Latest developments and applications of spoolable CT connector technology

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Agenda

- **Introduction**
- **Overall design drivers - specific requirements**
- **Latest developments**
- **Plastic bending performance**
- **Type of applications performed**
- **Track record**
- **Summary**

Introduction

- **CT Spoolable connector**
  - **Allows joining of two or more sections of CT**
  - **Development initiated in 2002**
  - **First application in October 2003 - ongoing since**

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Overall drivers

- **Overall drivers**
  - **Reduce weight of CT reel – offshore and onshore**
  - **Provide on-site connection method not involving welding**
  - **All work performed by CT crew – no specialized verification procedure after making connection (i.e. X-ray)**
  - **Proof-up only requires internal / external drifting and pressure testing**
  - **Easy to follow in between run checklist, for verification of fit for service**
  - **Increase CT utilization – alternative repair method – avoid specialized CT strings with low utilization (length)**
  - **Apply correct size of CT for the job – extend CT market**

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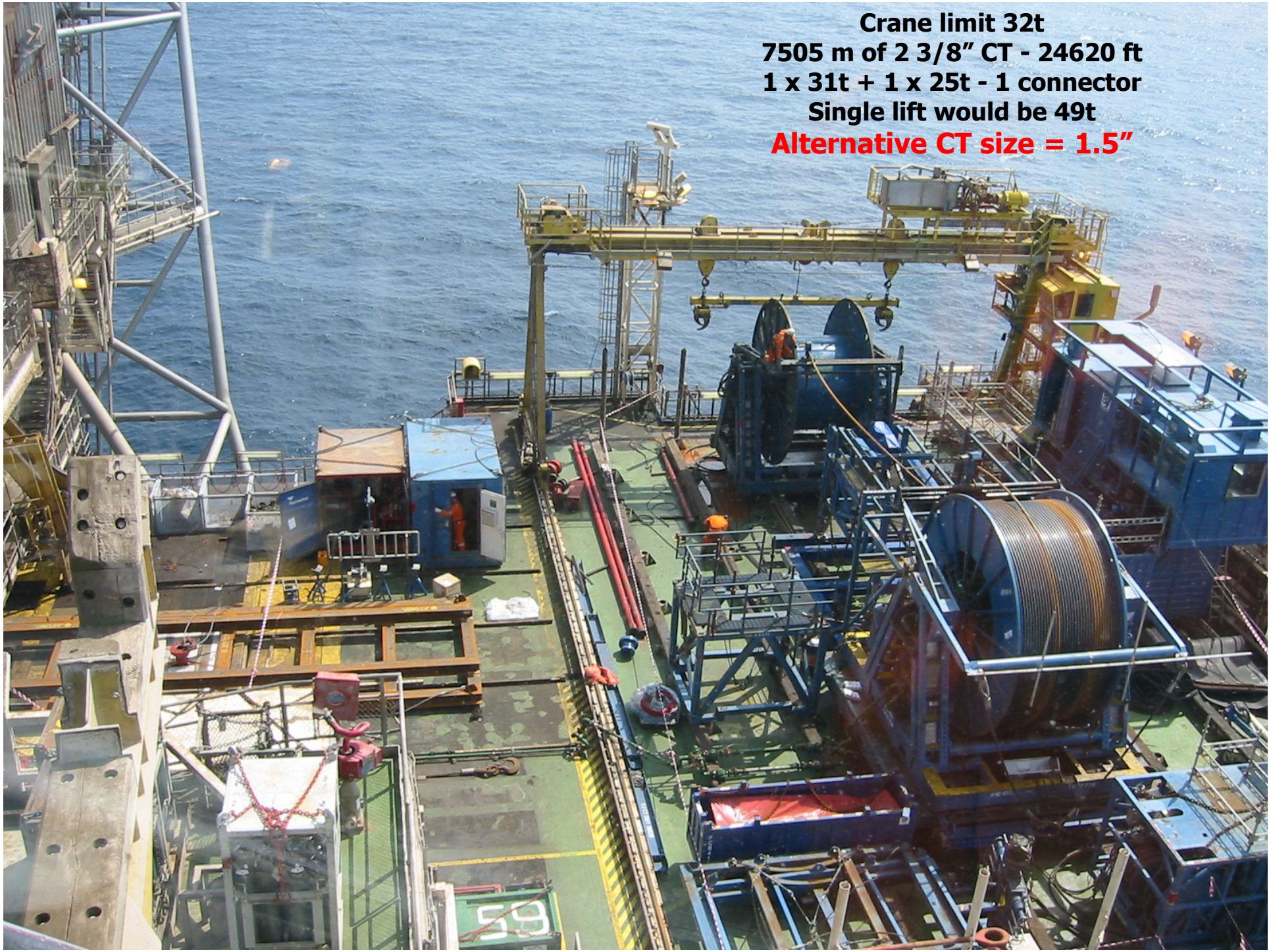
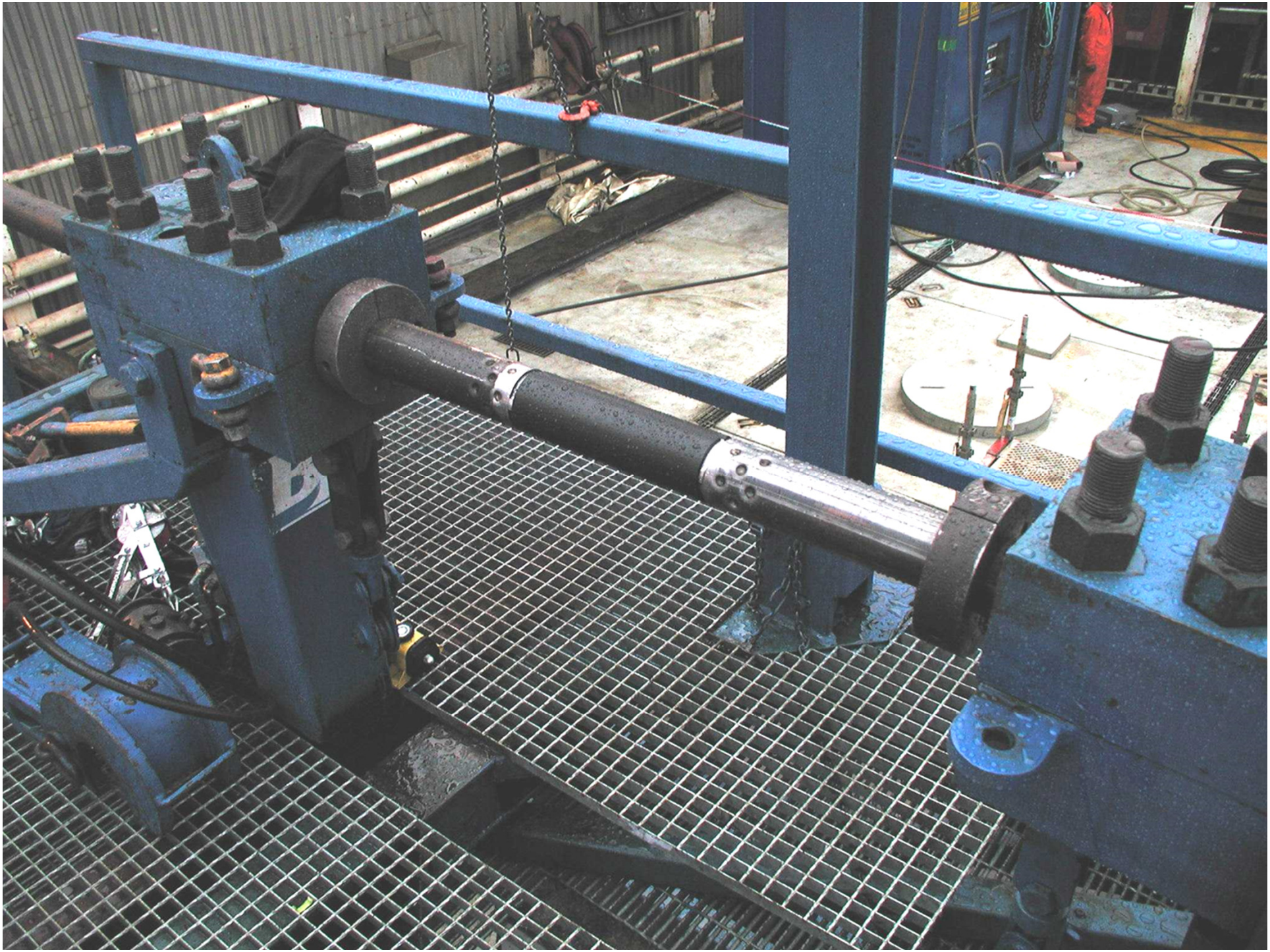

