

Parker Hannifin EPS Division Oil & Gas Product & Capabilities



ENGINEERING YOUR SUCCESS.

November 19, 2013

Key Facts About Parker Hannifin

Global Leader in Motion and Control (NYSE:PH)

\$13.1 Billion in revenues 2012

861,000 Products sold

468,000 Customers

58,000 Employees

13,000 Distribution/MRO outlets

1,100 Markets

311 Manufacturing plants

145 Divisions

53 Countries



Decentralized and Entrepreneurial



Parker's Motion & Control Product Groups

Aerospace



Key Markets
 Aftermarket services
 Commercial transports
 Engines
 General & business aviation
 Helicopters
 Launch vehicles
 Military aircraft
 Missiles
 Power generation
 Regional transports
 Unmanned aerial vehicles

Key Products

Control systems & actuation products
 Engine systems & components
 Fluid conveyance systems & components
 Fluid metering, delivery & atomization devices
 Fuel systems & components
 Fuel tank inerting systems
 Hydraulic systems & components
 Thermal management
 Wheels & brakes

Automation



Key Markets
 Alternative energy
 Conveyor & material handling
 Factory automation
 Food & beverage
 Life sciences & medical
 Machine tools
 Packaging machinery
 Paper machinery
 Plastics machinery
 Primary metals
 Safety & security
 Semiconductor & electronics
 Transportation & automotive

Key Products

AC/DC drives & systems
 Air preparation
 Electric actuators, gantry robots & slides
 Human machine interfaces
 Inverters
 Manifolds
 Miniature fluidics
 Pneumatic actuators & grippers
 Pneumatic valves & controls
 Rotary actuators
 Stepper motors, servo motors, drives & controls
 Structural extrusions
 Vacuum generators, cups & sensors

Climate & Industrial Controls



Key Markets
 Agriculture
 Air conditioning
 Appliances
 Food & beverage
 Industrial machinery
 Life sciences
 Oil & gas
 Precision cooling
 Process
 Refrigeration
 Transportation

Key Products

Accumulators
 Advanced actuators
 CO₂ controls
 Electronic controllers
 Filter driers
 Hand shut-off valves
 Heat exchangers
 Hose & fittings
 Pressure regulating valves
 Refrigerant distributors
 Safety relief valves
 Smart pumps
 Solenoid valves
 Thermostatic expansion valves

Filtration



Key Markets
 Aerospace
 Food & beverage
 Industrial plant & equipment
 Life sciences
 Marine
 Mobile equipment
 Oil & gas
 Power generation
 Process
 Transportation
 Water

Key Products

Analytical gas generators
 Chemical & microfiltration filters
 Compressed air filters & dryers
 Engine oil, coolant, fuel & oil filtration systems
 Filter vessels & housings
 Fluid condition monitoring systems
 Hydraulic & lubrication filters
 Hydrogen, nitrogen & zero air generators
 Process membrane & depth media filters
 Water desalination & purification filters & systems

Fluid Connectors



Key Markets
 Aerial lift
 Agriculture
 Bulk chemical handling
 Construction machinery
 Food & beverage
 Fuel & gas delivery
 Industrial machinery
 Life sciences
 Marine
 Mining
 Mobile
 Oil & gas
 Renewable energy
 Transportation

Key Products

Check valves
 Connectors for low pressure fluid conveyance
 Deep sea umbilicals
 Diagnostic equipment
 Hose couplings
 Industrial hose
 Mooring systems & power cables
 PTFE hose & tubing
 Quick couplings
 Rubber & thermoplastic hose
 Tube fittings & adapters
 Tubing & plastic fittings

Hydraulics



Key Markets
 Aerial lift
 Agriculture
 Alternative energy
 Construction machinery
 Forestry
 Industrial machinery
 Machine tools
 Marine
 Material handling
 Mining
 Oil & gas
 Power generation
 Refuse vehicles
 Renewable energy
 Truck hydraulics
 Trench equipment

Key Products

Accumulators
 Cartridge valves
 Electrohydraulic actuators
 Human machine interfaces
 Hybrid drives
 Hydraulic cylinders
 Hydraulic motors & pumps
 Hydraulic systems
 Hydraulic valves & controls
 Hydrostatic steering
 Integrated hydraulic circuits
 Power take-offs
 Power units
 Rotary actuators
 Sensors

Instrumentation



Key Markets
 Alternative fuels
 Biopharmaceuticals
 Chemical & refining
 Food & beverage
 Marine & shipbuilding
 Medical & dental
 Microelectronics
 Offshore oil exploration
 Oil & gas
 Pharmaceuticals
 Power generation
 Pulp & paper
 Steel
 Wastewater

Key Products

Analytical sample conditioning products & systems
 Chemical injection fittings & valves
 Fluoropolymer chemical delivery fittings, valves & pumps
 High purity gas delivery fittings, valves, regulators & digital flow controllers
 Industrial mass flow meters/controllers
 Process control double block & bleed
 Process control fittings, valves, regulators & manifold valves
 Permanent no-weld tube fittings
 Precision industrial regulators & flow controllers

Engineered Materials



Key Markets
 Aerospace
 Chemical processing
 Consumer
 Fluid power
 General industrial
 Information technology
 Life sciences
 Microelectronics
 Military
 Oil & gas
 Power generation
 Renewable energy
 Telecommunications
 Transportation

Key Products

Dynamic seals
 Elastomeric o-rings
 Electro-medical instrument design & assembly
 EMI shielding
 Extruded & precision-cut fabricated elastomeric seals
 High temperature metal seals
 Homogeneous & inerted elastomeric stages
 Medical device fabrication & assembly
 Metal & plastic retained composite seals
 Shielded optical waveguides
 Thermal management
 Vibration dampening

Engineered Materials Group Manufacturing Locations

Worldwide – Where You Need Us

North America

United States of America

- San Diego, CA
- North Haven, CT
- Miami Lakes, FL
- Elgin, IL
- Woodridge, IL
- Goshen, IN
- Ligonier, IN
- Syracuse, IN
- Lexington, KY
- Woburn, MA
- Gothenburg, NE
- Hudson, NH
- Fairport, NY
- Marion, NY
- Wilson, NC
- Fremont, OH
- Spartanburg, SC
- Lebanon, TN
- Livingston, TN
- Houston, TX
- Nacogdoches, TX
- Salt Lake City, UT
- Iron Gate, VA
- Lynchburg, VA

