Winch Monitoring for Increased Safety

…And Compliance with Appendix A

Presented by

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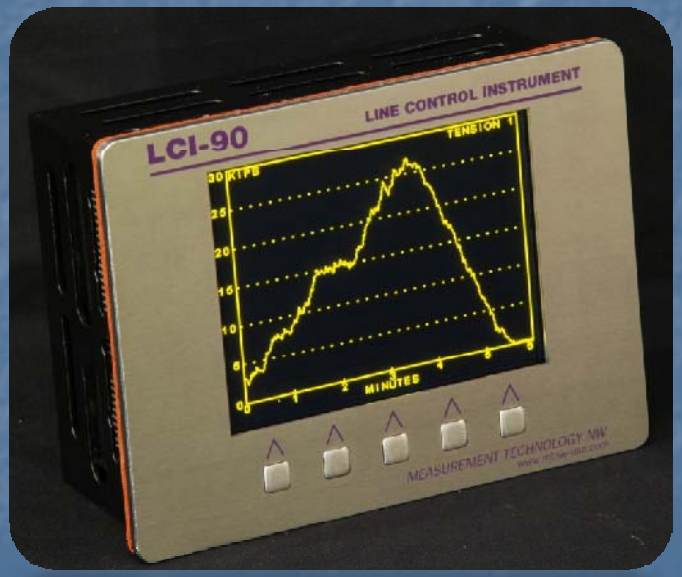
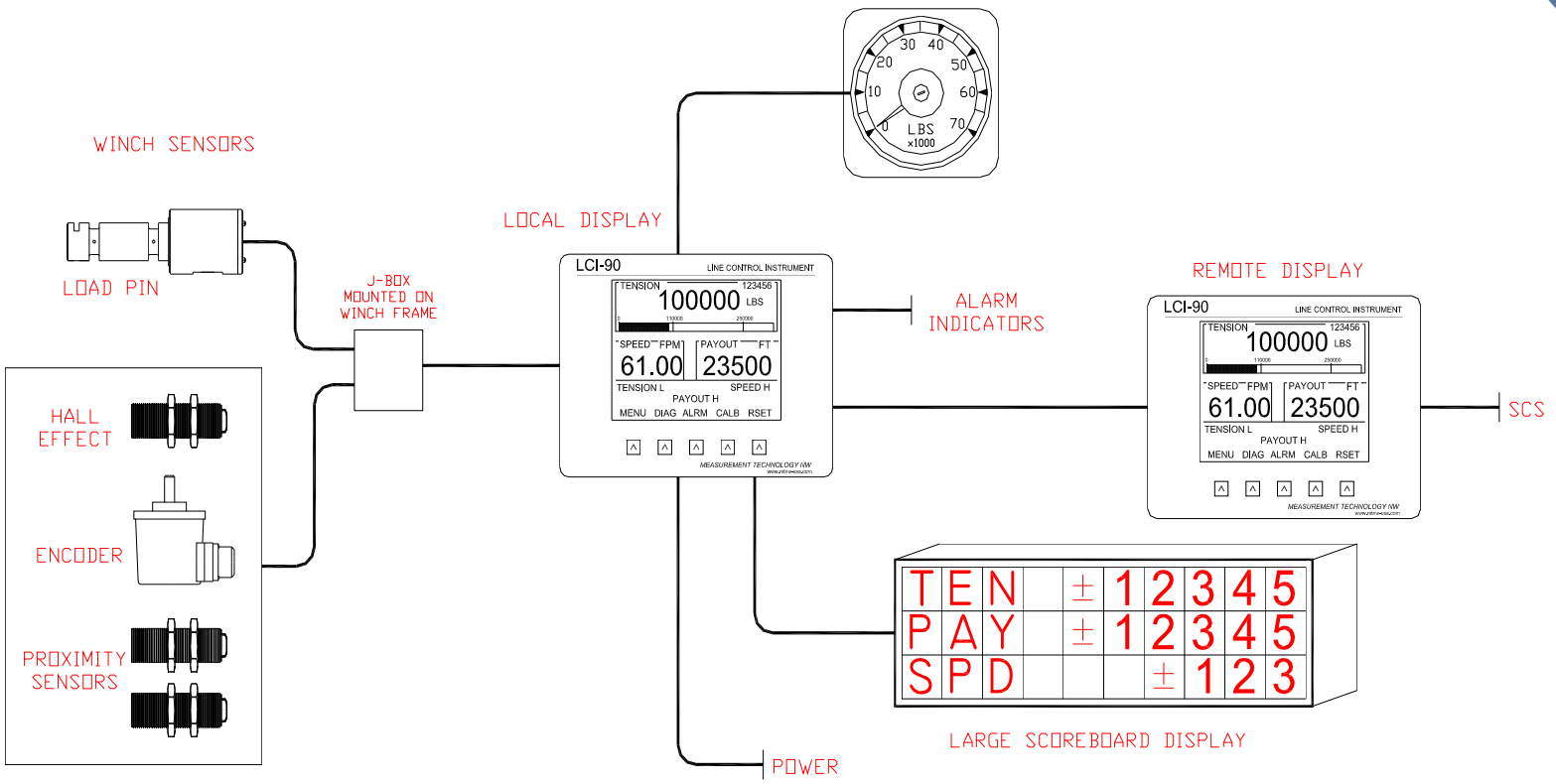
20+ Years Serving Multiple Industries

