

# *Consolidated Rig Works, L.P.*



## Company Overview and Product Offering



# ***Why, How, and What***

- Here at CRW, we genuinely believe in working with our customers to develop the safest, most efficient, and highest quality equipment available to the oil and gas service industry.
- We do this by working with our customers in a partnership atmosphere in order to customize equipment designs through a collaborative environment.
  - ❑ Develop and Build equipment that exceeds the industry's latest safety requirements
  - ❑ Meet the customer's specific needs with regard to efficiency; and
  - ❑ Produce equipment that is unparalleled in function and quality.



# ***CRW Product Offering***

## ***Coiled Tubing Equipment***

- **Offshore Cabins and Power Packs**
- **Skid Mounted Reels**
- **Trailer Mounted Package Configurations**
- **Electric over Hydraulic controls**
- **Support equipment**
- **Injector Transport Skids**
- **BOP/Lubricator Skids/Trailers**
- **Tractor mounted HPUs**





# CRW Product Offering

## Coiled Tubing Equipment





# CRW Product Offering

## Coiled Tubing Equipment





# CRW Product Offering

## Coiled Tubing Equipment



# ***CRW Product Offering***

## ***Pumping Equipment***

- **Trailer Mounted Pumping units**
- **Skid Mounted Pumping Units**
- **Manifold Trailers**
- **Chem-Add Units**





# CRW Product Offering

## Pumping Equipment





# ***CRW Product Offering***

## ***Pumping Equipment – Manifold Trailers***



# ***CRW Product Offering***

## ***Snubbing Equipment – Overview***

- **Offshore/Traditional Snubbing Jacks: 150K, 225K, 340K, 460K**
- **Integrated Snubbing Units: 300K**
- **Rig Assists: 50K, 172K**
- **Powered Rotary Packages**
  - **Thru Bores 7.06-14.63**
  - **Torque Options 3K-22K**
  - **Anti-Backspin Brakes Available**
  - **Gear Driven with Integrated Oil Bath and Pump**
  - **Bolt-On Design**
- **Skid Mounted Power Packs, 450BHP-600BHP**
- **Containerized Power Packs, 550BHP**
- **Counterbalance Winch Packages**
- **Telescopic Guide Tubes**
- **Gin Poles**
  - **Internal Hydraulic Scoping Cylinders**
  - **Spring Applied Locking Pins**
  - **2 Section and 3 Section Poles**
- **Milling Clamps: Hydraulic and Manual**
- **Snubbing Swivels: 4-port, 6-port, 7.06-11.13 Thru Bores**





# ***CRW Product Offering***

## ***Snubbing Equipment – Snubbing Jacks***





# *CRW Product Offering*

## *Snubbing Equipment – Snubbing Jacks*





# ***CRW Product Offering***

## ***Snubbing Equipment – Snubbing Jacks***





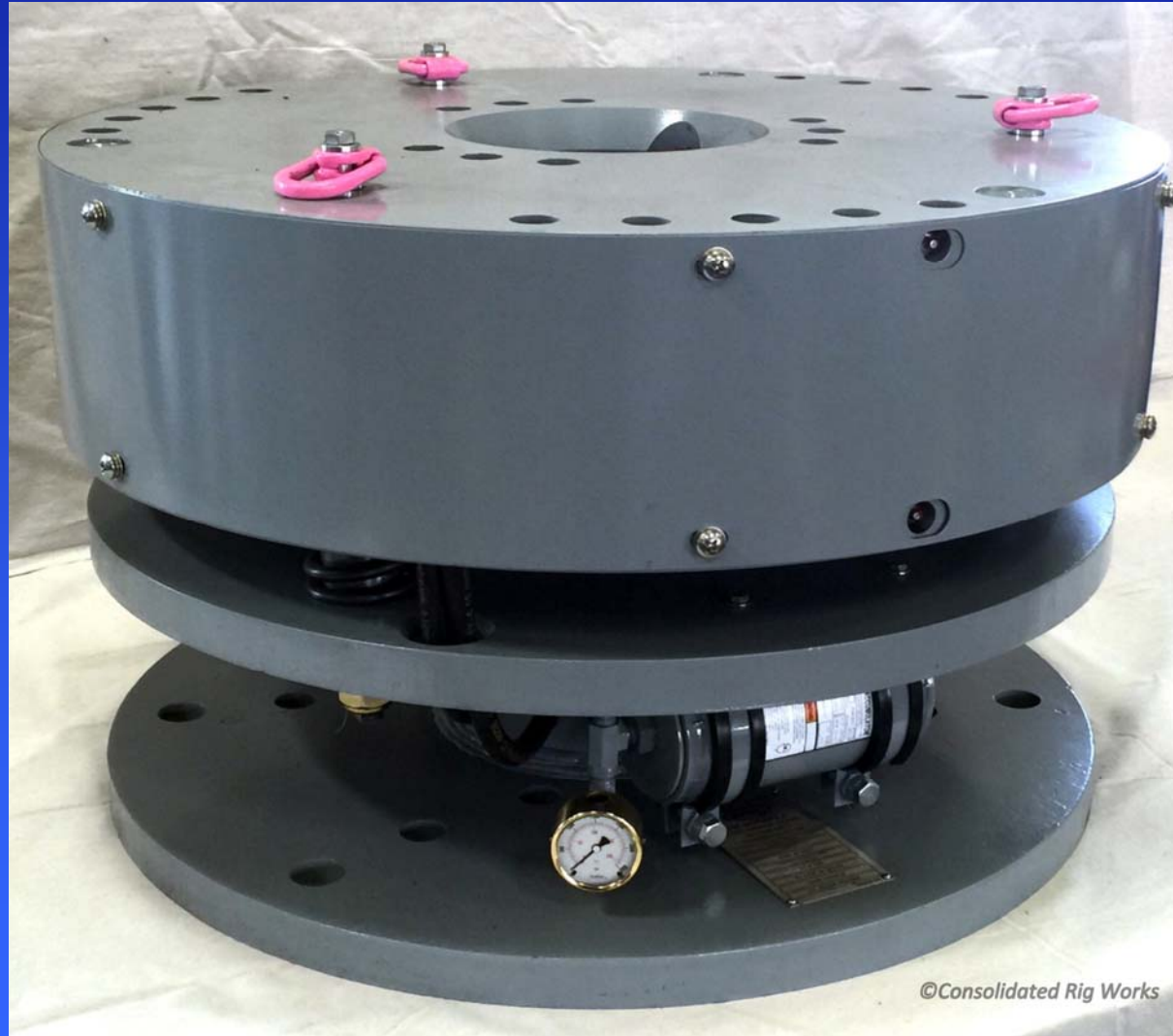
# ***CRW Product Offering Snubbing Equipment – Snubbing Power Packs***