Canada

- Orillia, ON

Mexico

- Tijuana, Baja California
- Zapopan, Jalisco
- Matamoros, Tamaulipas

Europe

Belgium

- Boom, Belgium

Czech Republic

- Sadska, Czech Republic

Denmark

- Helsingor, Denmark

Finland

- Oulu, Finland

France

- Saint-Ouen l'Aumone

Germany

- Bietigheim-Bissingen, Germany
- Pleidelsheim, Germany

Italy

- Adro (BS), Italy

United Kingdom

- Marlow, United Kingdom
- Glasgow, Scotland

South America

Brazil

- Sao Paulo, Brazil
- Macae, Brazil

Asia

China

- Dongguan-Guangdong, China
- Shanghai, China
- Shenzhen, China
- Tianjin, China



...and sales offices in all major countries



Engineered Materials Group Divisions

Chomerics



Composite Sealing Systems Division



Engineered Polymer Systems Division



Engineered Seals Division



Integrated Sealing Systems Division



Packing Division Europe



Rayco Technologies Division



TechSeal Division



O-Ring Division



O-Ring Division Europe



Medical Systems Division



Engineered Polymer Systems Division

Charter

- Designs and manufactures engineered elastomeric, polymeric and plastic seals and sealing systems for dynamic applications

Manufacturing Capabilities

- Plastics injection molding, urethane reactive extrusion, plastics compounding; rubber compression, transfer, and injection-compression molding; in-house elastomeric mixing, rubber to metal bonding; PTFE mixing, molding and sintering; CNC precision machining and milling, in-house prototyping and tooling.



EPS Division Manufacturing Locations



EPS Division Facilities

SALT LAKE CITY, UT



Division HQ
Polyurethane Products
IM Elastomer Parts

NACOGDOCHES, TX



Clipper® Oil Seals
Large Elastomer Parts
Expansion Joints

MARION, NY



ProTech™ Bearing Isolators
Machined PTFE

ELGIN, IL



PTFE Lip Seals
Machined PTFE

HOUSTON, TX



Machined PTFE/PEEK
Molded Elastomer Parts
Custom Kitting Services

GLASGOW, SCOTLAND



Machined PTFE/PEEK
Molded Elastomer Parts
Custom Kitting Services

BAJA, MEXICO



High Volume PTFE



EPS Products

Fluid Power Packings

- Rod Seals
- Piston Seals
- Wipers
- Bearings/Wear rings/Backups

Rotary Shaft Seals

- Oil Seals (metal case and polymeric): Clipper and Parker Oil Seal
- Bearing Isolators: Millennium and ProTech
- PTFE Lip Seals: FlexiSeal and FlexiLip (Radyne), FlexiCase
- Rotary Bearings

PTFE Seals

- Spring Energized Lip Seals: Flexiseal
- High Speed Lip Seals: FlexiLip (Radyne)
- Custom PTFE Seals
- Valve Seals (stems and seats)

Molded Rubber EOG Components

- Homogeneous Rubber based products
- Fabric/Metal Insert products

Expansion Joints

Engineered Plastics Materials

Fluid Power Packings



- Rod Seals
- Piston Seals
- Wipers
- Bearings / Wear Rings
- Backups
- Buffer Seals / Rings
- Integrated Piston™

Rotary Shaft Seals



- Clipper® Oil Seals
- Parker Oil Seals™
- Millennium™ and ProTech™ bearing isolators
- PTFE lip:
 - FlexiLip™ (Radyne)
 - FlexiCase™

PTFE Seals



- FlexiSeal®, spring-energized lip seals
- FlexiLip™ (Radyne), high-speed lip seal
- Custom PTFE seals
- Valve seals (stems, seats)
- High volume rings

Molded Rubber EOG Components



- Homogeneous Oilfield Rubber Products:
 - Liners
 - Wipers
 - Plugs
 - Savers
 - Blow out preventers
- Fabric / Metal insert Piston Seals

Non-metallic Expansion Joints



- RM DYNEX® non-metallic fabric expansion joints for thermal management of power generation ducting systems:
 - Premium: Mark II, Mark III, Mark V Modified, Mark V, 1200 GTA/GTB
 - Performance "E" class
 - Economy "X" and "LX" class
- Complementary tadpole tapes & high temperature insulating components

Engineered Plastics Materials



- Hylene®
- Resilon™ family of high performance polyurethanes



Oil & Gas (“O&G”) Sub-Markets

Oil and Gas			
Well Drilling	Well Completion	Well Production	Distribution
<ul style="list-style-type: none"> • Drills • Blow Out Preventers • Drilling Mud Systems • LWD and MWD Test Equipment • Casing and Pipe Connections • Sub-sea Risers and Connector Systems • Gimbal Bearings • Flexible Joints • Control valves • Compressors and Pumps • Drilling Service Expendables 	<ul style="list-style-type: none"> • Tubing Heads and Hangers • Packers • Well Controls and X-Trees • Cementing Equipment and Expendables • Well Head Completion Assemblies 	<ul style="list-style-type: none"> • Packer Elements • X-Trees • Injection Systems • Gas Lift Valves • Well Service Tools and Test Equipment • Oil Well Servicing Expendables • Compressors/Pump • Production Blow Out Preventers • Artificial Lift Systems 	<ul style="list-style-type: none"> • Marine and Offshore Loading Swivels and Turrets • Railcar Loading Systems • Pipeline Service Equipment: Pigs and Spheres • Pipeline Valves, Actuators • Pumps/Compress-ors: Rotary Face • Tank Systems • Tanker (Ship) Loading Systems

Drilling Segment: Sub-sea



- **Applications and Products**

- Drill Bits: Rotary Seals RM
- BOP: U-cups, PP, Ram Rubbers, Seal Kits
- Mud Pumps, Motors and Savers: Rotary RM, PP
- LWD and MWD Testing: PEEK Connectors, T-Seals
- Casing Hangers: PP, LCD Paks
- Casing Connectors: SS API, PP
- Risers: PP, LCD Paks
- Control Valves: Stems Pkg, EC Stacks