UNOLS Appendix A

- At a Safety Factor of 2.0 or less
  - 20 Hz tension data acquisition
    - 20 Hz logging (0.050 ms)
    - 20 Hz tension alarm evaluation, HI or LO
      - Visual and audible
    - 20 Hz data output rate
  - 10 Hz tension data display
    - Digital and time series format
  - System accuracy ≤ 3%
  - Re verify/calibrate every
    6 months

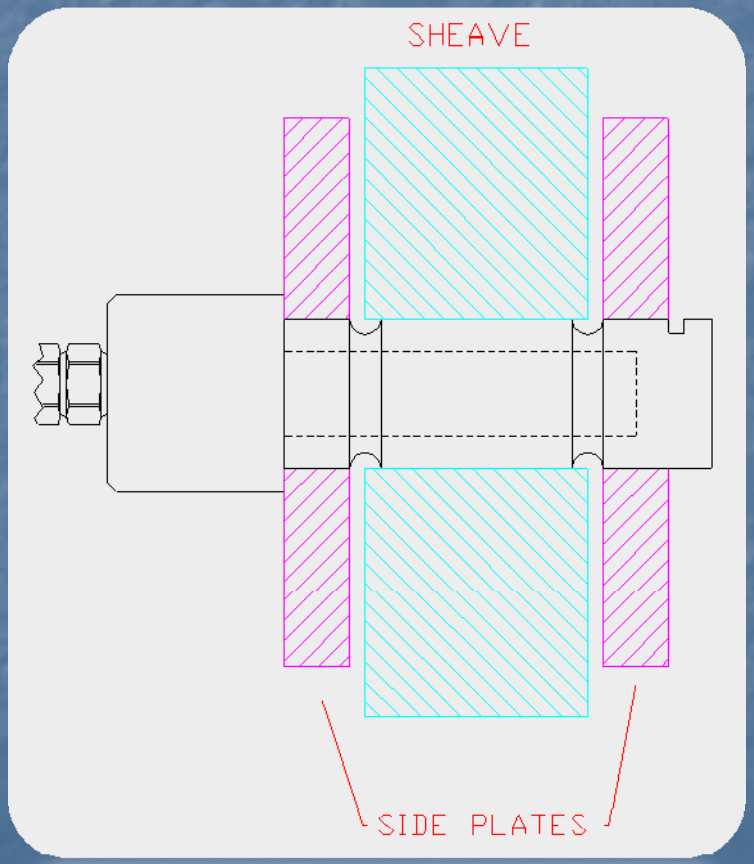


Winch Monitoring Overview



Tension Measurement

- Load Pins are the most common sensor found on research vessels



Tension Sensors #1

- Capacity
  - Full scale rating of the sensor, 100%
    - 0-10,000 pounds = 4 – 20 mA
  - Sensor response within the elastic properties of the metal deformation
- Proof Load
  - Maximum load sensor can bear before calibration is invalid
  - Typical rating 150%
- Catastrophic Load
  - Mechanical failure of sensor
  - Typically 300% but can be up to 800% in some sensors

