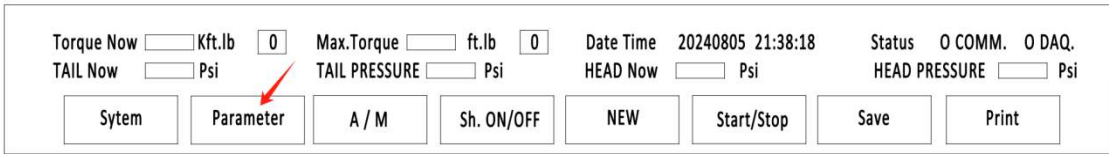
System

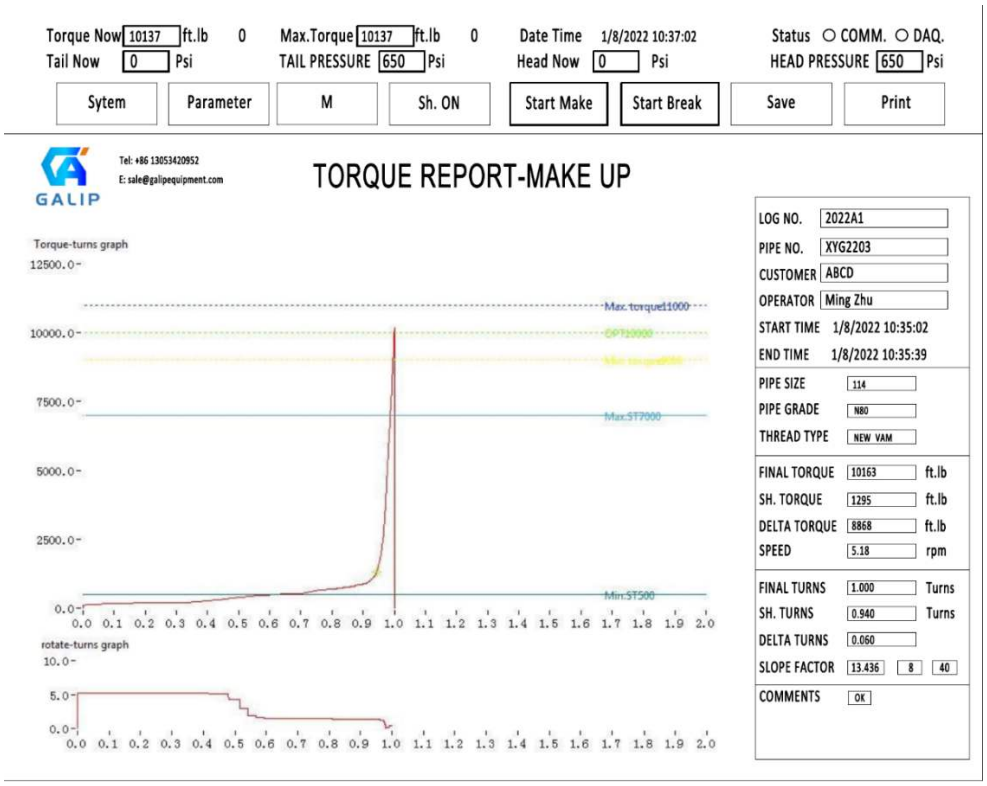
- **Parameter Input and Selection**:
    - You can input all parameters of the pipe in advance so that they can be selected from a dropdown menu in the software interface.



    - You can add and modify pipe-related parameters by clicking.
    - After selecting the pipe specifications (example shown below) — material, and thread type — the corresponding numbers will be automatically called up.