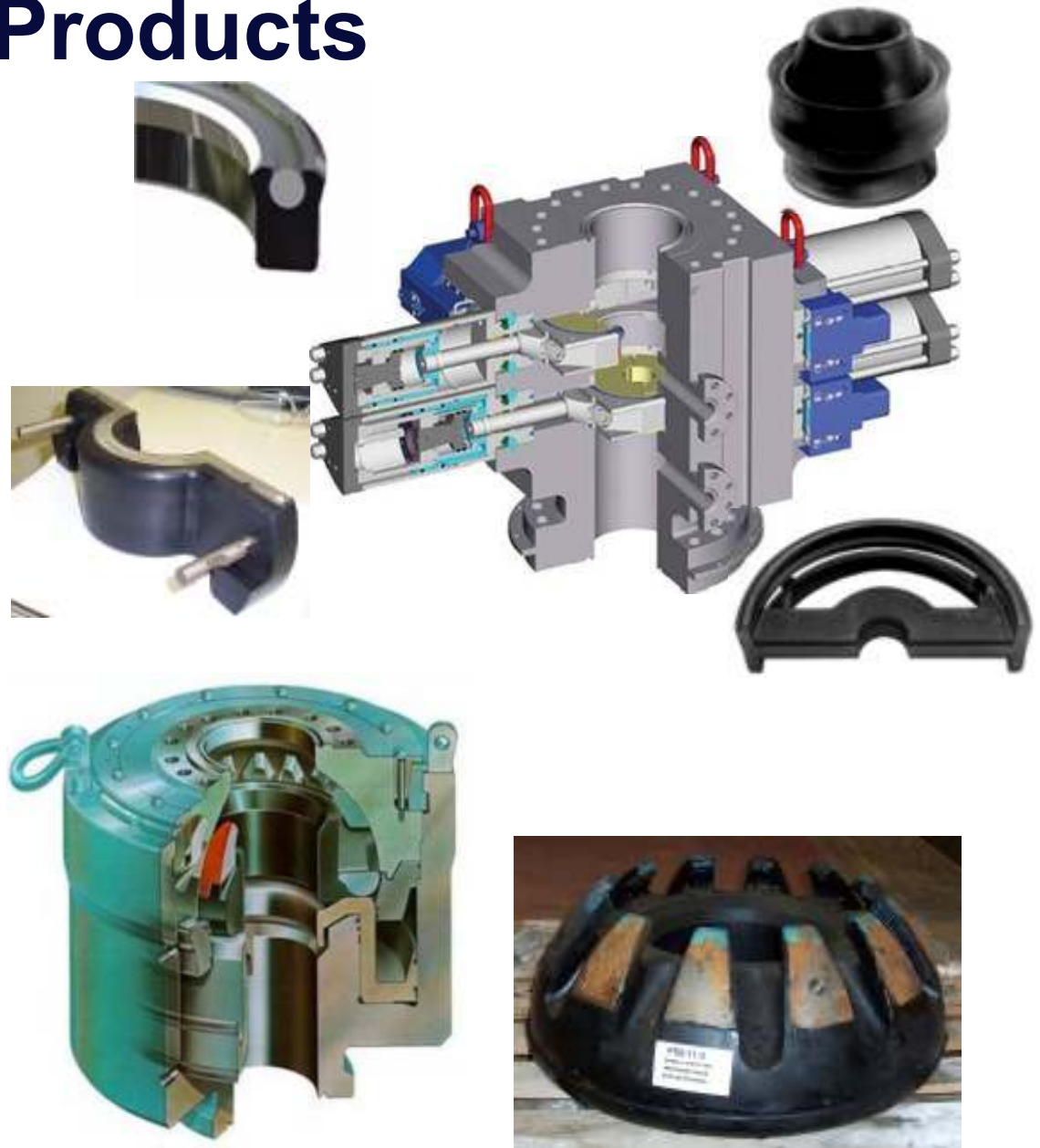
Drilling Segment: Land Based

- Application: Products
 - Drill Bits: Rotary Seals “RM”
 - BOP: U-cups, PP, Ram Rubbers, Seal Kits, Test Cups
 - Mud Pumps, Motors and Savers: Rotary RM, PP
 - Casing Connectors: API, PP
 - Pipeline Valves: Stems Pkg, EC Stacks
 - Motion Compensation Diaphragms
 - Drill Pipe Protectors
 - Pipe Wipers
 - Hammer Union Seals
 - Crown Bumpers
 - Kelly Wipers



Drilling: BOP Products

- BOP Elements
 - Top and Face Seals
 - Ram Rubbers
 - Spherical Elements
 - Stripping Elements
- Hydraulic Seals
 - Cylinder Solutions
 - API Connections
 - Static Seals
 - HT/HP Seals
- Static Seals
 - Door Seals
 - O-rings
 - Plate Seals
- Protectors



Drilling: Application Products

- Mud Pumps
 - Pony Rod Seals
 - Well Service Packings
 - Piston Cup
 - Valve & Seat Seals
- Directional Drillers
 - Shock Tools and Drill Jars Seals
 - Directional Drill Seals
 - Mud Motor Elastomer Boots
 - Seal Kits
- Drill Bits
 - Tri-cone Rotary Seals
 - Reservoir Bladders
- LWD and MWD Tools
 - PTFE Seals
 - V-set Packing
 - PEEK Connectors
 - T-Seals
 - Molded Connector Boots
 - Electrical Isolators
 - Conductive Seals
 - Electrical Integrated Seals



Mud Pump Sealing

Pony Rod Seal

- Pain –
 - 2 piece Garlock seal leaks, must replenish fluid
- Solution –
 - 1 piece patented Parker design does not leak and has longer life