# ***CRW Product Offering***

## ***Snubbing Equipment – Milling Clamp and Rotary Swivel***



# ***CRW Product Offering***

## ***Snubbing Equipment – Slip Bowls***

- **Industry Leading Slip Bowl Product Line**
  - ☐ 150K, 225K, 300K, 340K, 600K
  - ☐ Integrated Guide ring grooves
  - ☐ Designed and Manufactured to API-8c (*legacy bowls have exceptions*)
  - ☐ All bowls are proof loaded to 1.5:1 load capacity
  - ☐ Load path materials carry Charpy requirements for -20deg C
  - ☐ CRW offers a Slip bowl recertification program and spare parts for competitor's units





# CRW Product Offering

## Snubbing Equipment – Slip Bowls

### 150K, 225K, 300K

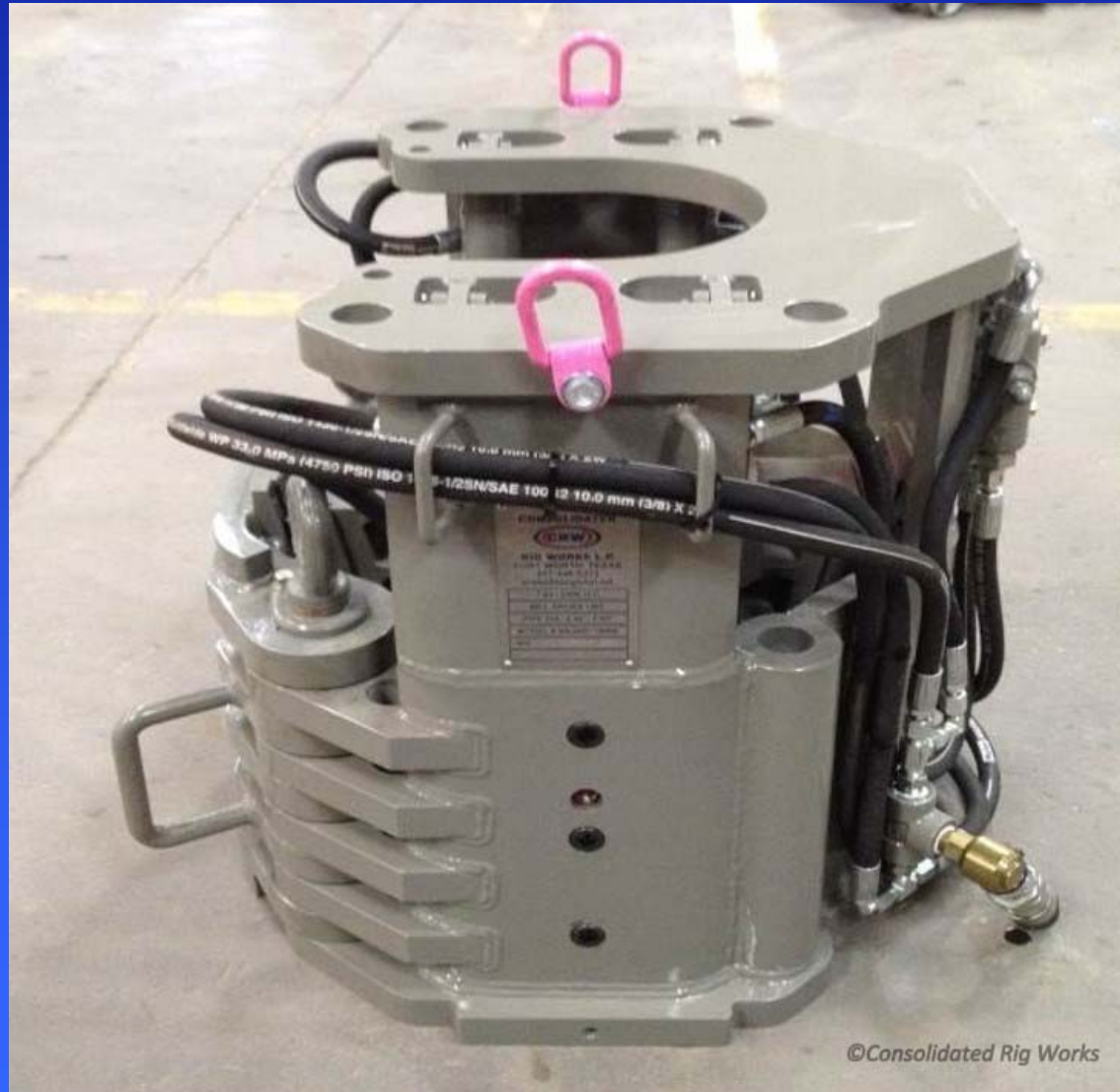




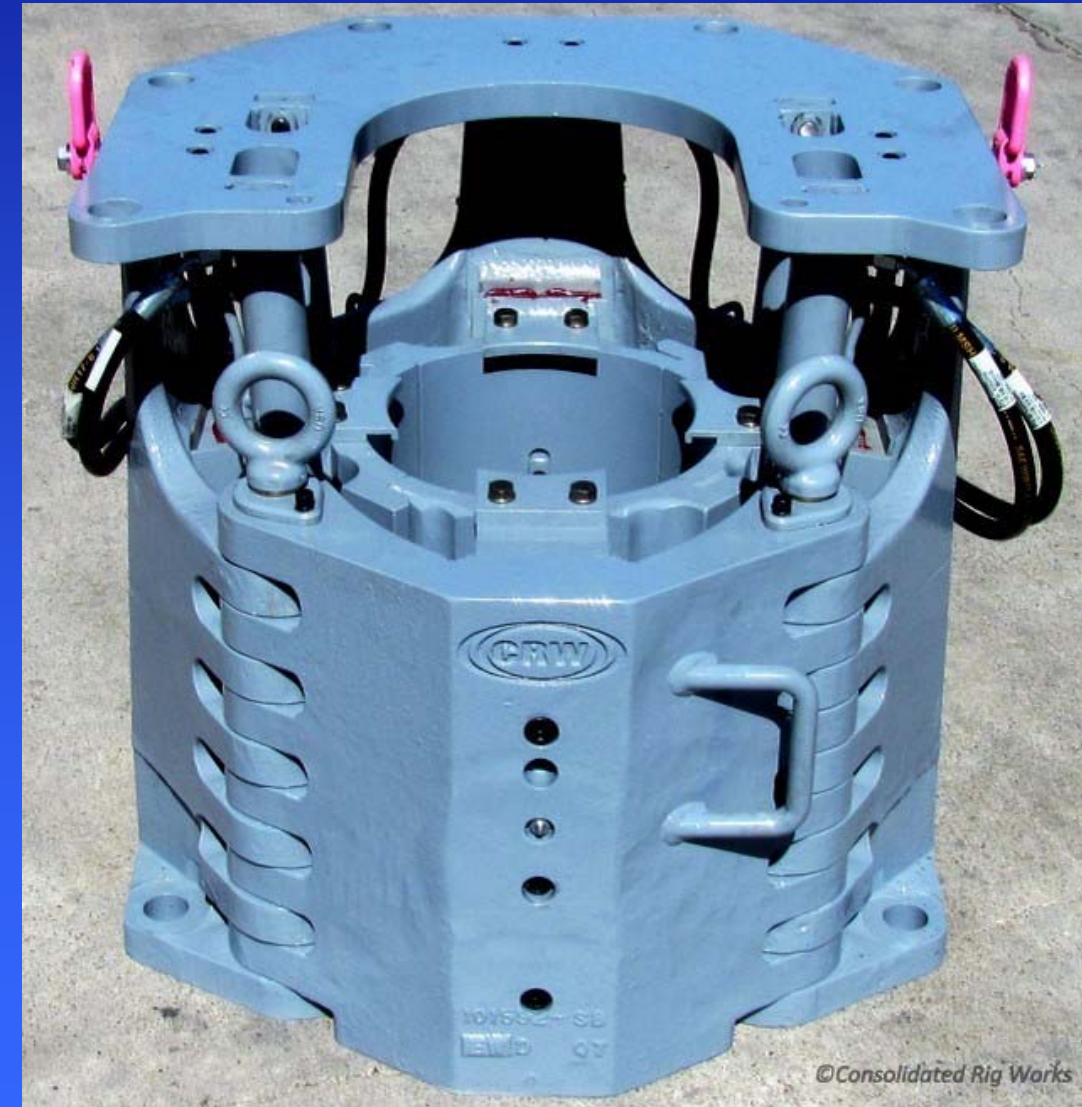
# CRW Product Offering

## Snubbing Equipment – Slip Bowls

### 340K, 600K



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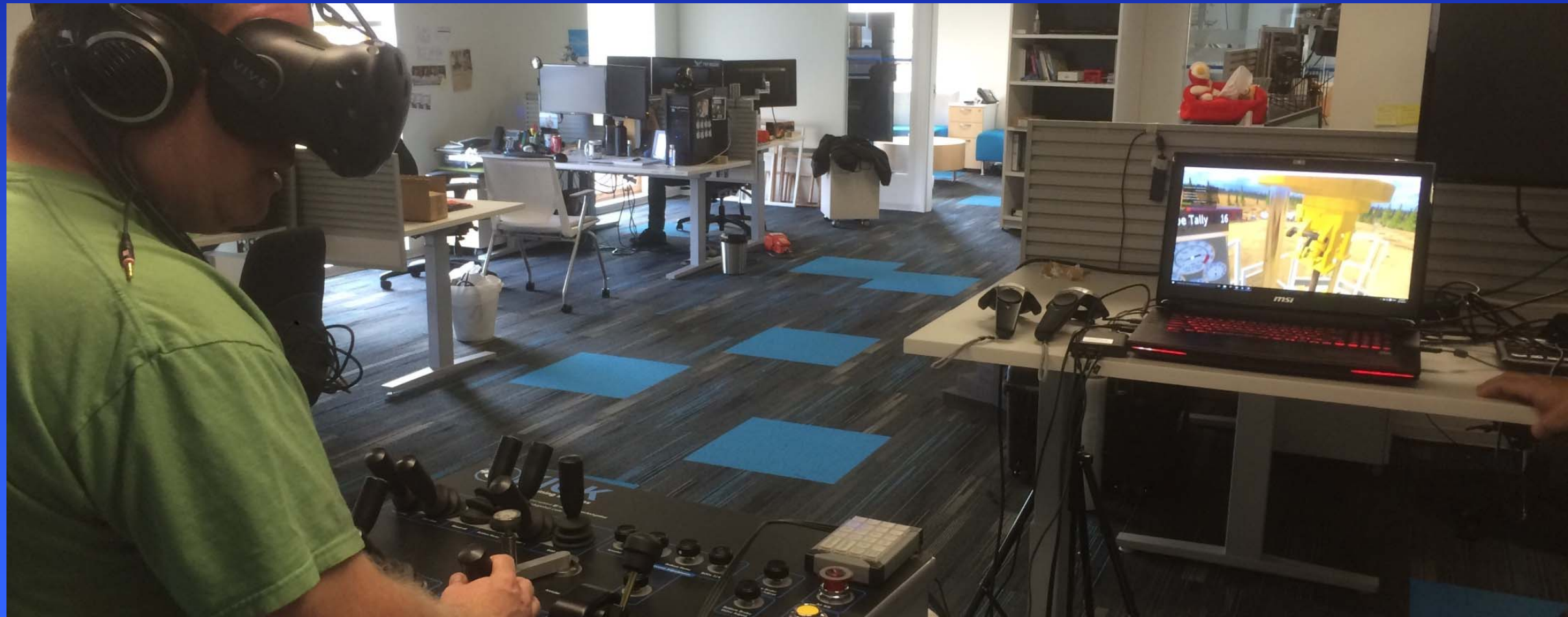
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# ***CRW Product Offering Snubbing Equipment – Snubbing Competency Training***