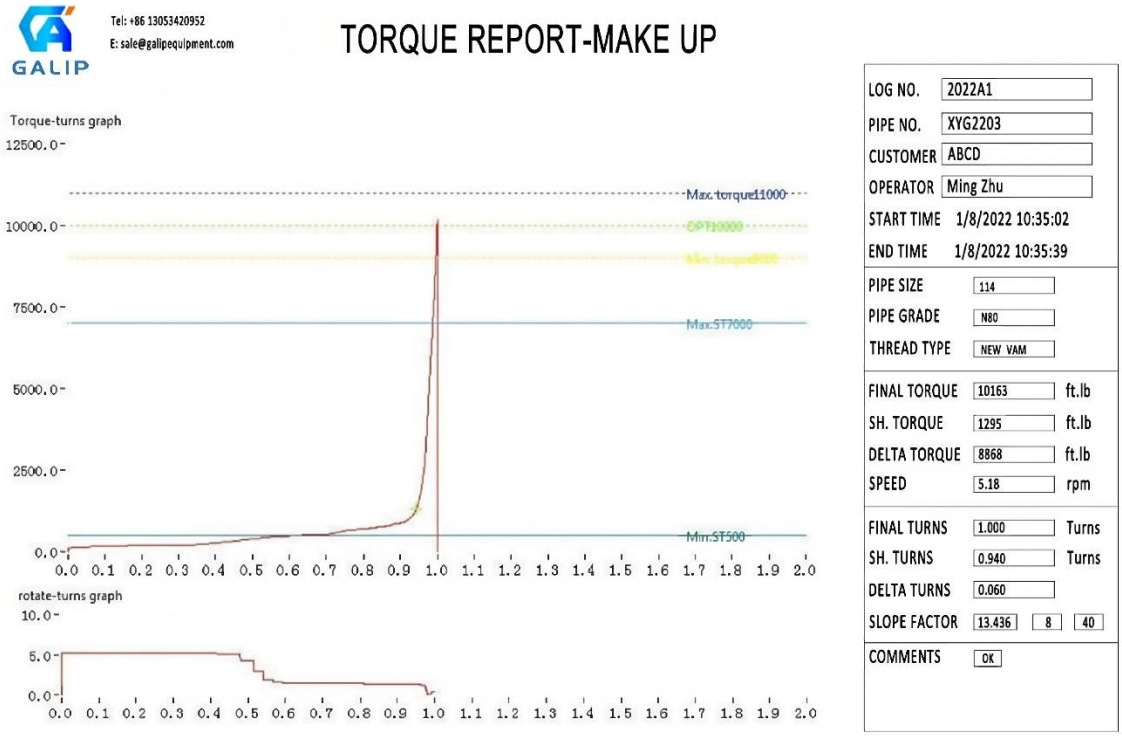
								Query	Add	Edit	Delete
PIPE SIZE	GRADE	THREAD TYPE	TAIL PRESSURE PSI	HEAD PRESSURE PSI	MAX. TORQUE ft.lb	OPT TORQUE ft.lb	MIN. TORQUE ft.lb	MAX. SHOULDER ft.lb	MIN. SHOULDER ft.lb	MIN. SLOPE FACTOR	MAX. SLOPE FACTOR
3.5	N80	VAM	860	860	11000	10000	9000	1500	8000	8	40
114	N80	VAM	900	900	13000	12000	11000	3000	9000	8	40

- **Real-Time Data Display**:



- The system provides real-time monitoring during the make-up process, displaying critical data such as torque, turns, and clamp pressure.
- Operators have full visibility and control over the operation, allowing for immediate adjustments if necessary.

- **Automated Control Systems**:
  - The machine ensures the head rotates smoothly through the run-in and ramp phases, stopping promptly at the target torque without significant overshoot.
  - Automated software control prevents the head from stopping or hesitating during the critical ramp phase, ensuring a smooth and efficient process.
- **Post Make-Up:**



After the make-up, the system and report will show:

- **Graphical Curve**: The torque-turns graph appears in the report, providing a visual representation of the torque-tu applied throughout the make-up process.
- **Torque Values: Maximum, Optimal, and Minimum Torques**: For example, Max. 9000 & Max. 11000 ft.lb, these values are automatically displayed in the corresponding curve positions.
- **Shoulder Torques:** Maximum and minimum shoulder torques, such as Max. ST7000 & Max. ST500 ft.lb, are shown in the corresponding curve positions.
- **Slope Factor**: The maximum and minimum slope factors are automatically displayed in the corresponding table positions, ensuring accurate monitoring and control.