Bushings

- Pain –
 - Current seals leak, must replenish fluid

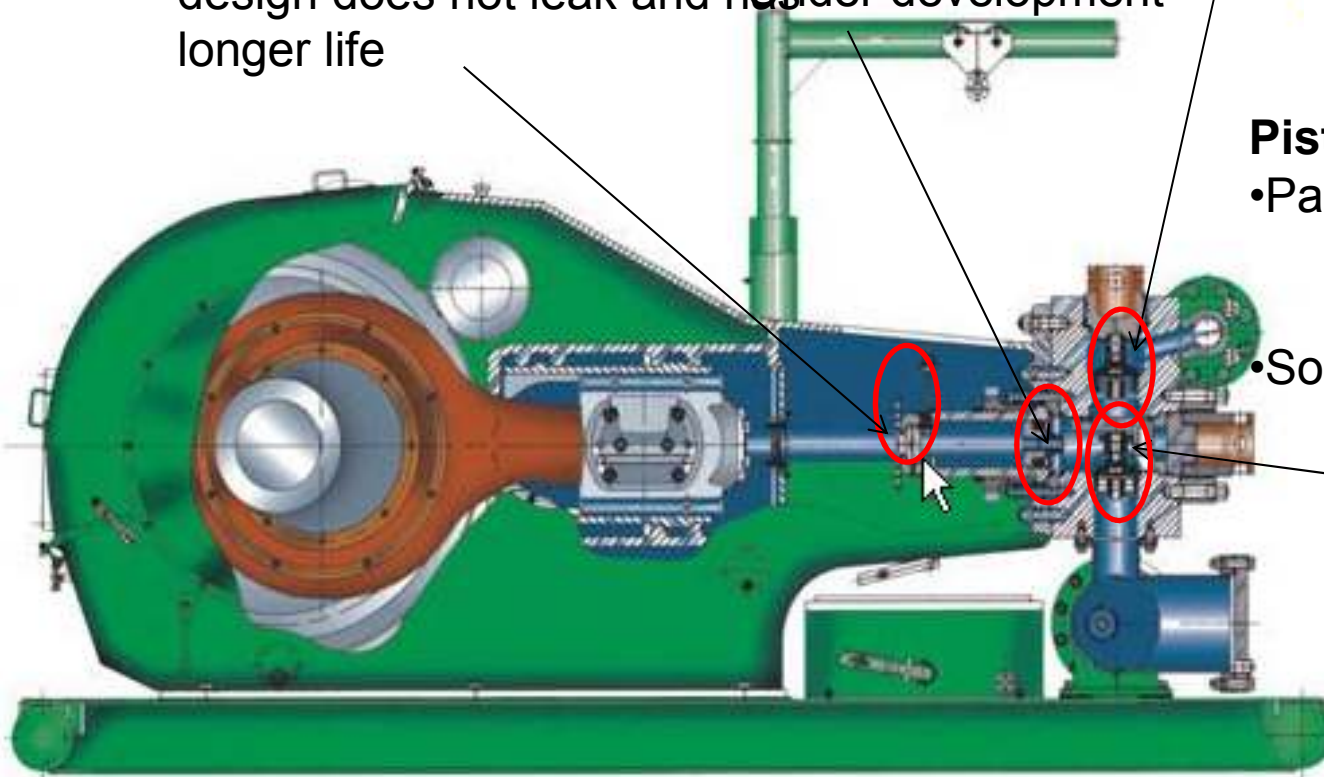
- Solution –
 - Parker design under development

Valve Seals

- Pain –
 - Current urethane valves last <400 hrs
- Solution –
 - Parker design with Resilon® polyurethane lasts > 800 hrs

Piston Seals

- Pain –
 - Current urethane pistons last <400 hrs
- Solution –
 - Parker design with Resilon® polyurethane lasts > 600 hrs



Crown Bumper System

Parker's patented Crown Bumper System reduces downtime, reduces damage and is easy to install*



Crown Bumper System

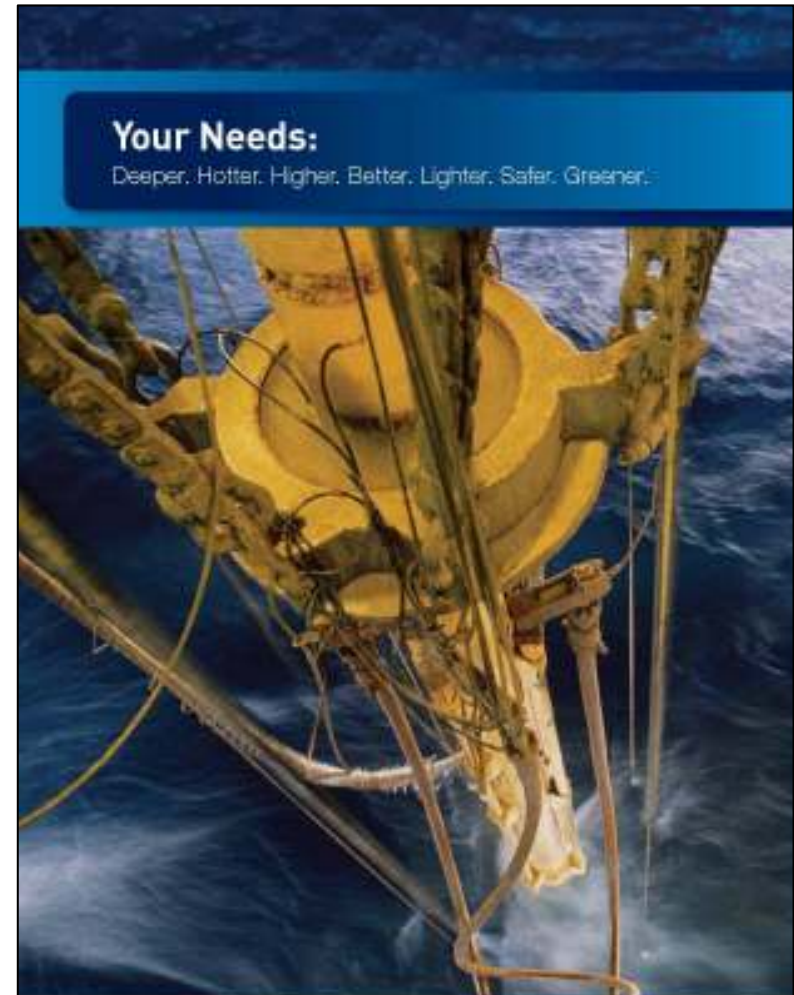
Parker's Crown Bumper was designed to replace the existing wooden bumpers found on many drilling rigs. The specially designed elastomeric bumper pads absorb up to 60% of the kinetic energy created by a post braking bump of the crown by the traveling blocks



The entire Crown Bumper assembly is wrapped in high strength netting for added safety.