**CRW has partnered with Serious Labs to offer global training solutions for snubbing hands and equipment operators.**



# ***CRW Product Offering Service/Rework***

- **Remanufacture**
- **Tune Up**
- **Upfit/Upgrade**
- **Hydraulic System Evaluation**
- **Paint**
- **Recertification**





# CRW Product Offering

## Service/Rework





# Equipment Pictures

## Testing

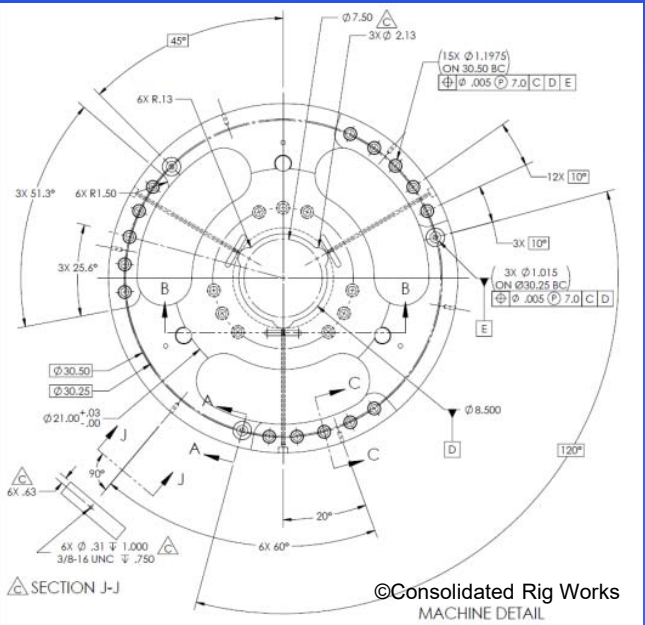
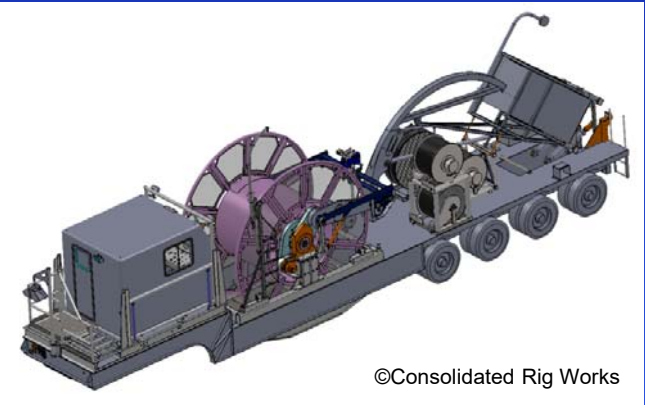
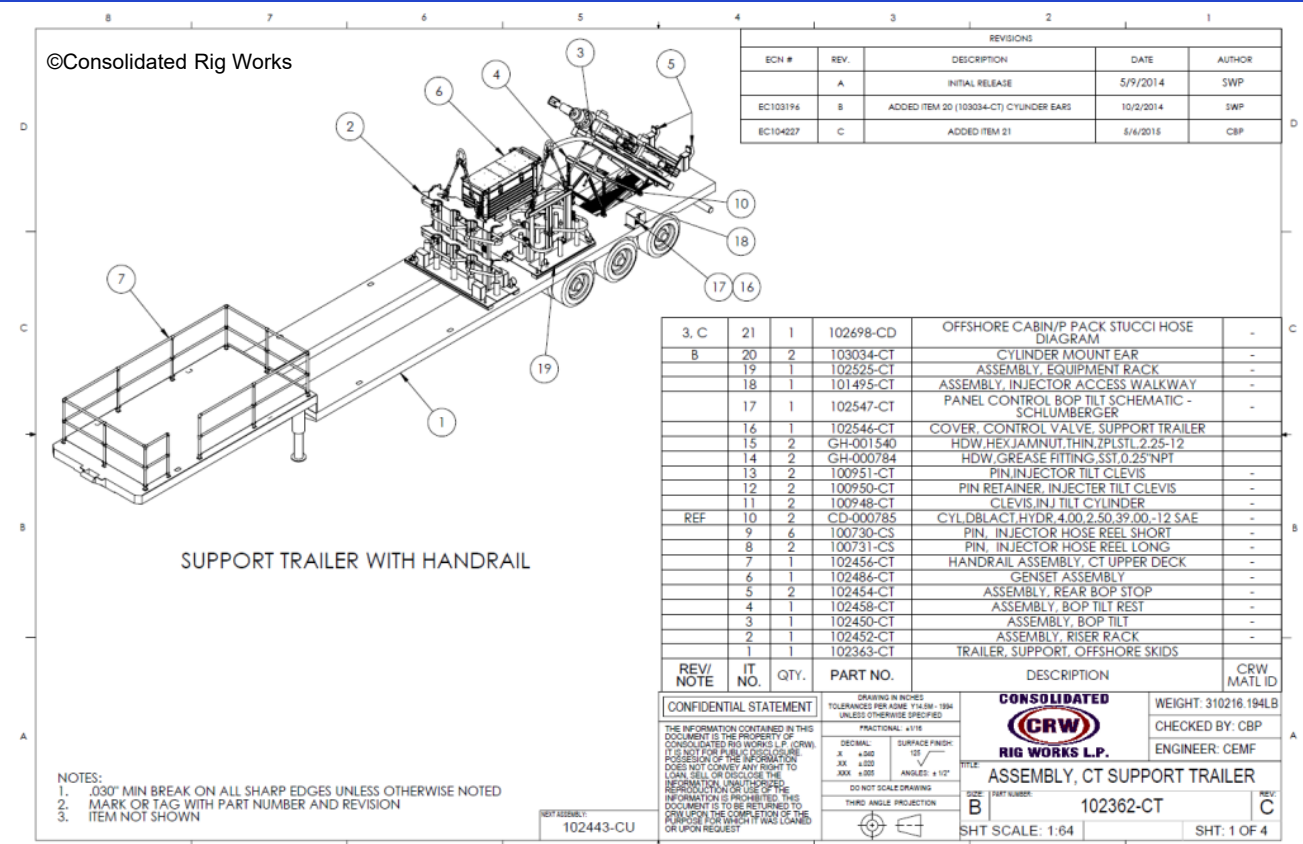
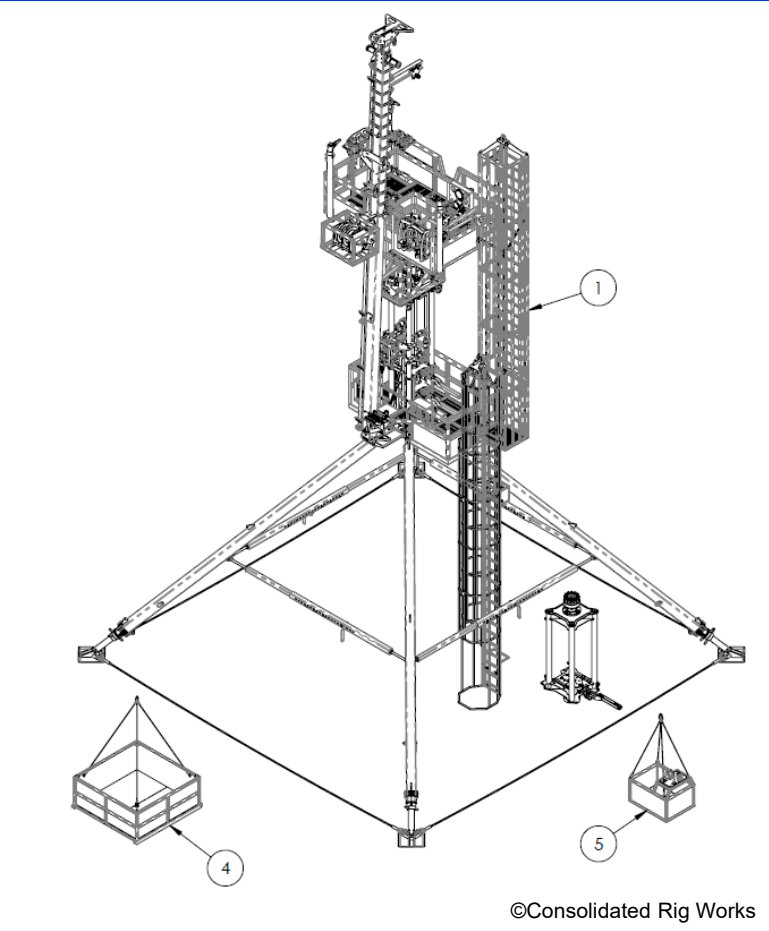




