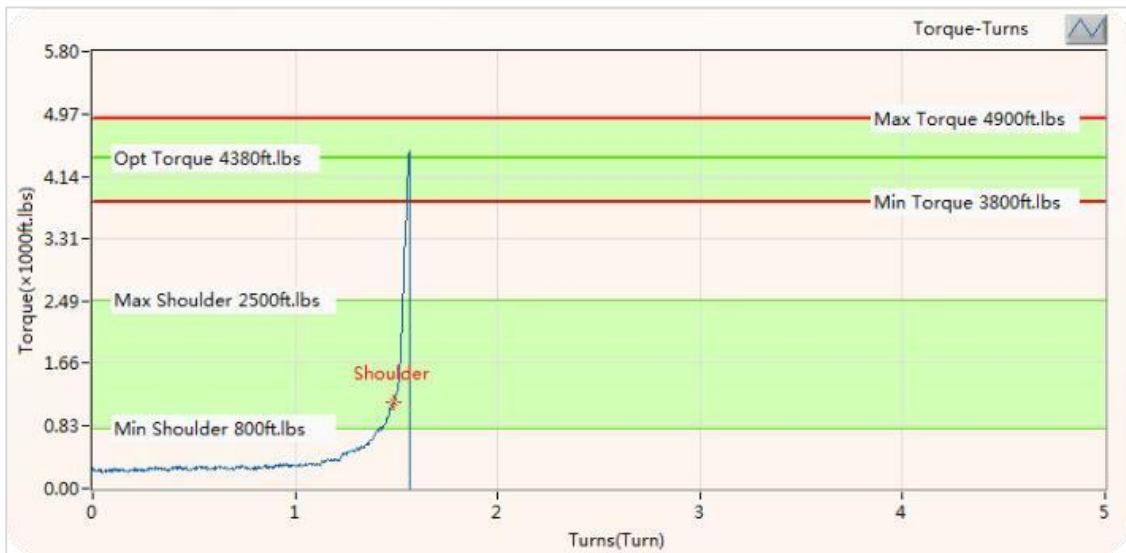




Torque Measuring Instrument Manual



TTMC Pro™

V 3.0

**YANCHENG TEDA DRILLING & PRODUCTION
EQUIPMENT CO., LTD**

◆ **Patent Notice:** All the equipment, appearance, software and software interface included in this manual have been applied for national patents and are protected by the National Patent Laws.

| The manual is applied for the following versions | | | | |
|--|------------------|---------------------------------------|-----------------------|-------|
| V3.0 | | | | |
| Item | chapter/ page | Remarks | Date of completion | Notes |
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Forward

Under the condition that Tarim Oilfield has high operation requirements of the “Three-high” well, and it is always very difficult and the filed is variable, in response to the advantages and disadvantages of current torque monitoring equipment, the company’s researching team develops the new oil and casing pipes torque monitoring instrument. The company’s key technical personnel have been working on the site for more than 15 years, and have deep understanding and research on nearly all the products of domestic and foreign brands. TTMC ProTM oil/casing torque monitor is intelligent, and easy to operate, which are welcomed and praised by the customers. It can replace the same type of American and German imports.

Introduction

TTMC ProTM oil/casing torque measuring instrument can be applied for the pipe operations, monitoring and controlling the operation quality of both offshore and land drilling platforms. The device provides two operation modes and four measuring methods, which can monitor and control the standard makeup torque in real time, so that the oil and casing pipe can reach the standard setting value, and can monitor the oil and casing pipe with special makeups to achieve the best sealing state. TTMC Pro monitoring system consists of a host machine, a data signal line, a tension/turn sensor, and an electromagnetic relief valve. After the several wells operation, it is proved that this instrument has high practical value for ensuring the operation quality of the oil and casing job, and reducing accidents and improving work efficiency.



Warning-Dangerous Operation!

It is not allowed to connect the sensor electrically, which will cause damage to the sensor or internal components of the host.

Notes-Data Security Considerations:

We strongly recommend regular data backup. This is the responsibility of the customer.



1.Main Technical Parameters

1.1 Explosion-proof



Figure1 Explosion-proof host Machine

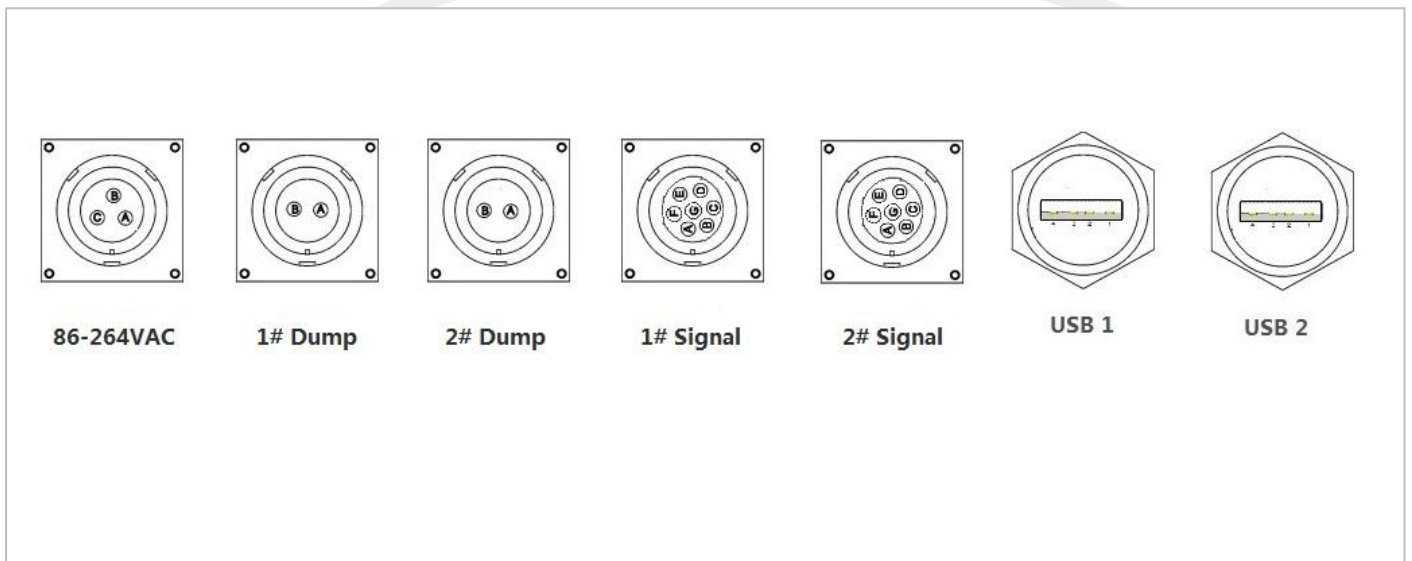


Figure 2 The schematic of Connection plugs

The explosion-proof machine(Figure 1) has passed the national explosion-proof certification and acquired the explosion-proof certificate, which can meet the safety requirements of the oilfield operation site. This system adopts high-precision, military-grade components,where the maximum error of the whole machine is less

than 0.5%.It can provide the precise control according the setting parameters, to effectively guarantee the quality of the oil and casing pipe buckle, and at the same time evaluate the quality of the oil casing buckle according to the graphical curve analysis, which provides an important basis for the quality of the work.