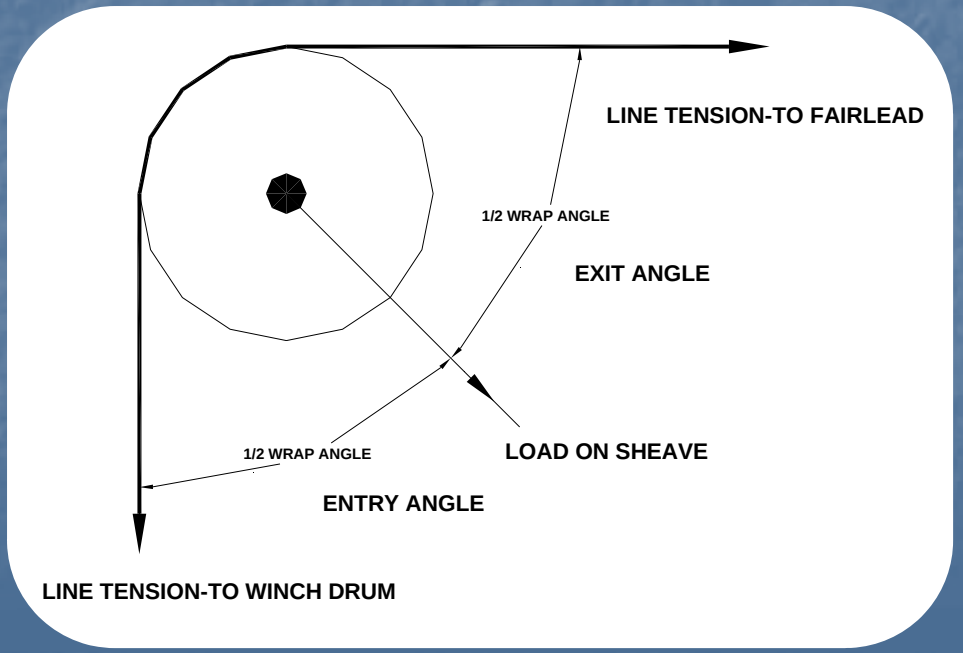
Tension Sensors #2

- Overloads
  - Line tension exceeds of proof load
    - Zero offset in sensor output
    - Critical safety application, replace
    - Mild overload can be recalibrated
- Do we need to replace sensors?
  - Both the raw strain gage and the amplified output will respond faster than 20 Hz
  - Sensor just one piece of the complex dynamic system
    - Reducing capacity will improve response and accuracy

Wrap Angle

- The wrap angle directly affects how line tension is measured
- Load on sheave = Line tension * WACF (wrap angle correction factor)
- Needs to be fixed, not variable
- Examples:
  - 120° Load on sheave = Line tension
  - 90° Load on Sheave = Line tension * 1.414
  - 0° Load on Sheave = Line tension * 2

- Devices exposed to these errors
  - Hanging sheaves
  - Sheaves that are in front of drum
    - dependent on layers



Corrections for Wrap Angle Errors

- Measure the angle with a inclinometer
  - Requires follower arm for line
  - Mechanical liability
- Dual Axis load Pin
  - Separate strain gages on x and y axis
  - Requires a instrument with correct algorithm
  - Expensive, extra internal electronics
  - Can only be used if only the exit or entry angle vary, not both