# Engineering Department Capabilities

## Drafting and 3D Modeling

CRW Uses SolidWorks for the design and development of our equipment. This Software enables us to quickly move from concept to production while maintaining design integrity and consistency.

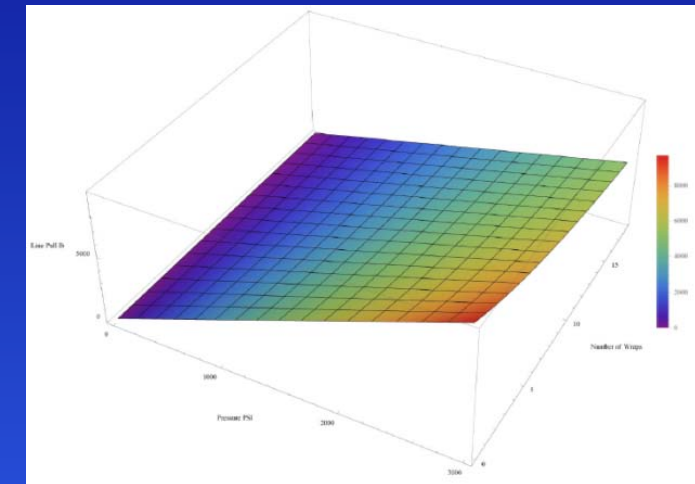




# Engineering Department Capabilities

## Classical Hand Calculations

- CRW uses Wolfram Mathematica, a powerful and professional symbolic solver.
- Structural Design Calculations
- API-8C Calculations
- OFS13/DNV2.7-3 Offshore Lift Calculations
- Fatigue Life
- Hydraulic Performance



Determine Total Length possible of Coil Tubing on Reel.

$$t_{l_{CT}} = \sum_{x=0.0}^{\text{Round}[n_{TW}]} 2 \pi \left( \frac{d_{RC}}{2 \text{ in}} + \frac{d_{CT}}{2 \text{ in}} + \frac{d_{CT}}{\text{in}} x \right) \frac{1 \text{ ft}}{12} n_{CW}$$

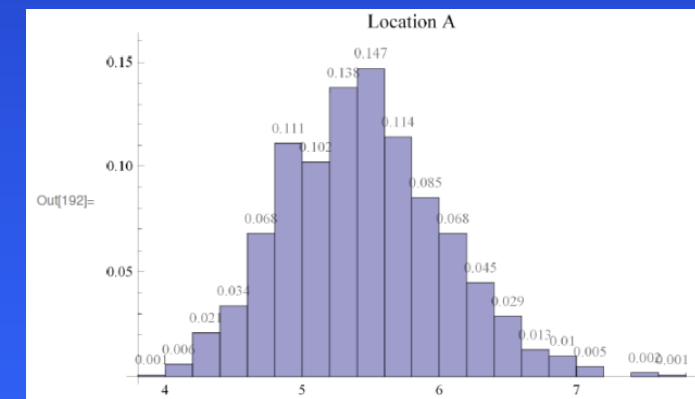
25 487.7 ft

Determine Number of Wraps required for 20,000 ft of coiled tubing.  
Summation considers 0 to be the first wrap and only considers whole wraps.

$$\frac{1}{2} \left( \sum_{x=0.0}^{16} 2 \pi \left( \frac{d_{RC}}{2 \text{ in}} + \frac{d_{CT}}{2 \text{ in}} + \frac{d_{CT}}{\text{in}} x \right) \frac{1 \text{ ft}}{12} n_{CW} + \sum_{x=0.0}^{17} 2 \pi \left( \frac{d_{RC}}{2 \text{ in}} + \frac{d_{CT}}{2 \text{ in}} + \frac{d_{CT}}{\text{in}} x \right) \frac{1 \text{ ft}}{12} n_{CW} \right)$$

20 026.1 ft

Actual wraps 17 and 18 are averaged together. It therefore takes 17.5 wraps to be at 20,000ft of 2in Coiled Tubing. This calculation considers each wrap separate and does not take into account the transition between wraps.