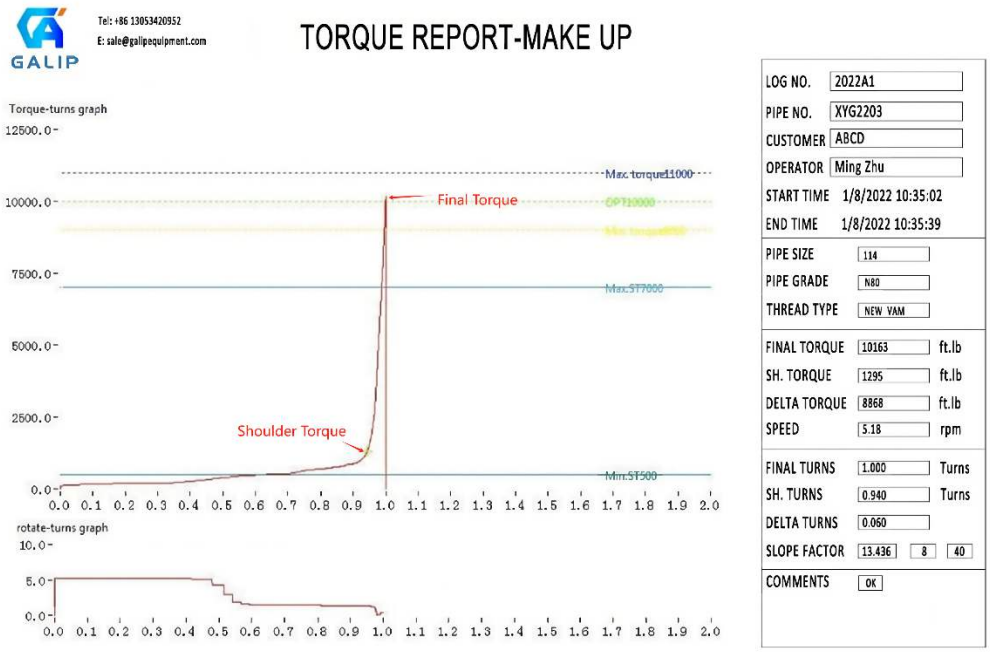
This detailed post make-up section ensures that every aspect of the make-up process is recorded and monitored, providing comprehensive data for quality assurance and operational efficiency.

Turns Measurement

1. We use a rotary encoder, with a resolution at 262,144 PPR. The encoder offers extremely high precision, making it suitable for ultra-high-precision applications. It provides an angular resolution of approximately 0.001373 degrees per pulse, which is comparable to a 1/1000-degree encoder.

Attribute	Value
Encoder Technology	Absolute
Pulses Per Revolution	262144
Maximum Revolutions	4096rpm
Output Signal Type	Ethernet IP
Shaft Type	Solid
Shaft Diameter	10mm
Supply Voltage	10 → 30 V dc
Resolution	30 Bit
Steps Per Revolution	262144Steps
IP Rating	IP65
Interface	Ethernet/IP
Overall Width	60mm
Overall Depth	65mm

2. The shoulder turns, delta turns and final turns will be accurately recorded.



3. The recording of turns should start recording the number of turns as soon as the tool joint or threaded connection begins to engage. Starting at this precise moment guarantees that all turns are accurately monitored, ensuring the quality and consistency of the connection.

4. The delta turns which measures between targeted torque values or shoulder points will be automatically calculated and used for the slope factor calculation.

Torque Measurement

- We use reaction load-cell or load sensors (tension and pressure sensors) /24V/485 communication with an accuracy of 0.0083% FS and repeatability of 0.017%.