National Explosion-proof Certificate:

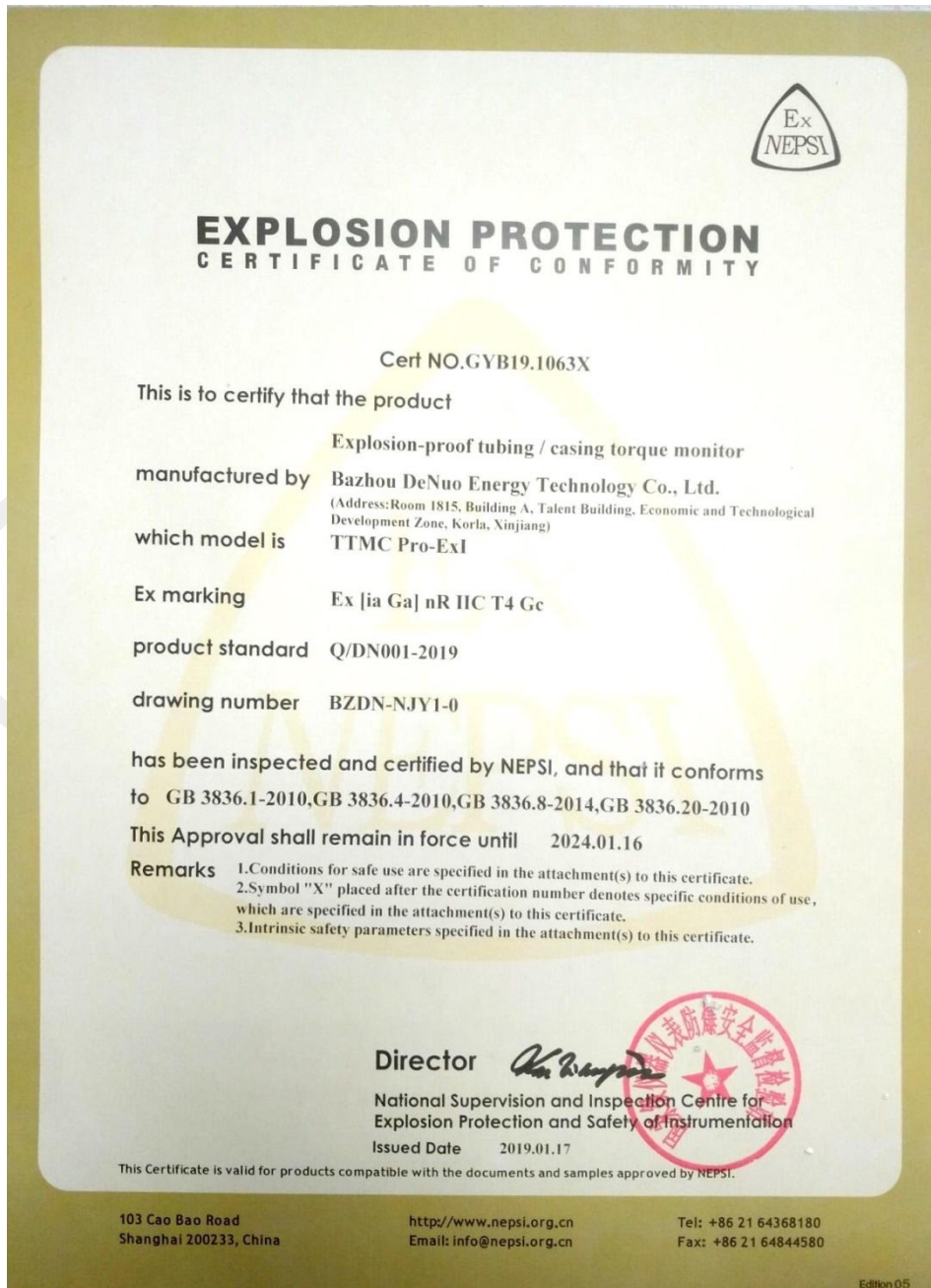


Figure 3 Explosion-proof Certificate

Sheet of the Measuring Range and Allowable Error

| Name | Measuring Range | Allowable Error | Note |
|----------------------------|-----------------|-----------------|------|
| Torque transmitter (KN) | 0—120 | ≤0.5%FS | |
| Turns Sensor(turn) | 0—100 | ±0.02 | |
| Speed (rpm) | 0-90 | ≤1% | |

The setting of explosion-proof host machine:

- a. Explosion-proof aluminum-alloy machine; Dual-core CPU / 4G memory, Windows 7 operating system.
- b. Dual channels for signal acquisition, one for use and the other for backup.
- c. Host power 86-264VAC 50/60Hz
- d. Wide temperature TFT LCD 10.4 industrial display, tempered glass protection.
- e. Standard 256G military wide temperature solid state drive (optional).
- f. Stainless steel integrated explosion-proof keyboard.
- g. Power control output 24V 1A.
- h. 2 USB connections.

1.2 Tension/Pressure Sensor

- a. Tension torque sensor

Measuring Range : 0 ~ 120kN

Precision : 0.1%

Power voltage : 12-24VDC

Output signal : 4 ~ 20 mA (three-wires system)

- b. Pressure (disc) torque transmitter

Measuring Range : 0 ~ 80KN

Precision : 0.1%

Power voltage : 12-24VDC

Output signal : 4 ~ 20 mA (three-wire system 三线制)

1.3 Turns Sensor

Power voltage : 12VDC

Detection distance : 6mm±10%

Frequency response : 2000Hz

Output form: NPN NO

Protection structure: Oil and vibration resistant, water and explosion proof

1.4 The Application Environment of Host Machine

a. Temperature:

Host Machine : -20°C~50°C

Torque Sensor : -20°C~60°C

Turn Sensor : -20°C~60°C

b. relative humidity ≤ 90%RH(non-condensing)

c. Power : 100-240VAC 50/60Hz

2. Operating Principles and Main Functions

2.1 Operating Principles

a. Torque measurement principle: If the friction between the clamp head and the caliper body and the acceleration of the upper buckle angle are ignored, the upper buckle torque value of the casing pipe is equal to the product of the hydraulic tongs tension and the hydraulic caliper arm's length.

The measuring torque sensor is connected to the hydraulic clamp tail rope, and the tension of the clamp tail rope measured during the buckle process, is converted into an electrical signal output. This signal is collected by the computer and multiplied by the length of the hydraulic clamp arm to obtain the upper buckle torque value.

b. Turns Measuring principles

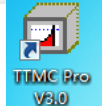
Proximity switch turn sensors are measured with proximity switches. The sensor is mounted on the side of the hydraulic clamp. In the low gear, the teeth which the large ring gear rotated will be sensed by the sensor. And then output the pulse corresponding to it.