MAX TRANSVERSE SHEAR STRESS:  $\tau_{CP} = \frac{3 \cdot V}{2 \cdot \text{area}}$  (CONSERVATIVE METHOD)  
WHERE V IS THE VERTICAL SHEAR FORCE

$v = \text{rafy}$   
 $\tau_{CP} = \frac{3 \cdot v}{2 \cdot \text{area}} / \text{units}$

6 476.98 psi

VON MISES STRESS:  $\sqrt{\sigma_x^2 + 3 \tau_{xy}^2}$  when  $\sigma_y = 0$

$\sigma_{CPW} = \sqrt{\sigma_{CP}^2 + 3 \tau_{CP}^2} / \text{units}$

12 512. psi

If  $\frac{\sigma_{CPW}}{\text{psi}} \leq \frac{\sigma_{YIELD}}{\text{psi}}$ ,  
CellPrint[TextCell["COMBINED STRESS IS ACCEPTABLE", Background -> Green, 24]],  
CellPrint[TextCell["COMBINED STRESS IS UNACCEPTABLE. RECALCULATION IS NECESSARY", Background -> Red, 24]]

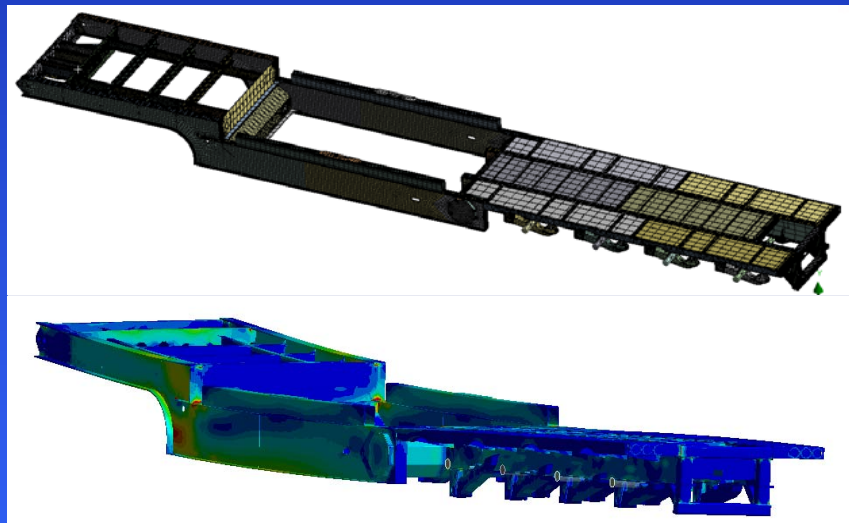
COMBINED STRESS IS ACCEPTABLE



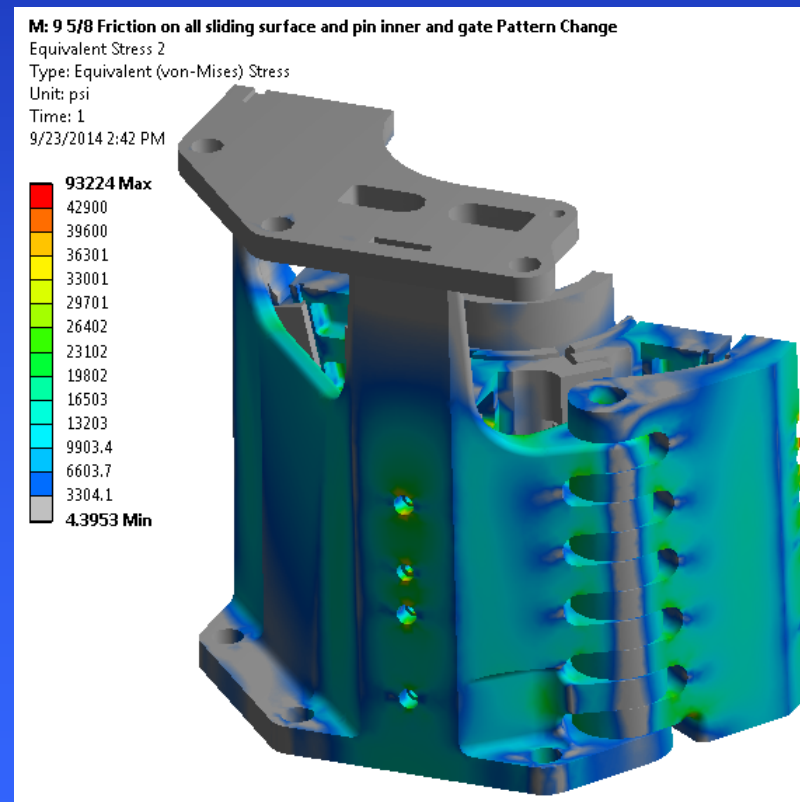
# Engineering Department Capabilities

## Finite Element Analysis (FEA)

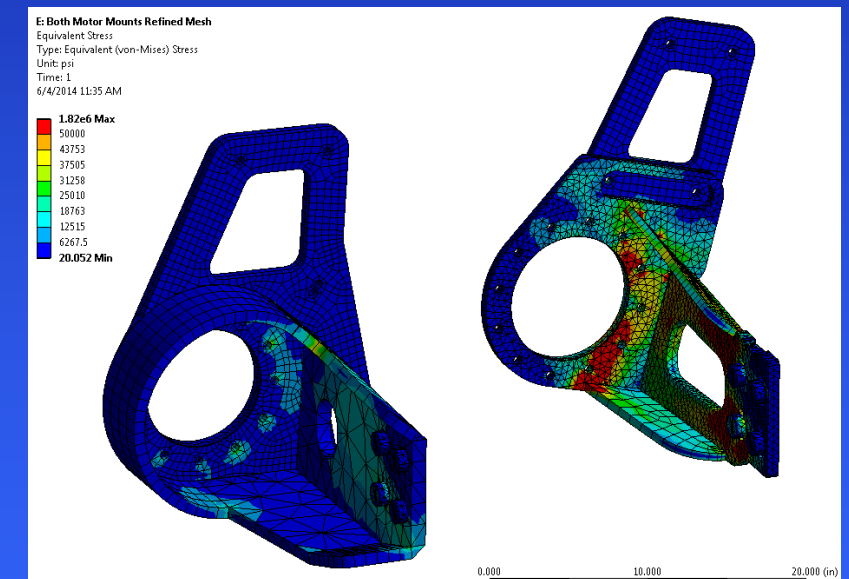
- CRW Uses ANSYS to perform Finite Element Analysis (FEA)
- CRW uses FEA to confirm hand calculations and to check that designs meet specification strength and deflection requirements.