Specifications

Type		C16i C3			
Nominal (rated) load (E_{max})		20 t	30 t	40 t	60 t
Accuracy class per OIML R60 Number of load cell verification intervals (n_{LC})		C3 (0.0180 %) 3000 (10 000 NTEP III LM)			
Minimum load cell verification interval (v_{min})	% of E_{max}	0.0100 (0.006 NTEP III LM)			0.0083 (0.006 NTEP III LM)
Minimum load cell verification interval (e_{min}) per EN 45 501 [... LC = max. number of load cells]	kg	5 [6 LC] 10 [10 LC]	10 [10 LC]	10 [6 LC] 20 [10 LC]	10 [4 LC] 20 [10 LC]
Nominal (rated) sensitivity (C_n)	digit	1 000 000			
Sensitivity tolerance	%	±0.03			
Temperature coefficient of sensitivity (TK_C) [1]	% of C_n / 10 K	±0.0080 [1]			
Temperature coefficient of zero signal (TK_0)		±0.0140			±0.0116
Relative reversibility error (d_{hy}) [1]	% of C_n	±0.0170 [1]			
Non-linearity (d_{lin}) [1]		±0.0180 [1]			
Creep upon loading (d_{cr}) over 30 min.		±0.0167			
Minimum dead load output return (DR), 30 min.		±0.0167 (±0.0150 NTEP III LM)			
Reference excitation voltage (U_{ref})	V (DC)	12			
Nominal (rated) supply voltage range (B_U)		8.5 ... 15 [2]			
Rated current consumption	mA	50 [2]			
Resolution	Bits	20 (at 1 Hz)			
Data rate	1 / sec	200 | 100 | 50 | 25 | 12 | 6 | 3 | 2 | 1			
Filter mode 0	Hz	8 ... 0.05 (low-pass)			
Filter mode 1		8 ... 3 (low-pass)			
Asynchronous interface		RS−485 / 4-wire (cable length up to 500 m)			
Baudrate	baud	1200 ... 115200			
Bus nodes		max. 32			
Nominal ambient temperature range (B_T)	°C	−10 ... +40			
Operating temperature range (B_{tu})		−20 ... +70			
Storage temperature range (B_{tl})		−50 ... +85			
Limit load (E_L)	% of E_{max}	150			
Breaking load (E_d)		> 350			
Relative perm. vibrational stress (F_{srel}) (oscillation width as per DIN 50100)		70			
Nominal (rated) load (E_{max})		20 t	30 t	40 t	60 t
Nominal (rated) displacement at E_{max} (s_{nom}), approx.	mm	0.65	0.75	0.85	1.22
Weight (G) with cable, approx.	kg	2.2	2.4	3.0	3.8
Degree of protection per EN60529 (IEC529)		IP68 (test conditions 1 m water column/100 h) IP69K (water at high pressure, steam cleaner)			
Material: Measuring body + housing Cable entry Seal Cable sheath		Stainless steel Stainless steel Viton Thermoplastic elastomer			

[1] The values for non-linearity (d_{lin}), relative reversibility error (d_{hy}) and temperature coefficient of sensitivity (TC_S) are recommended values. The sum of these values is within the cumulative error limit for p_{LC} = 0.8 according to OIML R60.

[2] Refer to table for power supply in the mounting instructions!

Options for C16i...

- **Cable length 20 m** (E_{max} = 20 t + 30 t)
- **Cable length 40 m** (E_{max} = 20 t ... 60 t)
- **Cable with metal mesh, 20 m** (E_{max} = 20 t ... 60 t)

- For right-hand make-up, measured tension lbs × arm ft = make-up torque ft.lb.
- For left-hand break-out, measured pressure lbs × arm ft = break-out torque ft.lb.
- The final torque and shoulder torque will be accurately recorded.
- The delta torque will be automatically calculated and used for slope calculation.

Determining Shoulder Torque

- Shoulder torque is determined by high-frequency data collection. The system can detect the shoulder torque.
- An arrow will appear pointing to the shoulder point, displaying the value in the curve and table (NEED TO UPDATE).

Judging Connection Quality

- Based on the values of shoulder torque, shoulder turns, and slope factor, the pipe connection can be judged as OK or NO. Also, users can comment on the make-up or break-out, which will show on the make-up or break-out report.

Equipment Features and Control

- **Clamping Pressure**:
    - The clamping pressure of the tail tong and head tong will automatically appear in the interface after being selected from the table.
    - This value will be automatically transmitted to the software; the software will control the electro-hydraulic proportional valve according to the value to stop the pressure in time to prevent excessive clamping pressure from damaging the pipe.
    - The real-time clamping pressure value will be displayed in the interface.

- **Action Control**:
    - Manual mode: use the electric control handle to control each action.
    - Automatic mode: each time a button is pressed, the equipment will automatically complete an action until make-up or break-out is completed.
    - Click "Start Make" to start the make-up process.
        - Manually operate the handle to move the pipe to the right position for the tail tong.
        - Press the button, the make-up process starts automatically.
            - When the shoulder torque is reached, the software immediately controls the electro-hydraulic proportional valve to reduce the flow to 10%, reducing the speed to prevent torque overload and ensure accurate torque recording.
            - When the optimal torque is reached, the software immediately stops the flow, the two hydraulic motors stop rotating, and pressure is maintained for 3 seconds to ensure no increase or decrease in torque, and the final torque is recorded in the table.