Crane limit 32t
7505 m of 2 3/8" CT - 24620 ft
1 x 31t + 1 x 25t - 1 connector
Single lift would be 49t
Alternative CT size = 1.5"



1.75" CT application

- **Small platform – 12 t limit**
  - **Welding and inspection would have been difficult**
  - **1.75" CT required to shift sleeves in horizontal wells**

Specific design requirements

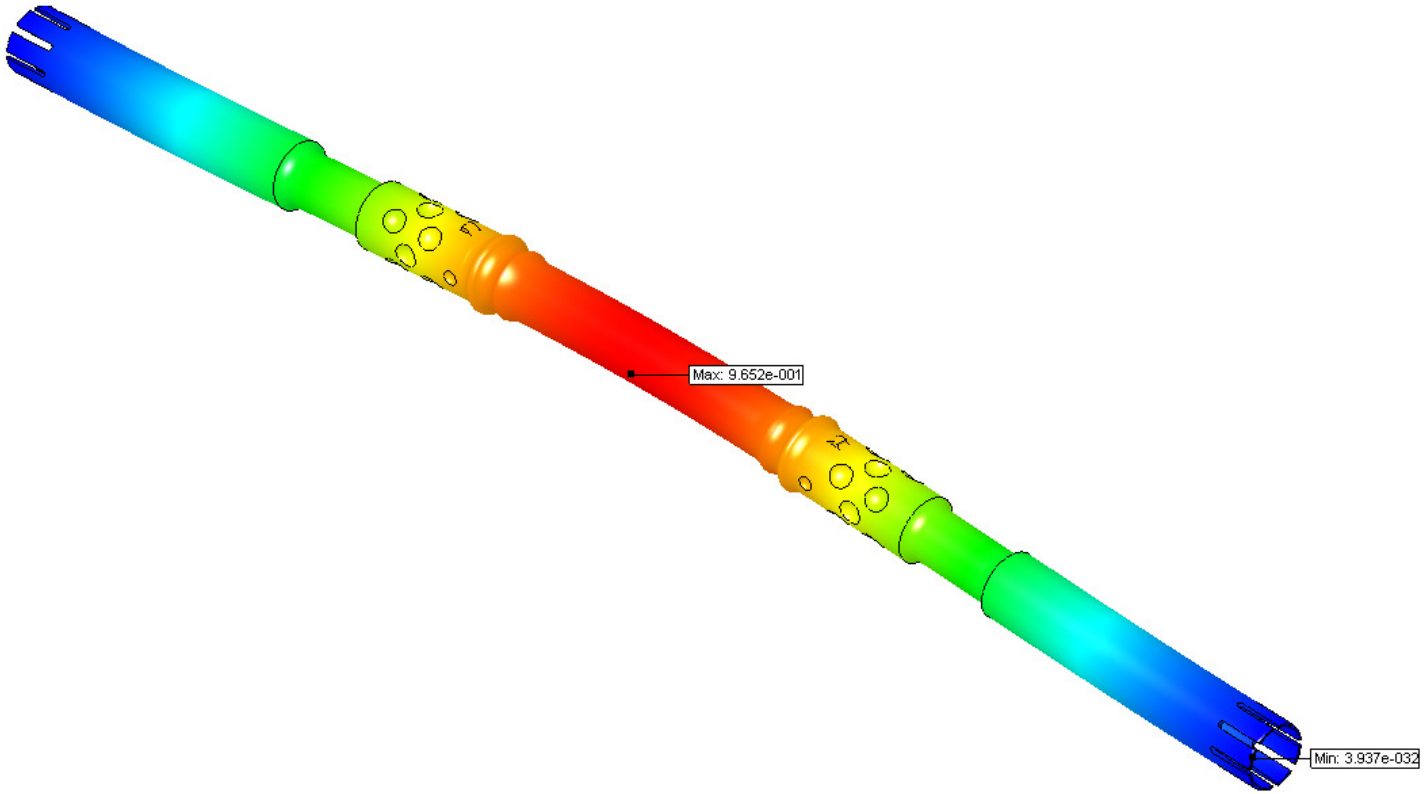
- **Specifics**
  - **Up to 4000 psi (27.6 MPa) dynamic pressure rating**
  - **10 000 psi (69 MPa) static pressure rating (or 80% of yield)**
  - **Up to 200 deg C temperature rating of seals**
  - **80% safe pull rating (same as CT)**
  - **Torque capacity in line with BHA end-connectors**
  - **Sufficiently large ID for passing of standard sizes BHA activation balls**
  - **Acid and H2S compatible**