2.2 Main Functions

- 1) Real-time display of the oil and casing pipes make-up torque curve changed with the number of turns or time, to control the make-up to achieve the best torque.
- 2) Four measurement methods are available, torque-time, torque-turns, torque-turns-speed, torque-turns-change rate.
- 3) Two kinds of operation control methods are provided, namely: manual and automatic.
- 4) Measurement data and graphics can be saved manually and automatically.
- 5) Report editing and data graphics playback functions.
- 6) Provide printout function for data reports and curve graphs.
- 7) Display the parameters such as the cumulative length of the well casing, the make-up time and date etc.
- 8) Provide integrated Chinese, English, metric, and imperial measurement and control software.

3. Introduction of the Software Function

3.1 The Main Interface of Software

Double-click this icon on the computer desktop: , and then the main interface (figure 5) and all the important controlling components and unique features are displayed in this framework.

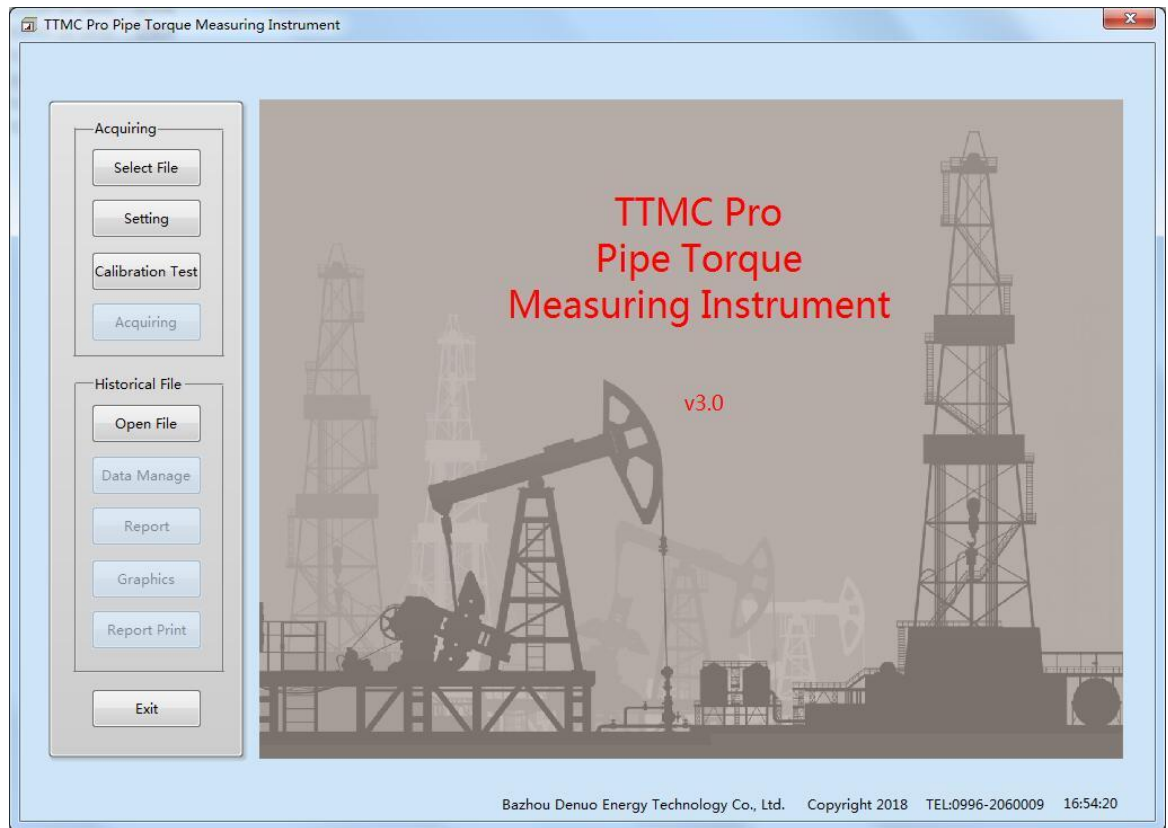


Figure 5 the main interface

Menu of the main interface:

| Main Interface | Button/Items | Description |
|----------------------|------------------|--|
| Acquiring Menu | Select File | Create a new file or open an existing data file |
| | Setting | Edit the operation items and relevant data |
| | Calibration Test | Calibrate torque zero and pulse number test |
| | Acquiring | Enter the measurement and control interface for real-time measurement and control torque |
| Historical File Menu | Open File | Read the existing data file |
| | Data Manage | Edit the information of first page of the report |
| | Report | Read, edit, and print the data file |
| | Graphics | Read, edit, and print the graphics file |
| | Report Print | print all the data files |

3.2 Select File

Create a new work item or open an existing data file.

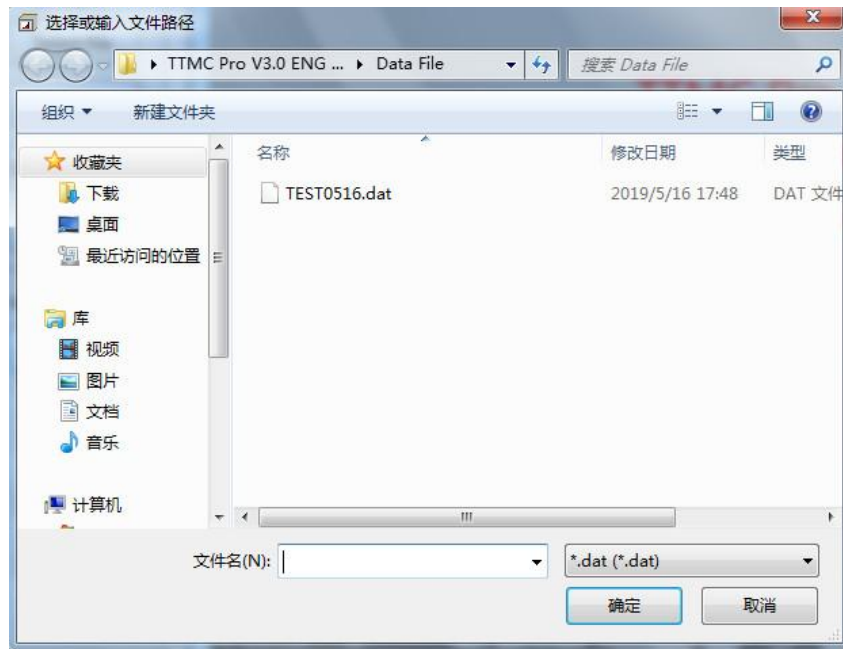


Figure 6 Select file dialog

3.3 Parameters Setting

Input all the data required by the operation, including manage details, pipe details, graph parameter, technical parameters etc.