Hydraulic Motors

- Two high-pressure plunger hydraulic motors provide rotational power and large torque.
- They drive two small gears to rotate the main gear on the spindle.
- The two hydraulic motors are installed in balance, which is beneficial for applying balanced torque.

Pressure Adjustment

- The equipment has a manual pressure adjustment valve.
- For high-quality threads, the software automatically controls the pressure without frequent adjustment, generally set at 21Mpa.

- Even with manual control, the torque is applied by controlling the electro-hydraulic proportional valve according to the voltage provided by the movement distance of the electric handle.

Print Out Report

- The software automatically records and completes the report in pdf format.
- All data is automatically saved and can be copied via USB for querying, generating curves, and reports.
- We supports remote online control and free upgrades for customers.

Modify Calibration

Calibration is essential for the correct operation of the bucking unit, ensuring accurate torque application and measurement. Here's a detailed procedure to modify and calibrate the system:

1. **Accessing Calibration Mode:**
    - Enter the system password to gain access to the calibration mode. This step ensures only authorized personnel can make calibration changes.
    - Once accepted, the editable fields will change to black, indicating they are ready for modification.
2. **Editing Calibration Table:**
    - The calibration table contains columns for applied torque and corresponding counts (voltage readings).
    - A red "REC" button will appear next to the current line in the table. Click this button to record the current reading (volts, in this case) into the right column.
3. **Calibration Procedure:**
    - Apply increasing reference torques and record the readings by clicking the "REC" button.

- Ensure that the torque values are accurately recorded in the table. Incorrect entries can be deleted, and new points can be inserted using the “INS” and “DEL” keys.
- Once the table is complete, save the values. The data is stored in the “INI” file, and a summary can be printed for records.

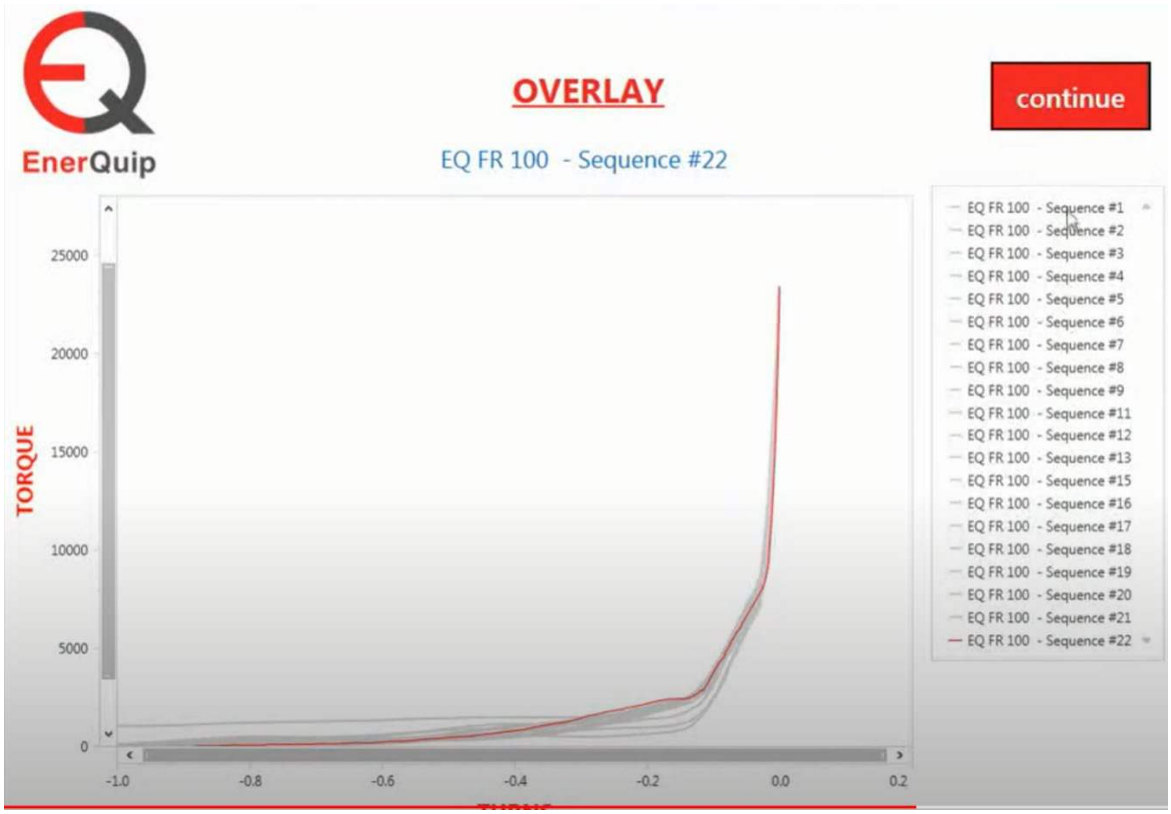
4. **Repetition for Different Directions:**
    - The calibration process must be repeated for both make-up (clockwise) and break-out (anti-clockwise) directions to ensure accuracy in both operations.
5. **Calibration at Mid-Point:**
    - Calibration should be performed at a set point of the stroke. Typically, the system is calibrated at the mid-point of the stroke to ensure the required torque is reached accurately.
    - Note that the actual torque can vary by as much as +/- 5% at different positions of the stroking piston, so mid-point calibration helps minimize this variance.