Latest developments

- **Enhancements**
  - **Increased fatigue life by better matching CT and connector**
  - **Increased internal diameters ID for passing of standard sizes contingency cutters (chemical / explosive)**
  - **Compatibility with internal cable to pass through without effecting cable**
  - **Machined from one piece – no loose or attached parts – no O-ring grooves (stress raisers)**
  - **Multigrade connector, suitable for CT of 80, 90 and 100 CT**
  - **Can be used on standard CT equipment (tight bend forms) – no modifications required**

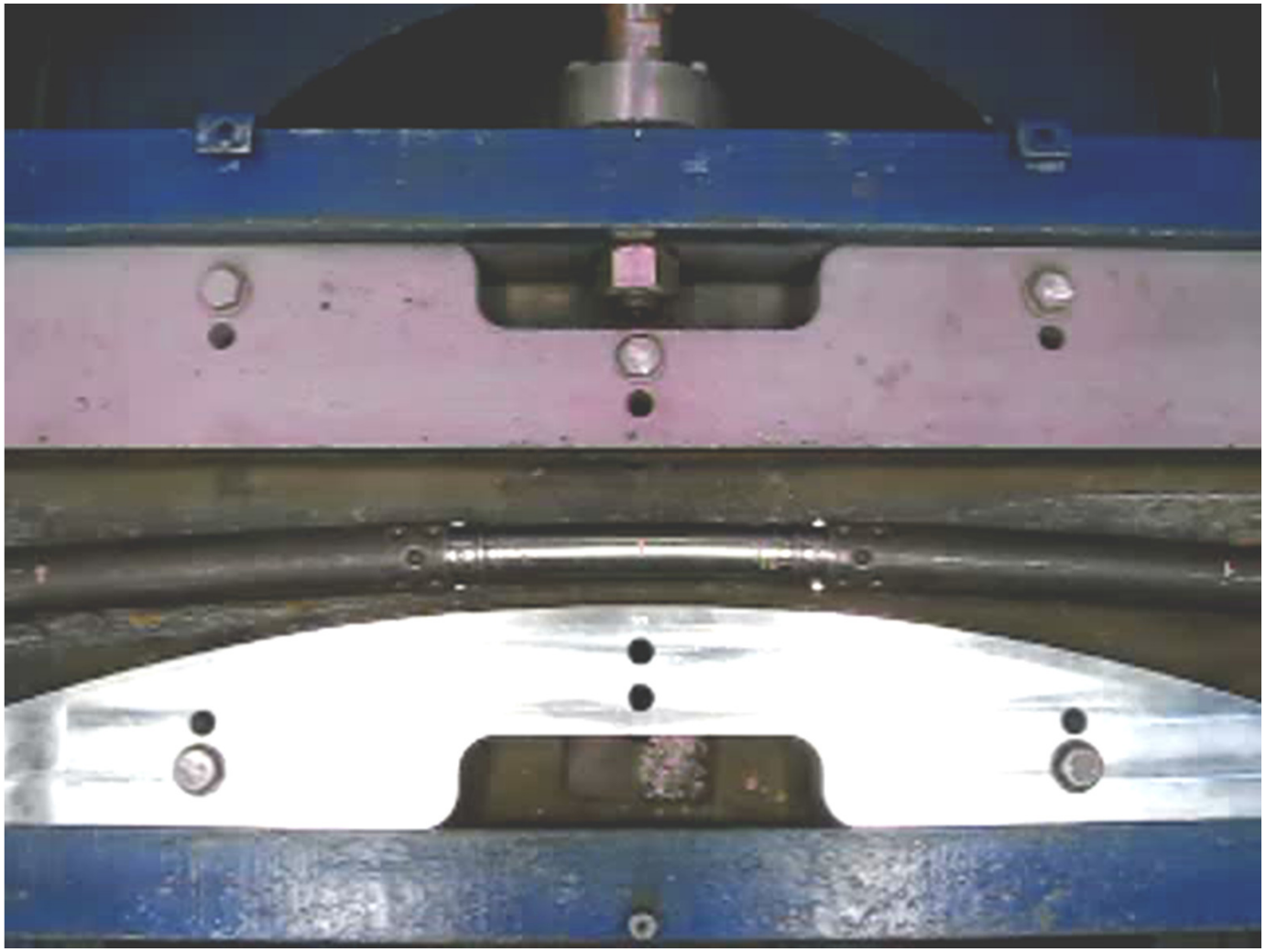
Plastic bending performance

- **Plastic bending simulation – put the major stresses where connector is defined best – reduce stress in CT-connector interface and seal area**