Calibration

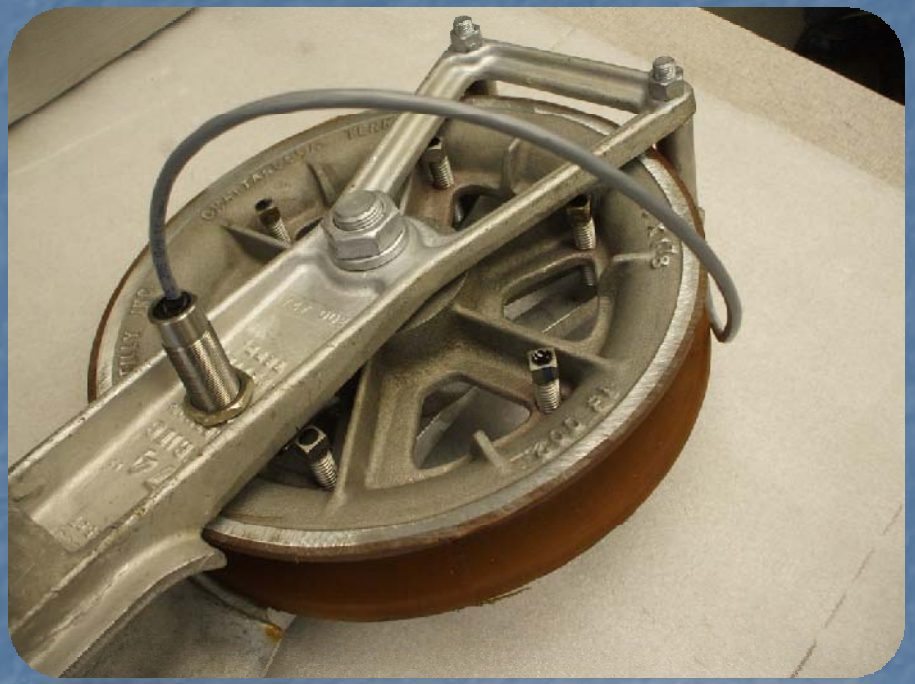
- Two point calibration
  - Collect two points: HI and LO
  - Linearity of sensors allows for this
  - How
    - Dead end certified dynamometer to deck
    - Pick up weights of known capacity
- Look up tables
  - Non linear sensor behavior or super accuracy required
  - Multi point
  - Enter sensor units at known weights
- Verified every six months
  - Recalibrate as needed

Speed/Payout Sensors #1

- Three main types commonly used
  - Encoder
    - High payout resolution potential
    - Fragile
    - Requires external housing
  - Proximity Sensors
    - Requires two sensors
    - Metal targets
    - Limited sensor to target distance
    - Good choice for retrofit

Speed/Payout Sensors #2

- Hall Effect Sensor
  - Single barrel device
  - Magnetic targets
  - Large gap distance
  - Best for retrofits
- Calibration
  - Zero count on display
  - Run known length of cable through sheave
  - Note pulses
  - Calculate Pulses per unit length



Displays – Current Units

- 10+ Years, over 1,100 displays in use
- Tension sample rate ~ 3 Hz
- Payout update rate ~ 3 Hz
- Fixed speed response
- Upgrades to 5Hz available
  - Limited availability
- Combined with our software
  - FS 5.0 to 2.5

UNOLS Vessels – LCI-90

- MELVILLE
- THOMAS G. THOMPSON
- ROGER REVELLE
- MARCUS LANGSETH
- KILO MOANA
- WECOMA
- ENDEAVOR
- CAPE HATTERAS
- HUGH R. SHARP
- PELICAN
- F.G WALTON SMITH
- RONALD H. BROWN

LCI-90i – Next Generation

The new display will be a direct replacement for existing LCI-90.