① Manage details:

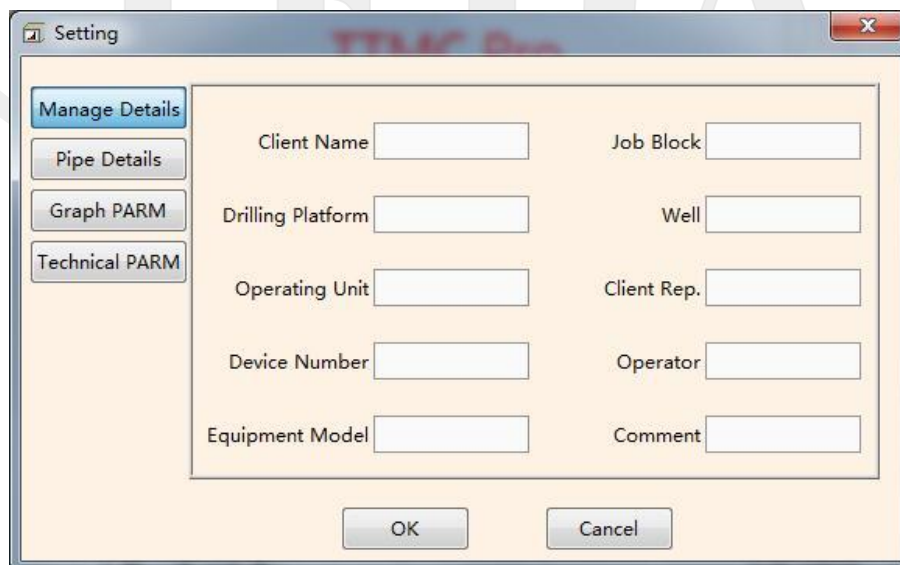


Figure 7 Manage details

Input the general information into the Manage details including the job block and operator information. This data can be displayed on the first page of the

report, which can be printed both by Chinese and English.

- Client Name: The name of the client.
- Drilling Platform: The name of the drilling platform.
- Operating Unit: The name of the operating company.
- Device Number: The Number of the device.
- Equipment Model: The model of the used equipment.
- Job Block: The block that the job belongs to.
- Well: The well number of the operating well.
- Client Rep.: The name of the client representative
- Operator: The name of the operator.
- Comment: Comments input.

② Pipe Details

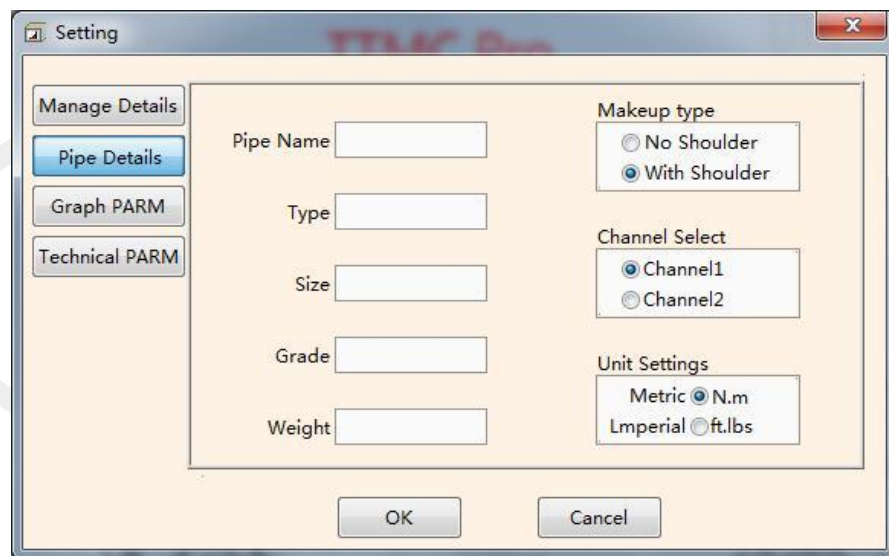


Figure 8 Pipe Details

In this tab, fill in the general information of the pipe, and the information will be displayed in the data information area on the left side of the real-time monitoring and controlling interface.

- Pipe Name: The name of the pipe.
- Type: The type of the pipe(required).
- Size: The size or OD of the pipe(required).

- Grade: The grade or quality of the pipe(required).
- Weight: The thickness or weight of the pipe(required).
- Makeup type: No shoulder - common type ; With shoulder - special type . If the no shoulder is selected, it means that the maximum shoulder and the minimum shoulder mark lines are turned off, as well as the shoulder inflection point detection function is turned off. If select the with shoulder, it is reversed.
- Channel select: to select the measuring channel, if the line is connected to the channel 1, then select the channel 1.
- Unit settings: torque unit select, Metric N.m, Imperial ft.lb.

③ Graph Parameters

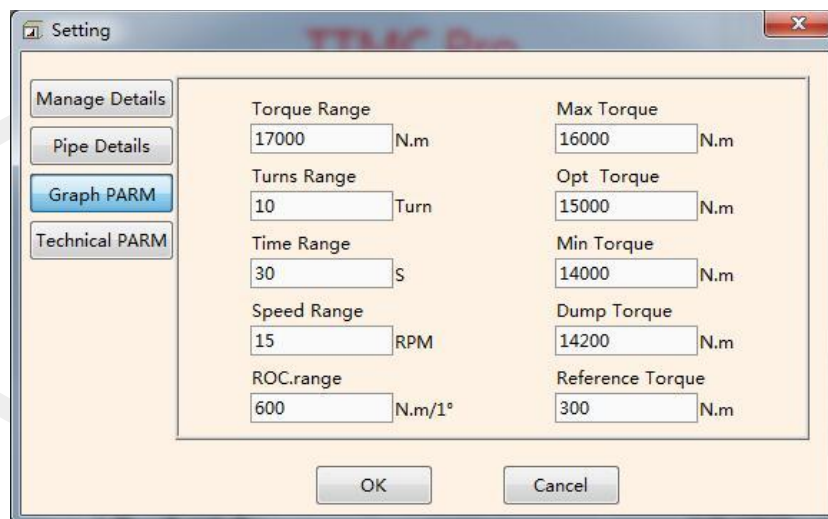


Figure 9 Graph Parameter

Fill in the technical data of the graphics in this tab.

Torque Range:The range of the torque vertical axis, requirements: > maximum torque.

Turns Range: The range of the ordinate axis of the turns, requires: > 0. The value is an integer and cannot have a decimal point.

During operation, if the makeup turns of one single

pipe exceeds the set turns range, the software will automatically add 5 turns to achieve the integrity of the recorded curve. After the curve is saved, the coordinate value is restored to the original setting value.

Time Range: The range of the horizontal time axis, requires: > 0 . The value must be a multiple number of 5.

During operation, if the makeup time of one single pipe exceeds the set time range, the software will automatically add 10 seconds to the time range to achieve the integrity of the recorded curve. After the curve is saved, the coordinate value will be restored to the original set value.

Speed Range: The range of values for turns per minute, (required).
Requirements: > 0

ROC. Range: Axis value range of the slope of the torque change, (required). Requirements: > 0 .

It is recommended to set it to 1/15 to 1/20 of "Best Torque".

Max Torque: The maximum acceptable makeup torque (required).

Opt Torque: The best makeup torque value (required), requirements: \leq maximum torque, \geq minimum torque.

Min Torque: The minimum acceptable makeup torque(required), requirements: \leq optimal torque, $>$ reference torque.

Dump Torque: Automatic dump torque, (required), required: \leq optimal torque.

