %

LL-V Series
- Designed for vertical entry into a tank
- Complete fluid submersion; corrosion resistant to most fluids
- True gage design with all welded stainless steel construction
- Range: 20 inH_2O to 50 psig; accuracy: ±0.1 %

Models 434, 435, 437 Wing Union Pressure Sensors
- Rugged design with Inconel® X-750 or NACE-compliant Inconel® 718 wetted parts
- Built to provide durability with abrasive or corrosive media
- Accuracy: ±0.1 %FSS BFSL (Model 435) high accuracy, or ±0.2 %FSS BFSL (Model 434, 437) standard accuracy
- Wide port aperture (Model 437) for use with more viscous media
- Compatible with WECO® 1502, 2002, 2202; intrinsically safe option available
- Protective cage option (Model 434, 435, 437)

Torque Shafts

Custom Torque Shaft
- Modify/design existing top drive shafts to measure torque
- Strain-gauge the complex large shafts found in top drives
- Calibrating to torque levels required on a top drive
- Modify/adapt the calibration rig flanges to the custom flanges on a top drive shaft

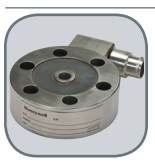
Operator Controls

Rotary Switches
- 3- and 4-position options
- May be engineered with lever or knob actuator
- Integral connectors (Metripak 280 and Sumitomo)
- Environmentally sealed design

e-Stop Switches
- Provides positive contact closure and opening when the switch is operated
- Environmentally sealed design (IP67 sealing)
- UV-resistant knob for outdoor use
- Knob available in a variety of colors

MICRO SWITCH Toggle Switches (Sealed and Unsealed), TL, NT, TS, TW, ET, AT Series
- Broad product range meets a variety of electrical and load requirements
- Sealed models built to withstand harsh, wet, dusty, and dirty environments
- 2 or 3 position, momentary and/or maintained action; 1-, 2- or 4-pole circuitries
- IWTS (integrated wire termination system) for ease of assembly & maintainability

Load Cells



Model 41
- Rugged, low profile pancake style
- All-welded stainless steel with double diaphragm design
- Load ranges of 5 lb to 500,000 lb; Accuracy: ±0.1 %
- Low sensitivity to extraneous loads
- Intrinsically safe option available

Model RM
- Rod end in-line tension load cell
- Rugged design with stainless steel, all-welded construction
- Load ranges from 2000 lb to 200,000 lbs; ±0.22 % to 0.29 % accuracy
- Low sensitivity to extraneous loads

Model MPB
- High capacity load measurements in a small size load cell
- Rugged stainless steel construction
- Load ranges from 15,000 lbs to 2,000,000 lbs
- Accuracy: ±0.25 % full scale

Model 3130
- Carbon steel, fatigue-resistant load cell
- Extremely resistant to extraneous bending and side loading forces
- Load ranges of 500,000 lbs to 1,000,000 lbs
- Accuracy: ±0.30 % full scale

Model 3156
- Carbon steel, fatigue-resistant load cell
- Extremely resistant to extraneous bending and side loading forces
- Load ranges of 25,000 lbs to 150,000 lbs
- Accuracy: ±0.30 % full scale

Model 3127
- Carbon steel, fatigue-resistant load cell
- Extremely resistant to extraneous bending and side loading forces
- Load ranges up to 2,000,000 lbs.
- Accuracy: ±0.30 % full scale

MICRO SWITCH Basic Switches

MICRO SWITCH Premium Large Basic Switches, BZ Series
- Accepted as the world-wide standard snap-action switch
- Best suited for high cost-of-failure applications
- Designed for 100k operations at full load or 10M for mechanical life
- Current ratings from 10 A to 25 A
- UL/CSA, CE, ENEC approvals

MICRO SWITCH Premium V-Basic Switches, V7 Series
- Best suited for higher cost-of-failure applications
- Designed for 100k operations at full load or 10M for mechanical life
- Current ratings from 0.1 A to 25 A
- UL/CSA, ENEC approvals

MICRO SWITCH Premium Miniature/Subminiature Basic Switches, SX Series
- Best suited for higher cost-of-failure applications
- Small size and light weight
- Current ratings from 0.1 A to 25 A
- UL/CSA, ENEC approvals

MICRO SWITCH Watertight Miniature Switches, V15W Series
- Miniature-sized basic switch designed for harsh-duty, wash down areas
- Rugged, highly accurate machine control for turning circuits on and off
- Compact, lightweight, and long-lasting
- UL, cUL, ENEC, CQC approvals

MICRO SWITCH Limit Switches

MICRO SWITCH Hazardous Area Switches, BX and LSX Series
- Designed specifically for dangerous indoor or outdoor locations
- Superior reliability and repeatability
- Explosion-proof design with flame path to contain and cool escaping hot gases
- O-ring seals render switches weather-proof, water-tight, dust-tight
- UL, CSA (BX, LSX Series); ATEX, IEC EX, NEPSI, European approvals (BX Series)

MICRO SWITCH Hazardous Area Switches, CX Series
- Hazardous atmosphere outdoor use – watertight, dust-tight
- Superior reliability and repeatability
- Rotary converts in seconds to clockwise, counter-clockwise, or both-way operation
- IP66; NEMA 1, 3, 4, 4X, 6, 6P, 13 sealing
- UL, CSA, ATEX, IEC Ex approvals

MICRO SWITCH Hazardous Area Valve Position Indicator, VPX Series
- Certified for ATEX, IEC Ex, CE, and cULus specifications for global applications
- Die-cast aluminum housing and various sealing (NEMA 4, 4X, 6, and 13)
- Versions available in both snap-action switches and intrinsically safe inductive proximity switches
- Versions of the VPX with proximity switches carry an Intrinsically Safe (IS) rating

MICRO SWITCH Hazardous Area Switches, EX Series
- Designed for dangerous indoor or outdoor locations
- Superior reliability and repeatability
- Smallest UL-listed housings available for use in hazardous locations
- O-ring seals render switches weather-proof, water-tight, dust-tight
- UL, CSA, ATEX, IEC EX approvals

MICRO SWITCH Heavy-Duty Limit Switches, HDLS Series
- Three series offer rugged, die-cast body and epoxy coating
- Boss-and-socket head design for secure head-to body retention
- Multiple mounting and actuator options
- UL, CSA, CE, CCC approvals

Limitless™ Wireless Solutions

Limitless™ Wireless Operator Interface, WOI Series
- Enables operator indication from locations where wiring is too costly or not possible
- Flexible operator type options (push button, rotary or key switch, etc.)
- Reduces installation/maintenance costs with no wires, conduit, connectors, etc.
- Eliminates issues with wire connection integrity on moving equipment

Limitless™ Wireless Non-Contact Switches, WLS Series
- MICRO SWITCH HDLS heritage combined with the latest wireless technology
- Enables presence/absence detection where wiring is an issue or not feasible
- Reduces installation/maintenance costs due to no wires, conduit, connectors, etc.
- Eliminates wire connection integrity issues on moving equipment

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