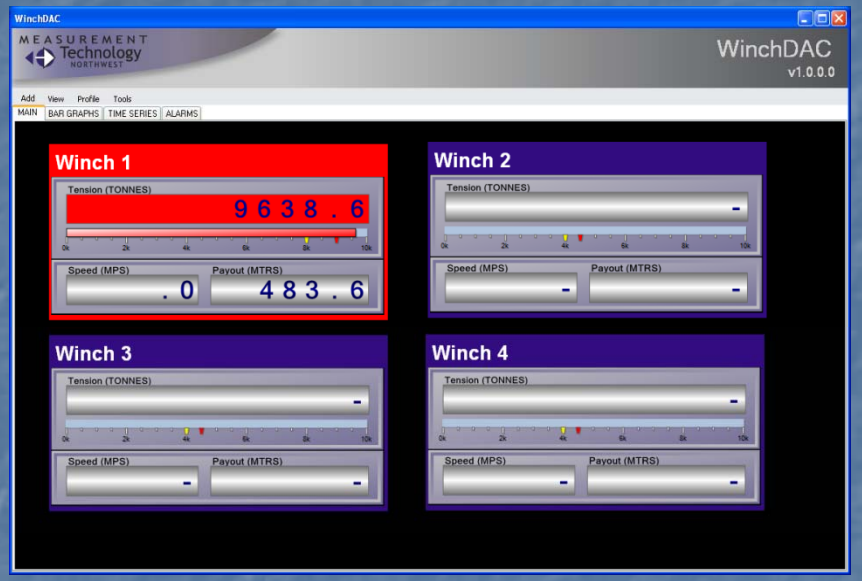
- 9-36VDC input power requirement
- 150 Hz tension sample rate across 4 channels
- Alarm evaluation, 150 Hz
- 4 independent quadrature counter channels
- Menu adjustable speed response
- On board data logging, removable CF disk
- RS-485, RS-232 and USB serial output
- Ethernet interface (static IP)
- Real time clock, date/time stamp output data
- Time series screen

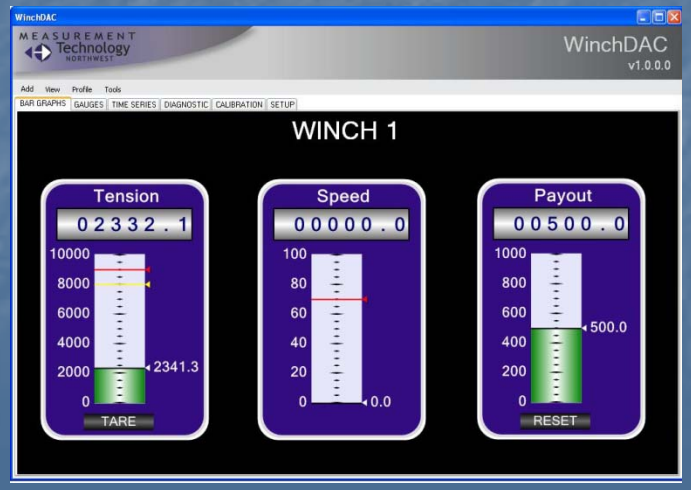
Complementary Devices

- LCI-90i Bridge Remote
  - Utilize color TFT display
  - Single button toggles between day/night
- LCI-80
  - Speed and Payout only
  - Same electronics as LCI-90i