Drilling: Riser Products

- Riser Seals
 - PolyPak®
 - LCD Packs
 - S-Seals
 - Custom
- Telescoping Joint Packers
- Diverter Seals and Elements
- Clamps
 - Control Line Clamps
 - MUX Clamps
 - Thrust Clamps
- Protectors/Stacking
 - Riser Shims
 - Riser Fins
 - Box and Pin Protectors
 - Flange Protectors
 - Bend Protectors
- Energy Management
 - Gimbal Bearings
 - Shocks
 - Pads
 - Bumpers



Sealing Solutions

- Riser: Sealsub, Box, and Pin Seals
 - Polypak Seal: Deep, Type B, BD,STD
 - NBR, XNBR, HNBR, FKM, Urethane, Polymyte
 - U-cup Seals
 - LCD Seals: Urethane, HNBR, FKM
 - S and FS Seals: NBR, HNBR, FKM, FFKM
 - MP-Seals: NBR, HNBR, FKM, FFKM
 - BT U-cup
 - Annular Type Seals
- Telescoping Joint Packer Seals
 - High Wear Urethane
 - Single & 2 Piece Design
 - NBR, HNBR, XNBR Rings & PTFE Inserts
- Diverter Flowline Seals
 - NBR, HNBR, Urethane
 - Spring, Steel, Hard Heel Rubber Back-Up Ring



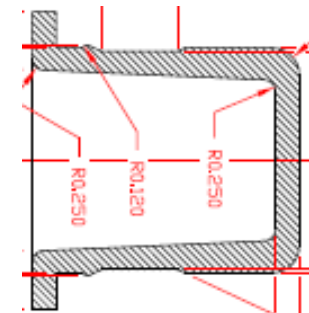
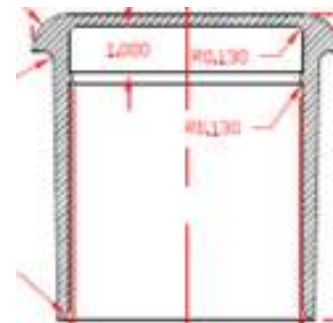
Riser Clamps / MUX Clamps

- Full Design and Engineering Capabilities
 - CAD
 - FEA
 - Product Testing and Validation
 - In-house Tooling
 - Injection Molded and Cast Molded Designs
- Key Features
 - Lower Weight, Buoyant
 - Fast Assembly
 - Reduced number of parts
 - Molded-in Insert fasteners
 - Molded-in hinge, 1 piece design
 - Fit existing package space
 - Superior Materials
 - Water Resistant – No rust
 - No Hydrolysis
 - UV Resistant
 - Tough
 - Custom Color/Branding
 - Lower Price Solution
 - High Volume Manufacturing



Box, Pin, Seal Sub Protectors/Plugs

- Protects the control lines from contaminants during shipping and storage
- Custom Design Capabilities
 - Full seal with lips
 - Breath holes
 - Assembly Features
- High Impact Molythane TPU or HDPE
- High Volume Molding Production
- Custom Color and Logos
- Injection Molded Finishes



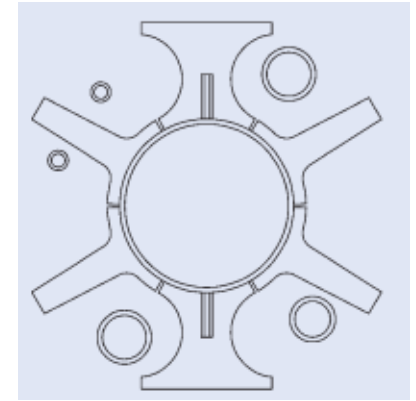
Flange Protector Designs

- Protects the flange and riser from contaminants and damage during shipping and storage.
- Flange Protector Designs
 - Cover the full flange, sub, and all box and pins
 - Male and female custom designs (one part for both ends, multiple types)
 - Alternative fastening options
 - Snap-on or traditional bolt fasteners
 - Material: HDPE to TPU
 - Custom color and logos
 - Structural packaging: protector and shipping crate combination



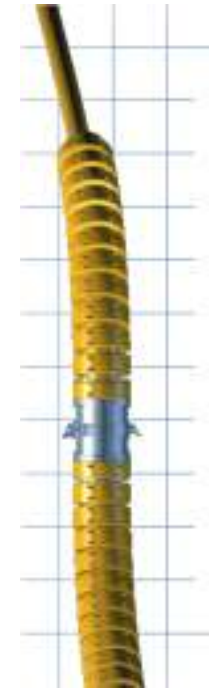
Riser Control Line Protectors: Fins, Shims, VIV Strakes

- Control Line Protectors: Custom designs to protect controls lines and to provide stacking features.
 - Run the length of the riser
 - Stacking Features
 - HDPE, PP, and Cast Urethane
- Anti-Vibration induced vortex (VIV) strakes



Umbilical and Bend Protectors/Restrictors

- Cable and flow line protectors
 - Materials: HDPE, PP, and TPU
 - High Volume, Low cost Injection molded solutions
 - Cast Urethane Solutions



Energy Management

Spider Gimbal Bearings/Assembly:

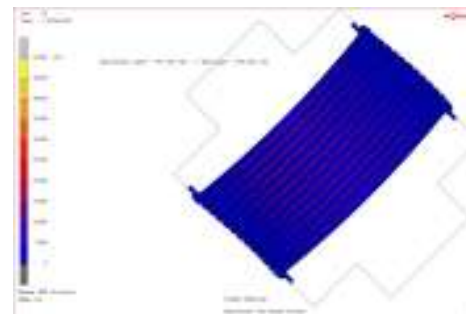
- Two gimbal bearing designs in production for OEM customers
- Complete gimbal assembly in development

Competitive Advantage:

- Shorter lead times
- Lower price w/ same performance

Design Parameters:

- 2,400,000 lb working loads
- 5,400,000 lb design verification loads
- 6, 8 and 10 gimbal arrangements available
- 12.5" & 14.5" designs currently available
- FEA analysis on all designs
- Complete testing per API standards



Energy Management

Subsea & Surface Flexible Joints

Competitive Advantage:

- Shorter lead times
- Lower price w/ same performance

Sub Sea Design Parameters:

- 6,000 psi rating
- 12,000 feet
- Complete testing per API standards

Diverter Design Parameters:

- 500 psi rating
- 2.5M pound load rating
- Complete testing per API standards



Completion

- **Application: Products**

- Anchoring and Sealing Solutions
- Tubing Heads and Hangers: Connectors, O-rings, Metal/Rubber
- Large Diameter Packers: Elements, V-rings, Bore Seals
- Flow Control Systems
- Well Controls and X-trees: Lip Seals, Valve Packing
- Cementing Equipment and Expendables: Pumps, Lips Seals, Valves, Plugs
- Well Head Completion Assemblies: S-seals, Rubber to metal, PEEK, metal seals

- **Product Lines:**

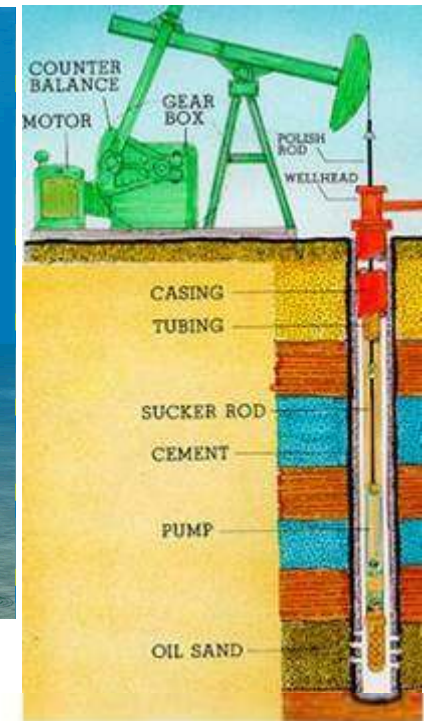
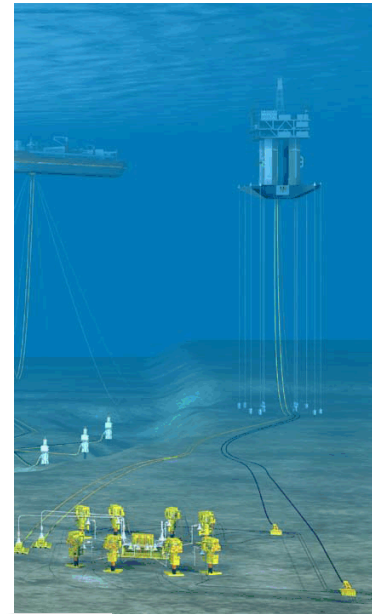
- Elastomer Lip Seals
- S-seal
- Metal/Rubber Seals
- Packers
- PTFE and PEEK Lip Seals
- V-rings and Rubber/Fabric Packing Seals
- Custom Molded Rubber and Plastic Parts
- HTHP Metal and Composite Seals



Production

- **Application/Products:**

- Packer Elements
- Annular Seals
- X-Mass Trees: Valve stems, packing, rod/piston
- Injection Systems
- Gas Lift Valves
- Well Service Tools and Test Equipment
- Well Servicing Expendables: swabs, wipers, strippers, pump down plugs, customer rubber
- Compressors/Pumps: PTFE, Rod, Piston, Rotary
- Production Blow Out Preventers
- Fishing Tools and Systems
- Artificial Lift Systems
 - Hydraulic, Gas, Pump



- **Product Lines:**

- Elastomer Lip Seals
- O-rings
- S-seal
- Metal/Rubber Seals
- PTFE and PEEK Lip Seals
- V-rings and Rubber/Fabric Packing
- Custom Molded Rubber and Plasti
- Packers

Centralizer Fin



EPS Division Well Servicing Products

Production Operations

- Top and Bottom Cementing Plugs
- Flex Plugs
- Cementing Valves
- Packer Elements
- Packer Seals and Hardware



EPS Division Well Servicing Products

Work Over Operations

- Swab Cups
- Pipe Wipers
- Oil Savers
- Rod Strippers
- Stripper Rubbers
- Sucker Rod Guides
- Tubing Protectors
- Water Savers
- Tubing Testers – Bar Type



EPS Division Well Servicing Products

Value Added:

Integrated Systems Approach

- Integrate Various Sealing Products With Metal Components
- Provide End User / Customer With Fully Assembled System



Distribution (Wellhead to Refinery)

- **Applications**

- Marine and Offshore Loading Swivels and Turrets:
- Railcar Loading Systems
- Pipeline Service Equipment: Pigs and Spheres:
- Pipeline Valves, Actuators
- Pumps/Compressors: Rotary Face
- Tank Systems: Pumps, Skimmers, Floats
- Tanker (Ship) Seals and Systems: Custom

- **Product Lines:**

- Elastomer Lip Seals
- O-rings
- Metal/Rubber Seals
- PTFE and PEEK Lip Seals



EPS Engineering & Development Capabilities



ENGINEERING YOUR SUCCESS.

November 19, 2013

Parker In-House Custom Rubber Mixing



4 Mixing Centers Across EMG

- Wilson, NC
- Goshen, IN
- Lebanon, TN
- Pleidelsheim, Germany



Automated Weigh-Up &
Sealed R.M. Storage for
Quality Control



TPU/TPE Production Capabilities

Parker is the leading global manufacturer of custom urethanes for sealing applications

EPS SLC, Utah Plant

- **1 Batch Cast Cell**
- **2 Continuous Reactive Extruders**
- **1 Twin-screw Compounder**
- **Custom Coloring Capabilities**
- **Underwater cut pelletizing capabilities**
- **Grinding, Blending, Drying and Packaging Capabilities**

Pradifa Stuttgart, Germany Plant

- **1 Batch Cast Cell**
- **1 Continuous Batch Caster**
- **Custom Color Capabilities**
- **Grinding, Blending, Drying and Packaging Capabilities**