Trailer Strength Investigation



600K Slip Bowl  
Certified to API-8C



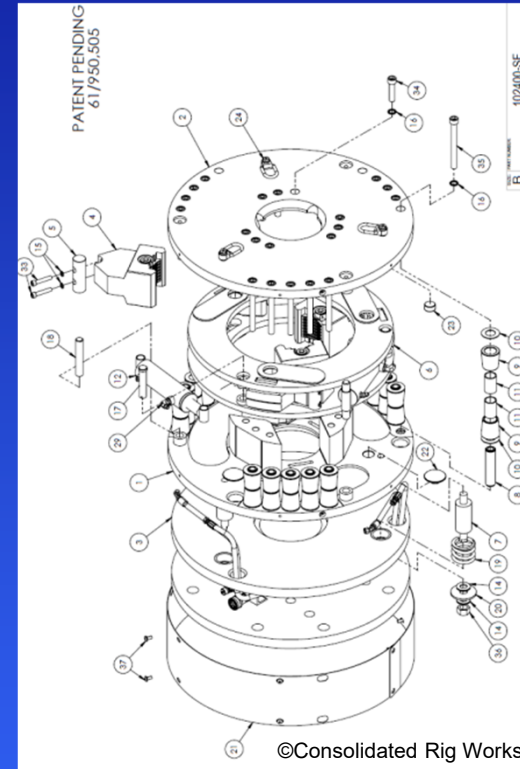
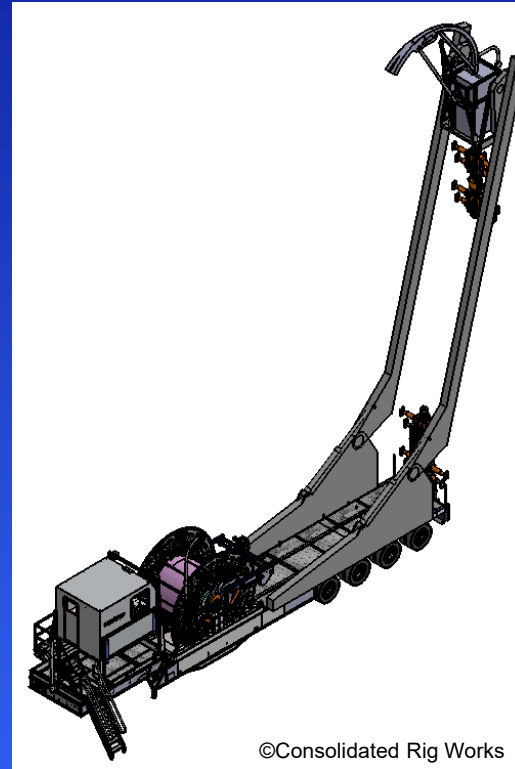
Tubing Reel Motor Mount  
Optimization



# Engineering Department Capabilities

## Research and Development

- CRW is continuously researching and developing new methods and specialty equipment to meet our customer's needs for improved efficiency and safety.
- CRW is your source for custom designed and manufactured equipment to meet your specific requirements.
- Current products under development:
  - 11-1/8 thru bore snubbing swivel for continuous rotation of traveling slip bowls without disconnecting the hydraulic connection.
  - 22K FT-LB Hydraulic Milling Clamp
  - 75K Jointed Pipe Injector
  - Electric Over Hydraulic Offshore Coiled Tubing Power Pack
  - Coiled Tubing Mast Unit
  - Snubbing Slip Bowls Certified to API-8C



# ***Engineering Department Capabilities***

## ***Technical Manuals and Documentation***

- **Technical Specifications, Installation, Set-Up and Maintenance Guidelines**
- **Select Project Photographs**
- **Reference Assembly Drawings**
- **Test Documents**
- **Material Certifications**
- **Weld Procedures**
- **Certificates of Conformance**
- **Certificates of Compliance**





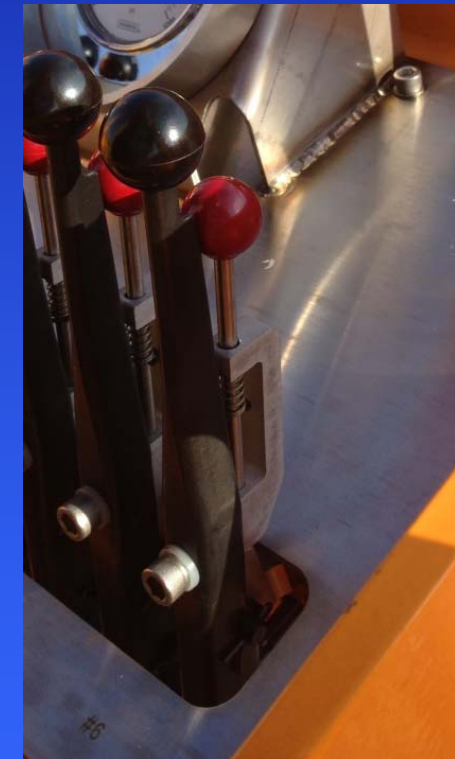
# Engineering Department Capabilities

## 3D Printing

- CRW has in-house 3D Printing capability. We use 3D printing as an aid in developing new equipment and for actual production quality components.



3D Printed 150K slip bowl carrier used to direct investment cast the carrier prototypes. 3D printing reduced the lead time to product testing by 3 months.