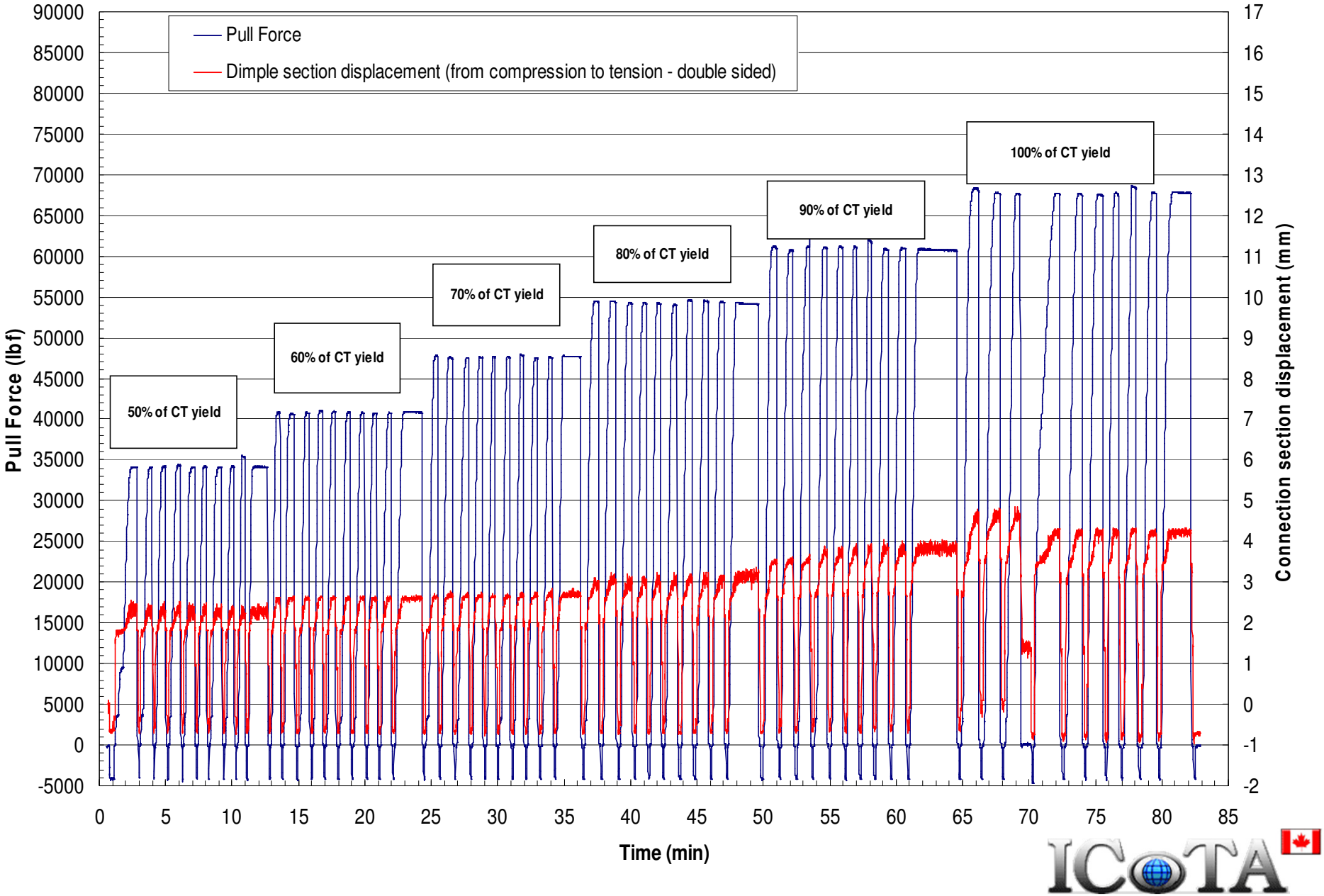


Plastic bending performance

- 2.0” CT 4000 psi (27.6 MPa) 55” bend radius



Pull test connector with 2.0" CT800 x 0.156"



Type of applications performed

- **Applications:**
  - **Cleanouts**
  - **Scale milling**
  - **Open hole drilling**
  - **Acid fracing**
  - **Perforating**
  - **Chemical washes – scale squeezes**
  - **Fishing**
  - **Water shut offs – chemical and plug setting**

Spoolable connector track record

- **32 jobs (wells) completed**
  - **178 runs completed**
  - **35 installations**
  - **Max. number of runs for one 2 7/8" connector = 19 runs**
  - **Max. number of runs for one 2 3/8" connector = 17 runs**
  - **Max. number of runs for one 1.75" connector = 11 runs**
  - **Typical weight reduction 30 – 40% - maximum achieved was 53% (with 2 connectors)**
  - **Current sizes available from 1.75" – 2 7/8" CT**

Summary

- **Enabling technology**
  - **Have created CT applications that did not exist before**
  - **Many are high end applications, representing new grounds for CT**
  - **Increased safety - especially for 2 3/8” and 2 7/8” CT**
  - **Increased utilization of CT – less inventory – less specialized CT strings (length)**
  - **Used technology as alternative CT repair method**
  - **Latest developments increased suitability of spoolable connector technology, while also providing contingency options**

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Thank you !

Questions ?