Rubber Testing

ASTM Procedures	Number
Compression Set	D395, D1229
Durometer Hardness Testing and Verification	D2240
Low Temperature Bend and Brittleness Testing	D2137
Ozone Resistance Testing	D1149, D1171
MDR (Moving Die Rheometer) Testing	D2084
Resistance to Liquids	D471
ASTM Tear B and Tear C Testing	D624
Tensile, Elongation and Modulus Testing	D412
Heat Age Testing and Beilstein Testing	D573, D865
TR10/TR70	D1329
Demattia Cut Growth Testing (Flex Testing)	D813



Additional Procedures

Abrasion Testing
Fourier Transform Infrared Spectrophotometer
Differential Scanning Calorimetry (DSC)
Gas Chromatography – Mass Spectrometry (GCMS)
Permeation Testing
Compression Stress Relaxation (CSR)
Thermogravimetry Analysis (TGA)
Part Failure Analysis



Analytical Lab Capabilities

- Hardness (Shore A-Shore D)
- Tensile Strength (psi/MPa)
- Elongation (%)
- Tensile Modulus (100 and 300) (psi/MPa)
- Tear Strength (pli)
- Compression Set (%)
- Glass Transition Temperature (°F/°C)-DSC
- Softening Temperature (°F/°C)-TMA/Vicat
- Melting Temperature (°F/°C)-DSC
- Crystallinity (%)-DSC
- Dynamic-Mechanical (G', G'', Tan Delta)
- Hysteresis (DMA)
- Wear (Taber Abrasion, mg)
- Friction (Static/Dynamic)
- Melt Flow Index
- Stress/Strain Curves
- Compatibility Tests
- Microhardness, IRHD
- Specific Gravity/Density
- Rebound Elasticity
- Stress Relaxation



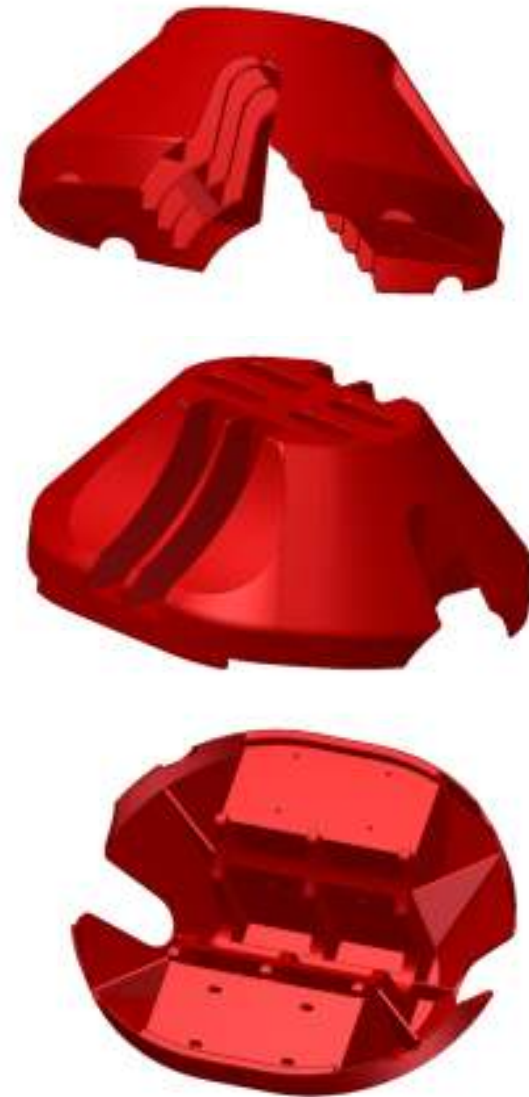
Full Service Mechanical Lab Testing

- Hydraulic Lab
 - Full Cylinder Testing
 - Rod Test Stands
 - Piston Test Stands
 - Wiper Test Stands
- Pneumatics Lab
- Rotary Lab
- Customer Specific Tests
 - Packers
 - HT/HP Tests
 - Competent Testing
- Surface/Hardware Testing



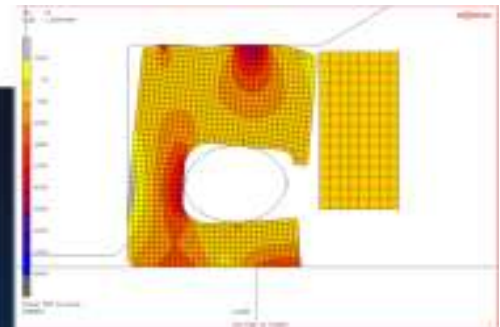
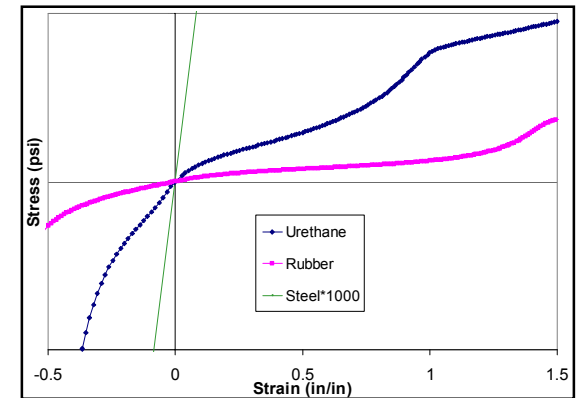
CAE Capabilities

- Drafting Services
 - 2D: Autocad, Pro/E, Catia
 - 3D: Inventor, Solid Works
 - Others available as required
- Design Services
 - Per ASTM, ASE, DIN, ASME, API, NACE
 - Hydraulic Experts
 - Oilfield Application Experts
 - Tool Design Experts
 - Design for manufacturability



Finite Element Analysis

- In-house material characterization
 - Hyperelastic Material Model
 - Uniaxial tension
 - Simple compression
 - Planar tension
 - Thermoviscoelastic Material Model (Time-Temperature Superposition)
 - Dynamic Mechanical Analyzer
 - ViscoShift & ViscoData
 - Non-linear Material Modeling
 - Friction Modeling



Highest Quality Standards

- Manufacturing facilities are registered to:
 - ISO 9001
 - ISO TS16949
 - AS 9100
 - ISO 14001
 - ISO 13485
- Continuous improvement through the implementation of:
 - Six Sigma methodology
 - Lean manufacturing
 - TQM methodology
 - Advanced product quality planning (APQP)
 - Feasibility studies
 - Kaizen events



Oil & Gas Materials



ENGINEERING YOUR SUCCESS.