Reference Torque: The reference value of the torque, record when the torque exceeds this value.

④ Technical Parameters

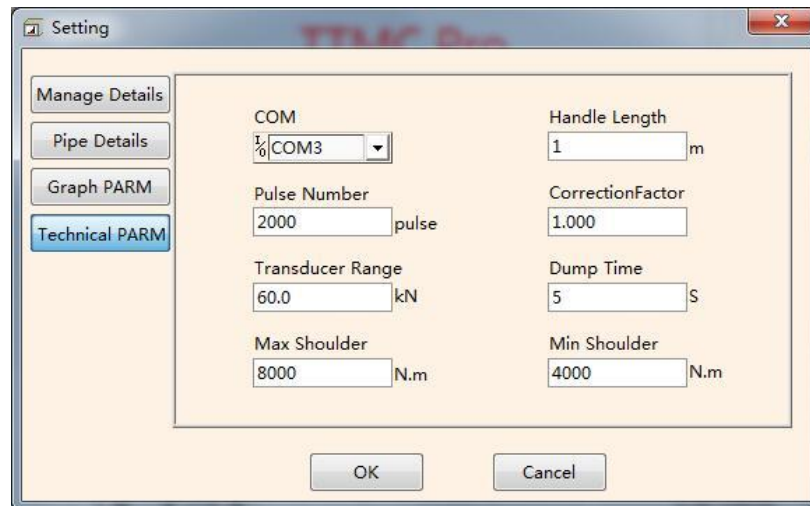


Figure10 Setting parameters

This tab fills in the relevant technical parameters.

COM: The port selection of the acquisition card, the default connection before leaving the factory is **COM1** port.

Pulse Number: The pulse number is the number of gear pulses per one revolution of the hydraulic clamp, and is also the reference value of the number of turns; this value is measured at the “calibration interface”.

Transducer Range: The rated range of the sensor (required). (input the range of the connected sensor).

Handle Length: The length of the hydraulic clamp arm(required) , must be filled in accurately. The filling error will affect the accuracy of the torque output.

Correction Factor: The correction coefficient is multiplied by the measured torque to obtain the actual make-up torque, and is mainly used to correct the torque measurement error caused by the deviation of the clamp tail rope and the thread oil. In general, the "correction factor" value is set to 1.000. (required)

Dump Time: The duration of outputting the dump signals to cut off the hydraulic power, can select the integer value of 1 to 5 seconds. In general, customers are advised to use 2 seconds. (required)

Max Shoulder: The maximum allowable with shoulder torque. This parameter is designed for the with shoulder, only shows the green marking and green areas in the recording graphic with shoulder oil and casing pipe. **If set to 0, the corresponding line is not displayed.**

Min Shoulder: The minimum allowable with shoulder torque. This parameter is designed for the with shoulder, only shows the green marking and green areas in the recording graphic with shoulder oil and casing pipe. **If set to 0, the corresponding line is not displayed.**

⑤ Save the parameters

After entering or selecting the parameters in the four groups of tabs, click the "confirm" button to save all the input parameters in this article.

Click the "Cancel" button to discard the parameters .



注意

Once the first makeup record is saved, when you change the unit (metric, imperial), the TTMC Pro will not calculate the value of the previously saved settings (such as the casing data).

3.4 Calibration Test

Calibrate the torque zero and test turn pulse signals (see Figure 11).

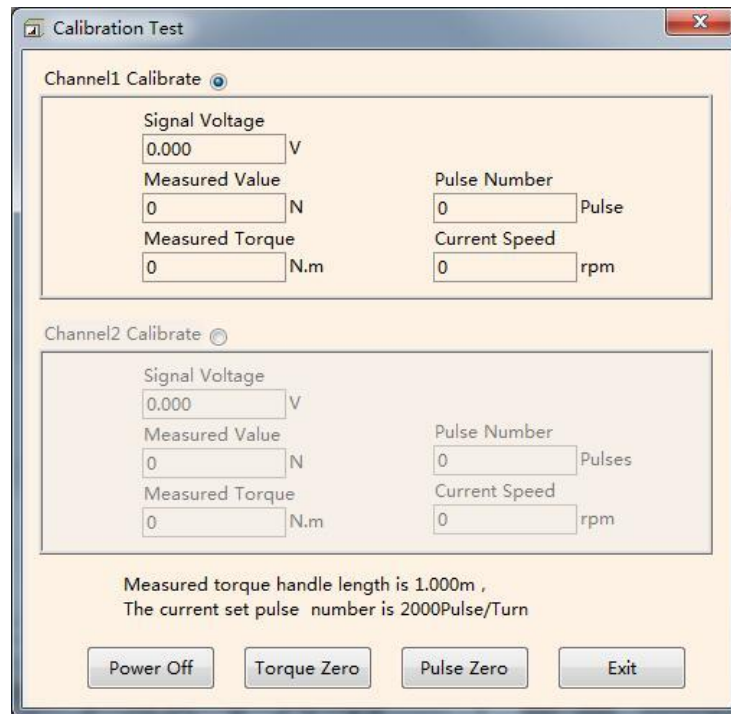


Figure11 Calibration Test Window

The calibration test function is used to calibrate the torque zero point of each channel, calibrate the torque value, measure the number of pulses output of the turn sensor, and also check the installation connection of the instrument and whether the torque, number of turns and control channels are normal or not.

(1) The interface provides four function buttons:

a. Power off: Used to test 1#, 2# control channels. During the rotation of the hydraulic tongs, click the “Power Off” button to cut off the power of the hydraulic caliper and stop it.

b. Torque Zero: Used to calibrate the torque zero of the torque sensor.

c. Pulse clear: to clear the selected turn channel (1# or 2#).

d. Exit: Exit the test function and return to the main interface. When exiting the “Calibration Test” function, if a torque zero calibration is performed, the system will prompt to save the new torque zero point.

(2) The interface provides four channels to measure data.

Torque channel calibration (1# channel, 2# channel) and turn channel test (1# channel, 2# channel). Use mouse to click the checkbox, the corresponding measurement channel is activated, and the values of each parameter in the frame are displayed continuously.

The torque channel calibration shows three parameters:

- a. Signal voltage: Show the collected torque signal voltage value. The signal voltage value without load is about "1.000V".
- b. Actual force value: Display the tension value of tension sensor, and the unit is "N". Click the "Torque Zero" button and the display value will return to zero, which is 0.00kN.
- c. Actual measured torque: Calculate the torque value according to the actual sensor range and clamp arm length, and multiply by the correction factor to correct. This value is the actual measured torque. The unit is N.m. Click the "Torque Zero" button and the display value will return to zero, which is 0N.m.a.
- d. The measured length of the clamp arm is indicated in the label.

The turn channel test shows two parameters:

- a. Pulse number: The number of pulses output by the cumulative turn sensor. This value can be cleared by clicking the Pulse Clear button.
- b. Clamp speed: The current speed of the hydraulic clamp, in rpm (rev / min).