Logging System

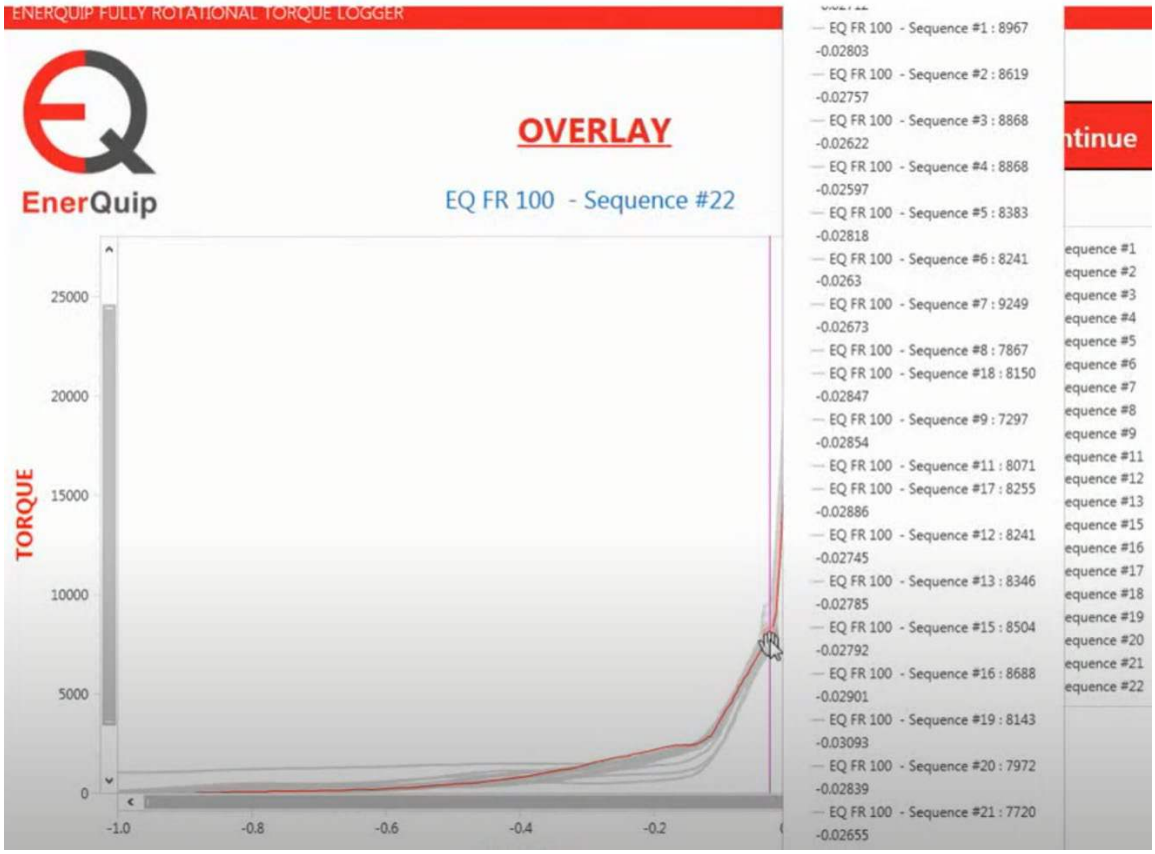
We are planning to develop a logging system to provide detailed comprehensive reporting for the make-up and break-out processes of tubular connections. Although we have not yet developed a system like this, we have discussed it with our software engineers and are confident that we can create it before the machine is assembled.