November 19, 2013

H₂S & RGD Approved Materials

- Parker has materials approved to the most stringent O&G standards:
 - Norsok M-710
 - API 6A
 - ISO 23936-2
 - Total
- Material Types Approved
 - HNBR
 - Aflas
 - FKM
 - FFKM

Available Elastomer Polymers

- Nitrile (NBR)
- Hydrogenated Nitrile (HNBR)
- Polyacrylate (ACM)
- Vamac (AEM)
- Neoprene (CR)
- Ethylene-Propylene (EPR, EPDM)
- Butyl (IIR)
- Polyurethane (AU, EU)
- Fluorocarbon (FKM)
- Tetrafluoroethylene-Propylene (TFE/P)
- Perfluoroelastomer (FFKM)
- Hifluor (FKM)
- Silicone (VMQ)
- Fluorosilicone (FVMQ)

Standard Nitrile (NBR)

-30 F to + 250 F

- Recommended For
 - General Purpose
 - Petroleum
 - Silicone Fluids
- Not Recommended For
 - Ozone (Air)
 - Ketones
 - Automotive Brake Fluid
 - Aircraft Brake Fluid
 - Steam and Hot Water

Most common seal
material in the world

Carboxylated Nitrile (XNBR)

-25 F to + 250 F

- Recommended For
 - General Purpose
 - Petroleum
 - Silicone Fluids
 - Wear / dynamic apps
- Not Recommended For
 - Ozone (Air)
 - Ketones
 - Automotive Brake Fluid
 - Aircraft Brake Fluid
 - Steam and Hot Water

“Nitroxile”

Swells slightly more in
water than standard nitrile

Hydrogenated Nitrile (HNBR)

-25 / -40 F to + 300 F

- Recommended For
 - R-134a
 - Petroleum oils
 - Silicone Fluids
 - Air
 - Hot water
- Not Recommended For
 - Ketones
 - Automotive Brake Fluid
 - Aircraft Brake Fluid

KB163-90

N1173-70

N4007-90

KA183-85

Low Temp

Similar to nitrile plus air
(ozone) resistance

Hydrogenated XNBR: (HXNBR)

- New new polymer technology
 - Combines the wear resistance of XNBR with ozone stability of HNBR
 - Compression set is questionable
 - Excellent wear resistance
 - Still in the “feel & learn” stage
 - HXNBR \neq XHNBR

Ethylene Propylene (EPR, EPDM)

-65 F to + 300 F

- Recommended For
 - Water and Steam
 - Alcohols
 - Ketones
 - Amines
 - Air
- Not Recommended For
 - Petroleum oils
 - Di-Ester Based Synthetic Lubricants

Good for practically anything that is water soluble

A-type Fluorocarbon (FKM)

-15 F to + 400 F

- Recommended For
 - Petroleum oils
 - Silicone Fluids
 - Acids (Black ONLY)
 - Aromatic solvents
 - Halogenated hydrocarbons
 - Air
- Not Recommended For
 - Ketones
 - Steam and Hot Water
 - Amines
 - Low Temperature
 - Automotive Brake Fluid
 - Aircraft Brake Fluid

Today's standard for excellence

Best compression set available

Most FKM compounds are A-type

GLT Fluorocarbon (FKM)

-40 F to + 400 F

- Recommended For
 - Petroleum oils
 - Silicone Fluids
 - Acids (Black ONLY)
 - Aromatic solvents
 - Halogenated hydrocarbons
 - Air
- Not Recommended For
 - Ketones
 - Steam and Hot Water
 - Amines
 - Automotive Brake Fluid
 - Aircraft Brake Fluid

Good -40 F low temp FKM

Gives up a little resistance to comp
set and alcohols

LTFE Fluorocarbon (FKM)

-55 F to + 400 F

- Recommended For
 - Petroleum oils
 - Silicone Fluids
 - Acids
 - Aromatic solvents
 - Halogenated hydrocarbons
 - Air
 - Gas / alcohol blends
- Not Recommended For
 - Ketones
 - Steam and Hot Water
 - Amines
 - Automotive Brake Fluid
 - Aircraft Brake Fluid

New polymer technology

Best low temp FKM

Outstanding alcohol resistance

GFLT Fluorocarbon (FKM)

-35 F to + 400 F

- Recommended For

- Petroleum oils
- Alcohols
- Silicone Fluids
- Acids (Black ONLY)
- Aromatic solvents
- Halogenated hydrocarbons
- Air

- Not Recommended For

- Ketones
- Steam and Hot Water
- Amines
- Automotive Brake Fluid
- Aircraft Brake Fluid

Combines low swell with low temp
Worst comp set of all FKMs

Aflas® (TFE/P)

+15 F to + 450 F

- Recommended For

- Petroleum oils
- Alcohols
- Silicone Fluids
- Bases
- Amines
- Air
- Steam / Hot water

- Not Recommended For

- Low Temperature
- Gasoline

Poor compression set
Primarily used in chemical
plants

Parofluor™ (FFKM)

+5 F to + 550 F

- Recommended For
 - Practically everything
 - Extreme high temperature
 - Aggressive chemistries
- Not Recommended For
 - Refrigerant gases
 - Low cost applications
 - Low temperatures

Older generation of FFKM
Still has outstanding
performance

Parofluor ULTRA™ (FFKM)

+5 F to + 608 F

- Recommended For
 - Practically everything
 - Extreme high temperature
 - Aggressive chemistries
- Not Recommended For
 - Refrigerant gases
 - Low cost applications
 - Low temperatures

Competes directly with Kalrez
and Chemraz

The best of the best

Hifluor™ (FKM)

-15F to + 400 F

- Recommended For
 - Practically everything
- Not Recommended For
 - Refrigerant gases
 - Low cost applications
 - Low temperatures

Same chemical properties as FFKM but about 20% less expensive

Thank You!



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ENGINEERING YOUR SUCCESS.

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