(3) Calibration torque zero point

After the instrument is installed and before entering the measurement and control state, the torque zero point should be checked first. Set the calibration test function to the torque measurement function. Under the condition that the sensor is not under the force, check if the "measured force value" and "measured torque" are zero. If the offset is large, click the "Calibrate Zero" button to recalibrate the torque zero. After the calibration zero point is executed, the system prompts whether to save the new torque zero point when exiting the "Calibration Test" function. Select "OK" to save the new zero point, select "Cancel" to use the original torque zero.

For the pulse number of proximity switch turn sensor, it can be measured by the makeup or the idle hydraulic clamp. Mark on the casing or hydraulic clamp, and when the hydraulic clamp rotates one revolution. the number of pulses displayed in the pulse counting window is the number of pulses of the sensor. You can enter this value into the "Pulse number" parameter of the "Set Parameters"

tab. In order to improve the measurement accuracy, it is also possible to rotate a few more turns, and the average number of pulses per revolution is the number of pulses of the sensor.

3.5 Acquiring

After calibrating the torque zero point, enter the real-time measurement and control interface to acquire the data.

Before entering the measurement and control, pop-up setting parameter confirmation interface, and carefully check that all the setting parameter information is right without any error before and then enter the measurement and control interface. **If the graphic parameter data is not logically filled, the system will red the error data to prompt (see Figure 12).**

Tip: Confirmation interface (Figure 12) can only used to view the set parameters and cannot be modified. If you need to modify the parameters, you must enter the “Set Parameters” function.

Before entering real-time measurement and control, select the measurement method, which is divided into four types:

1. Torque-time
2. Torque - number of turns
3. Torque - number of turns - speed
4. Torque - number of turns - rate of change

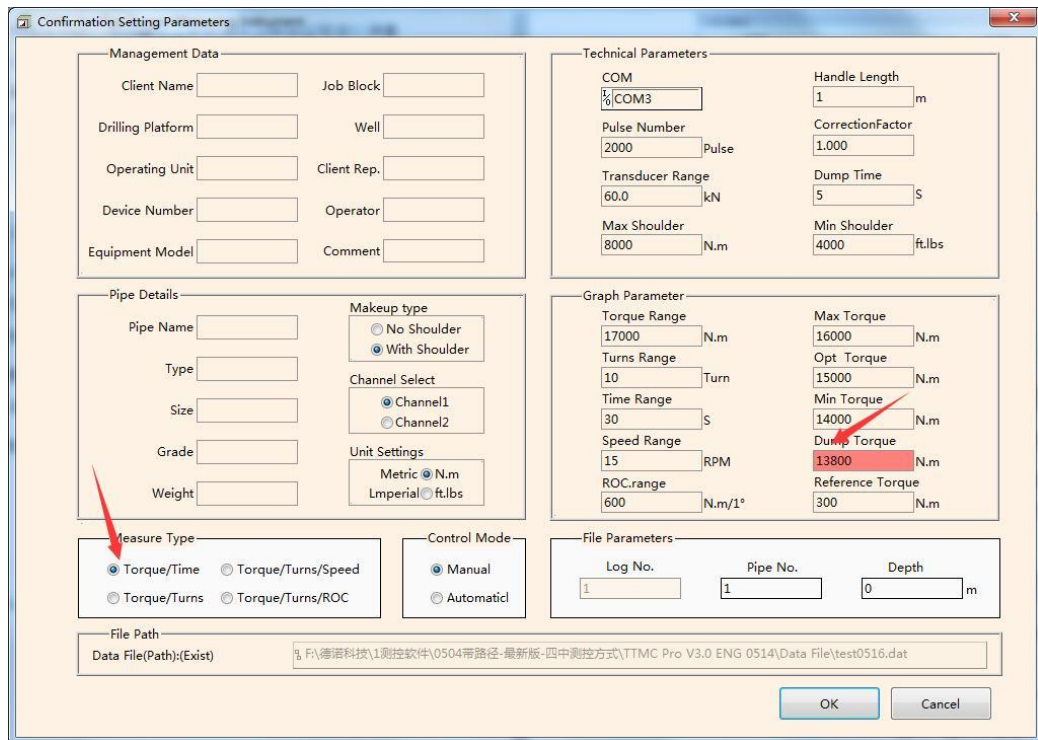


Figure12 Confirmation interface of setting parameters

If it is found that the data bar turns red, you do not return to the setting parameter interface to reset this parameter and insist on setting this value, then click the “OK” button, a prompt dialog box will pop up (see Figure 13), click “OK” to enter the real-time measurement and control interface.

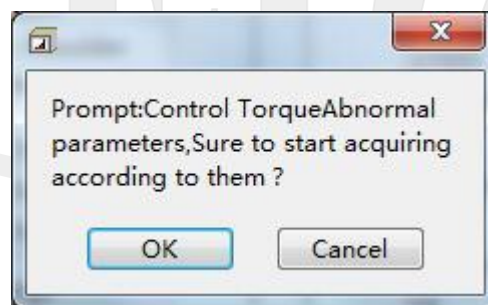


Figure 13 Prompt Dialogue

Real-time measurement and control interface:

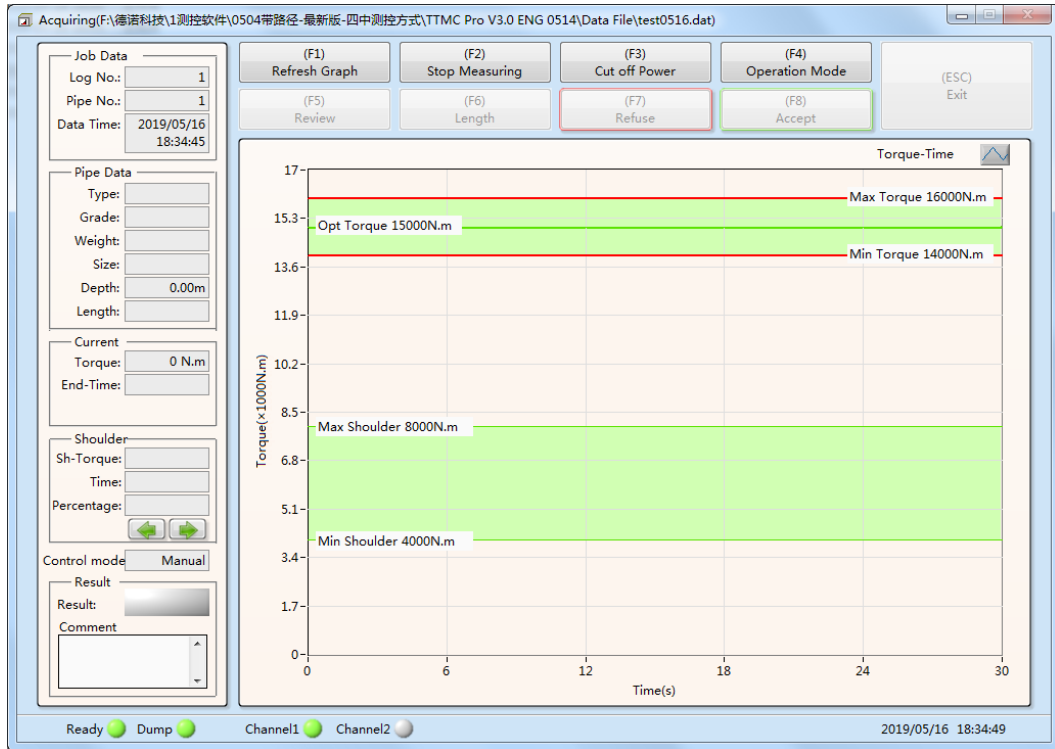


Figure 14 Real-time measurement and control interface

Real-time measurement and control interface button description:





| interface | button/item | Description |
|-------------|---------------------|--|
| Button/item | (F1) Refresh Graph | Clear the currently displayed torque curve data. If the curve reaches the unloading torque and the makeup is finished, the graph is not saved, click “Refresh Graph” button to enter the next monitoring page. |
| | (F2) Stop Measuring | |
| | (F3) Cut off Power | Manually unload the power clamp |
| | (F4) Operation Mode | |
| | (F5) Review | |
| | (F6) Length | |
| | (F7) Refuse | |
| | (F8) Accept | |
| | (ESC) Exit | |

F1 Refresh graph Clear the currently displayed torque curve data. If the curve reaches the unloading torque and the makeup is finished, the graph is not saved, click “Refresh Graph” button to enter the next monitoring page.

F2 Stop Measuring Stop the current curve record, activate the “View Graph” and “Exit” buttons , click the “View Graph” to view or click the “Exit” button to exit the software directly; or click the “Refresh Graph” button to continue monitoring.

F3 Cut off power Manually unload the power clamp

- pressure.
- F4 operation mode Choose automatic and manual mode.
This button is locked during the makeup process and can't be used.
- F5 Review View the current working data graph curve.
- F6 Pipe length Input the length of the single pipe
- F7 Refuse Save the current non-qualified torque curve
- F8 Accept Save the current torque curve.
- ESC Exit Exit the present measuring interface.

Status indicators     2018/12/07 11:40:21

- Ready Software Status Green: Ready, Red: Not Ready
- Dump Pressure relief valve status Green: Off, Red: On
- Channel 1 Channel selection Green: Use current channel, grey: The current channel is not used.
- Channel 2 Channel selection Green: Use current channel, grey: The current channel is not used.

Left information bar Job data Display pipe recording time

Technical data Display the technical parameters of the current pipe

Real-time Display the current torque and end time or end turn for real-time monitoring.

shoulder **The real-time shoulder information is displayed. Due to the complicated working conditions of the field, the position of the shoulder may be biased during the measurement and control of the instrument, it is allowed to perform correction by the customer. Use the mouse to press the ←, → keys to move the shoulder cross cursor left and right to correct it to the correct position. During the movement, the displayed shoulder**

torque and the number of shoulder turns will change accordingly.

Results

The software automatically evaluates the makeup curve. After the torque curve reaches the optimal torque cutoff power, it automatically changes from gray to green. If you click the “qualified makeup” button, the word “OK” is automatically added in the green column. If you click “ failed makeup”,it automatically changes to the "red" box and the word "failure" appears (see the figure below).

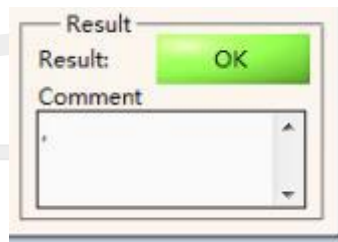


Figure 15 Results

In the real-time measurement and control interface, in order to prevent on-site misoperation to make sure the safety of makeup, a protection mechanism is written on the lower computer's measurement and control board. For example, after the power is turned off, the graphics are not saved in time or the software loses the signal, but the wellhead operator continues makeup operation while the torque already reaches the set value,the measuring board will send a discharge power signal to ensure that the thread is not damaged.