Bolt in VA20 Control Valve Safety Locks were 3D Printed and tested for form fit and function prior to being released for production. Safety Locks can be installed on any standard VA20 Valve handle, and are typically used for BOP control valves.

# ***Production Capabilities Fabrication Shop***

## ***Fab A:***

- **Experienced and Certified Welders**
  - MIG, TIG, SMAW, FCAW
- **Heavy steel structural weldment fabrication**
- **High pressure piping and manifold fabrication**
- **Reservoir manufacturing (hydraulic, fuel, etc.)**
- **Machine shop**
  - Experienced machinist on staff
  - Several milling machines and lathes
  - Typically used for rush work and small parts
- **Snubbing Slip Bowl fabrication, refurb, and testing department**

## ***Fab B:***

- **Hydraulic and Final Assembly areas**
- **Equipment Refurbishment, Retrofit, Upgrade**
- **Personnel are highly knowledgeable about the equipment.**
  - Specializing in oilfield mobile hydraulic powered systems
- **Great wealth of experience**
  - Many leads have been with CRW for more than 10 years.
- **Fab B personnel complete the testing phase of most products.**





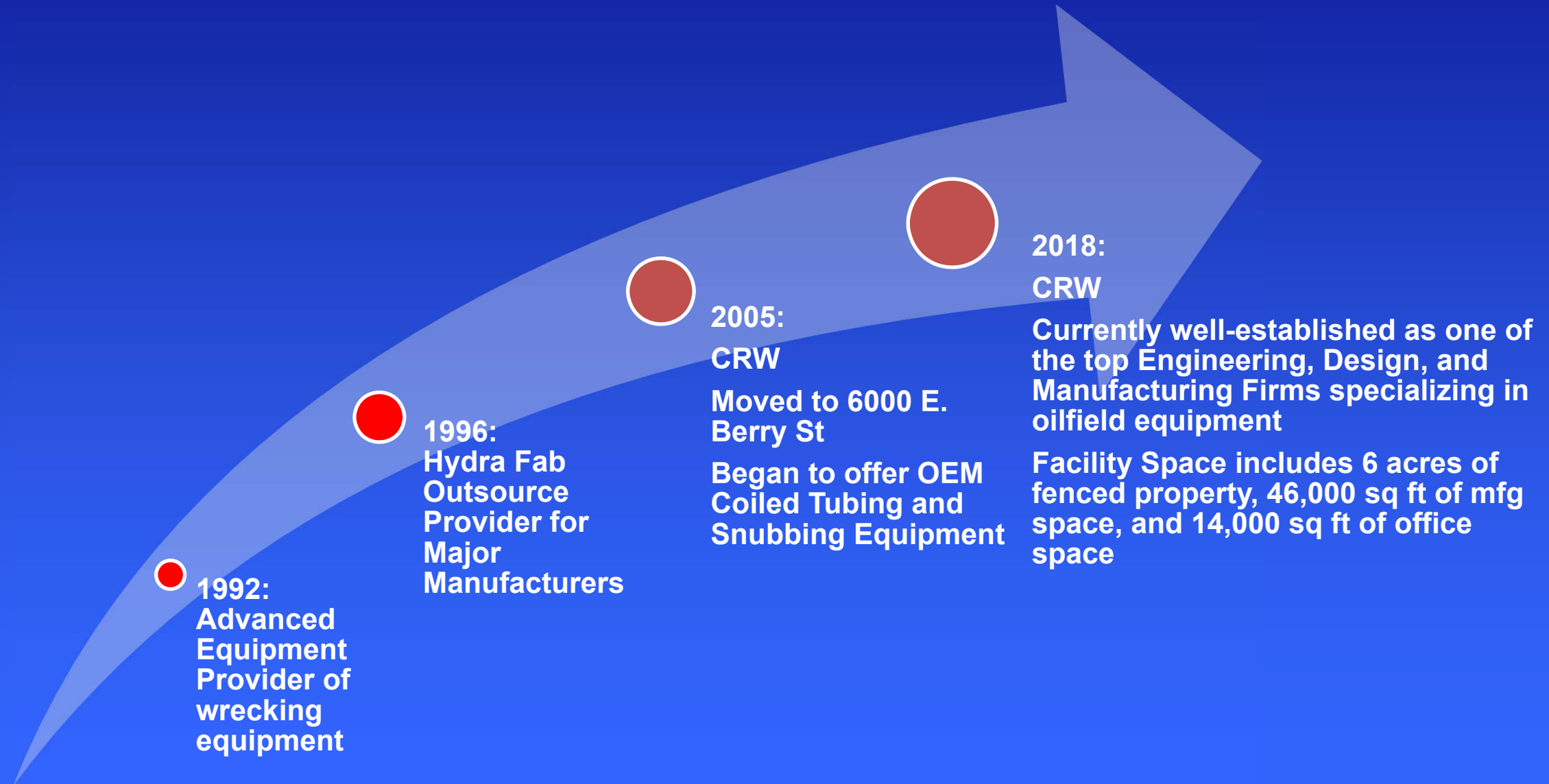
# Quality Assurance/Quality Control

- **Product Inspection**
  - Outsourced Parts/Assemblies
  - Machined Parts
  - Weldments
  - Assembly
  - First Article
  - Raw Material
  - Witness Pull Test
  - Witness NDE
  - Paint
  - Shelf Items
- **Non-Conformance Reports (Accountability)**
  - Corrective and Preventative (Internal/External)
- **Material Traceability**
- **Internal/External Audits**
- **Instrument/Equipment Calibration**
- **Vendor Program**
  - Receiving
  - Vendor First Article
- **Document Control**
  - Forms
  - Data Collection
- **Safety**
  - Monthly Safety Meetings





# CRW History



# CRW Website

[www.CRWLP.com](http://www.CRWLP.com)



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### Consolidated Rig Works

Welcome to Consolidated Rig Works, L.P., a solutions based organization, with experience and knowledge, ready to provide cutting edge technology to the oilfield, industrial and commercial heavy equipment industry.

CRW is committed to providing our customers with the best possible service and products, in a timely manner, at a competitive price. CRW has a high level of product knowledge and their applications. All products and services exhibit the high quality, design and usability, for which CRW has become known.

Consolidated Rig Works, LP: Where Ideas And Technology Create Solutions



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