1. **Graphical Representation of Torque and Turns**:
    - **Torque-Turns Graph**: The system will generate a torque-turns graph for each make-up sequence. This graph visually represents the torque applied throughout the make-up process, allowing operators to see the relationship between torque and rotation.
2. **Sequence Overlay**:
    - **Overlay Functionality**: The logging system will include an overlay feature that allows multiple sequences to be displayed on the same

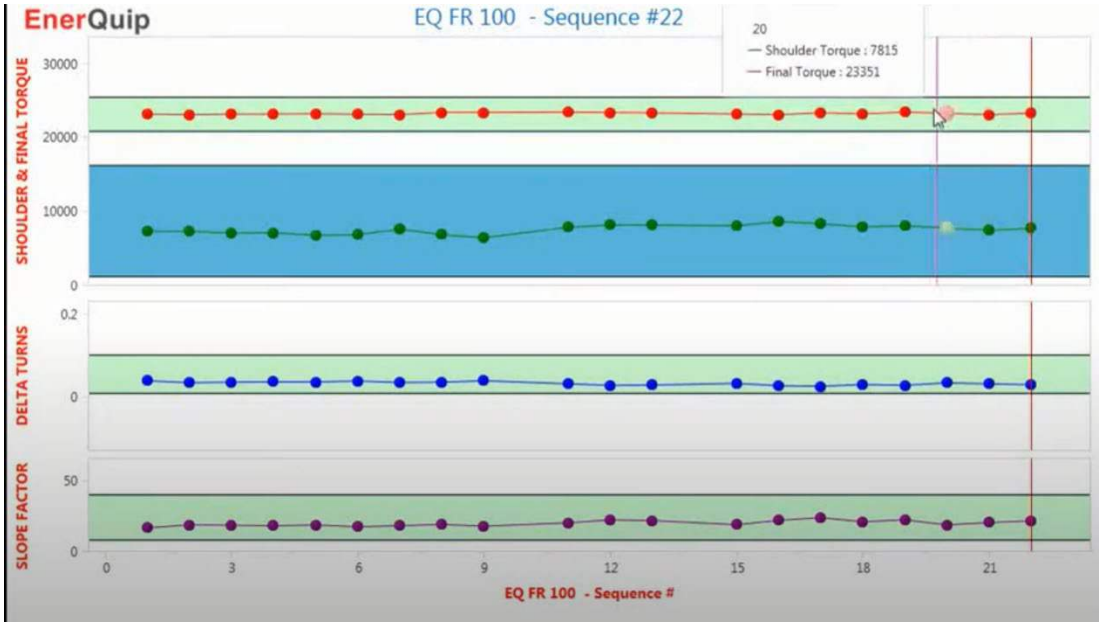
graph. This helps in comparing different make-up sequences and identifying any anomalies or inconsistencies.



3. **Detailed Data Logging**:
    - **Sequence Information**: Each sequence will be logged with detailed information including sequence number, operator name, start and end times, pipe specifications, and torque values.
    - **Shoulder and Final Torque**: The system will log the shoulder torque and final torque for each sequence, ensuring precise monitoring of these critical points.



4. **Multi-Parameter Monitoring**:
    - **Parameters Monitored**: The logging system will monitor and log various parameters including shoulder torque, final torque, delta turns, and slope factor. Each parameter will be plotted separately for detailed analysis.



We believe that this advanced logging system will significantly enhance the precision, reliability, and efficiency of the make-up and break-out processes for tubular connections.