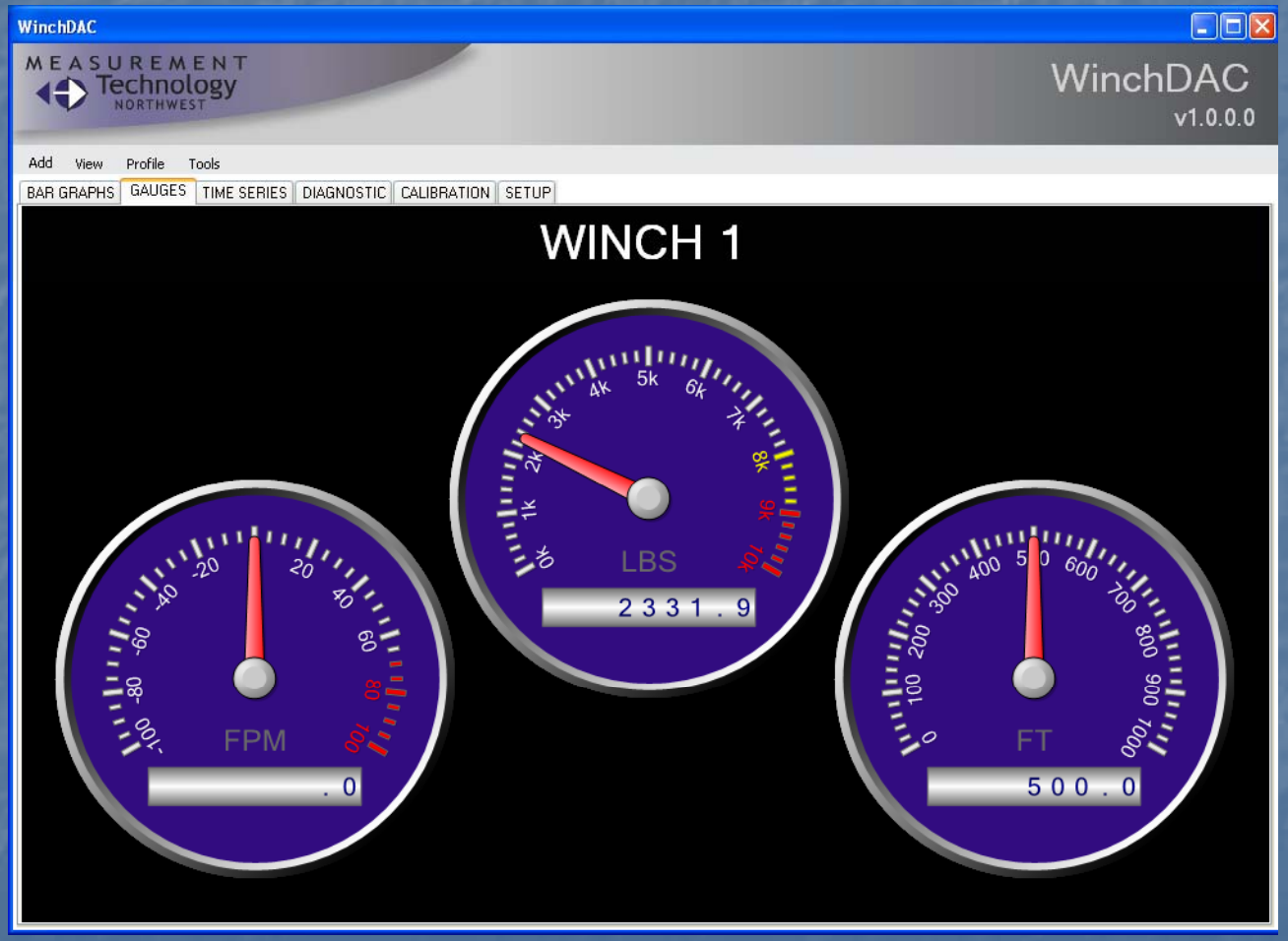
Software – WinchDAC

- Appendix A Compliant
  - Data logging real-time
- View Line Parameters
  - Time Series
  - Vertical Bar Graphs
  - Analog Dials
- Alarm Indication
- Display setup/calibration
- Automatic email/alarm notification
  - Email notification - exceed elastic limit of wire





Software – WinchDAC



Appendix A Compliance

- For Factor of Safety ≤2.5, systems need to be upgraded
  - Displays (local and remotes), software
- LCI-90R units will be phased out
  - Do not respond to updated serial data rates
  - New remotes will be the LCI-90i to allow remote reset
- Serial data can still be transmitted via existing networks to meet the standard
  - Recommend moving data networks to Ethernet

Single or Multi-Winch Displays?

- Winch control station location
  - Multi Winch Requires station to be close together
  - Operator Comfort
- Operator Interface Requirement
  - Select Active Winch
    - Menu Structure Selection
    - External Select Switch

Multi-Winch LCI-90i Display

Revelle Hydro Control Station

Winches With No Monitoring?

- Levelwind
  - Expensive
  - Long down time
  - Engineering required
  - Integrated/accurate
- External Sheave
  - Needs fixed wrap angle
  - Engineering required
  - Prone to error
- External Tensiometer
  - Portable, independent of winch
  - Maximum flexibility

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