3.6 Four Measuring Methods

1. Torque-time

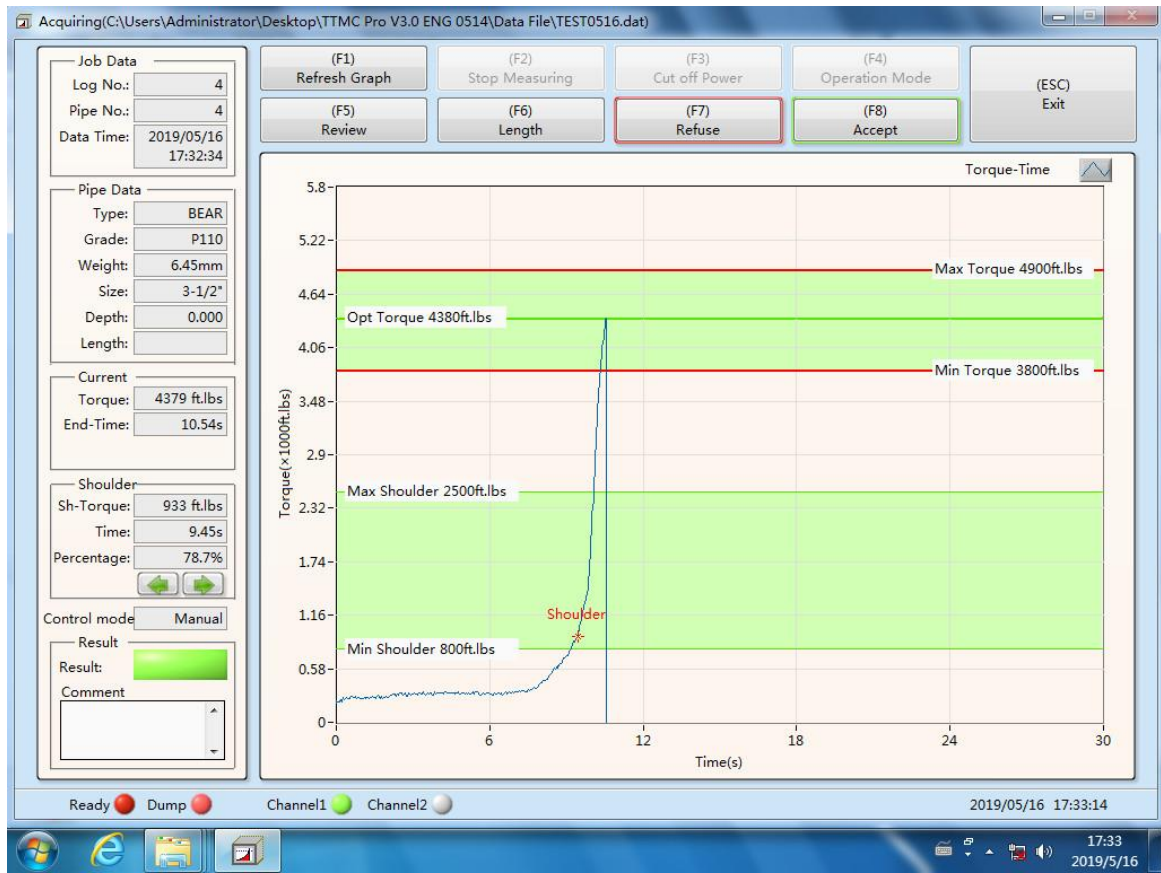


Figure16 Torque-time real-time measuring curve

2. Torque-turns

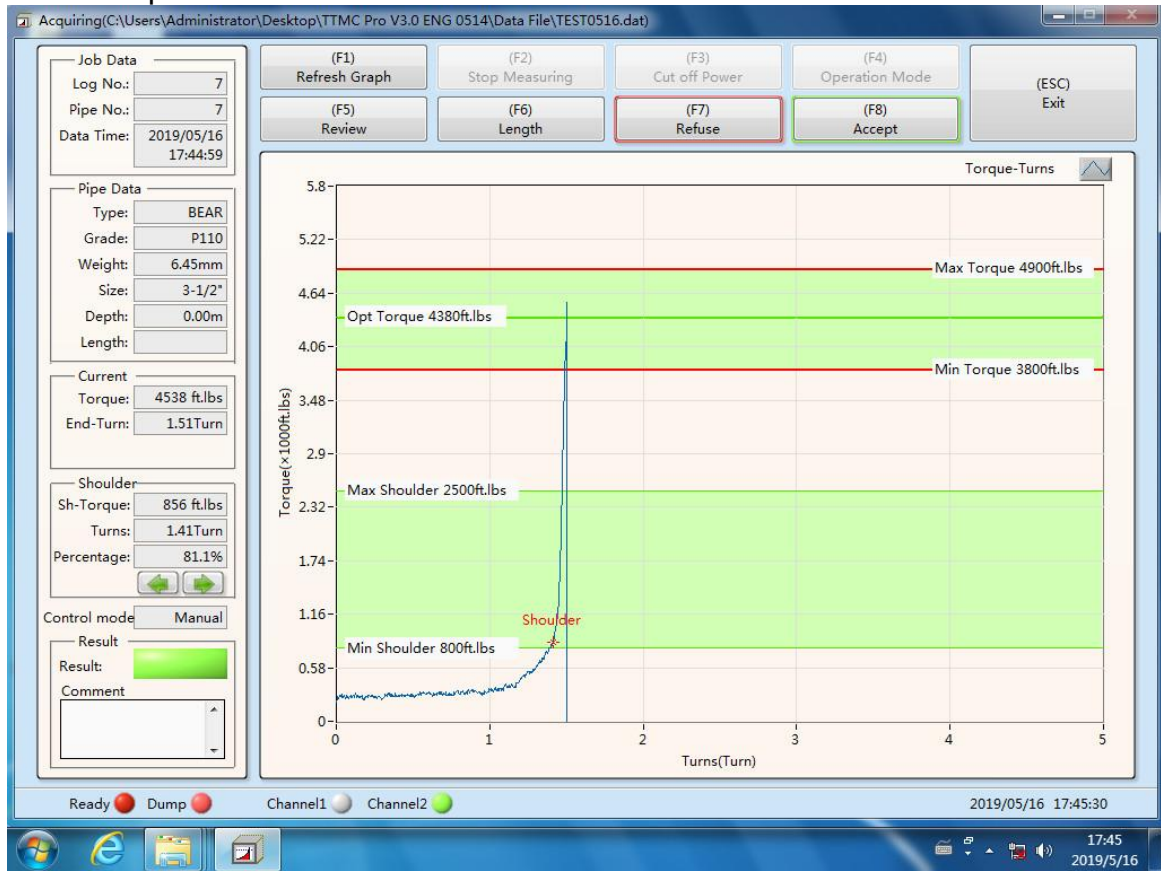


Figure 17 Torque-turns real-time measuring curve

3. Torque-turns-Speed

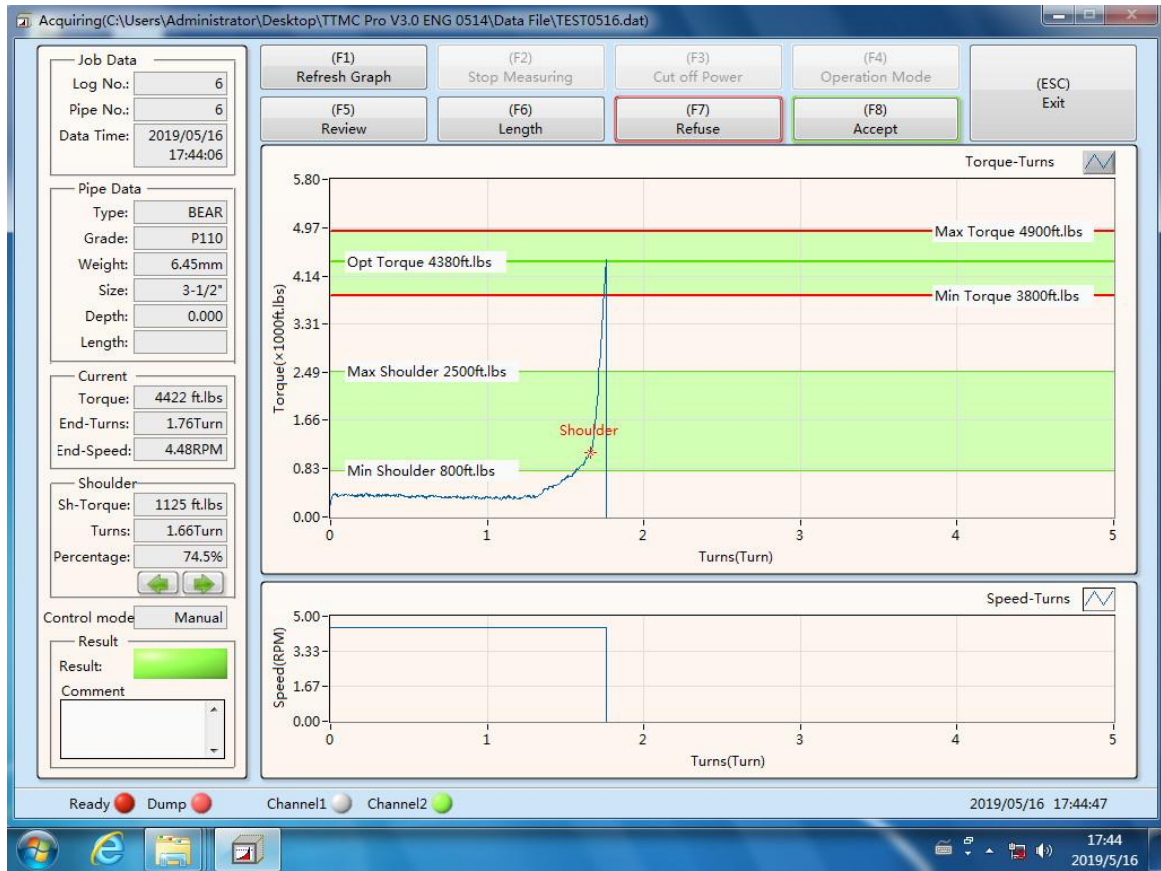


Figure 18 3.Torque-turns-Speed Real-time measuring curve

4. Torque-turns-ROC

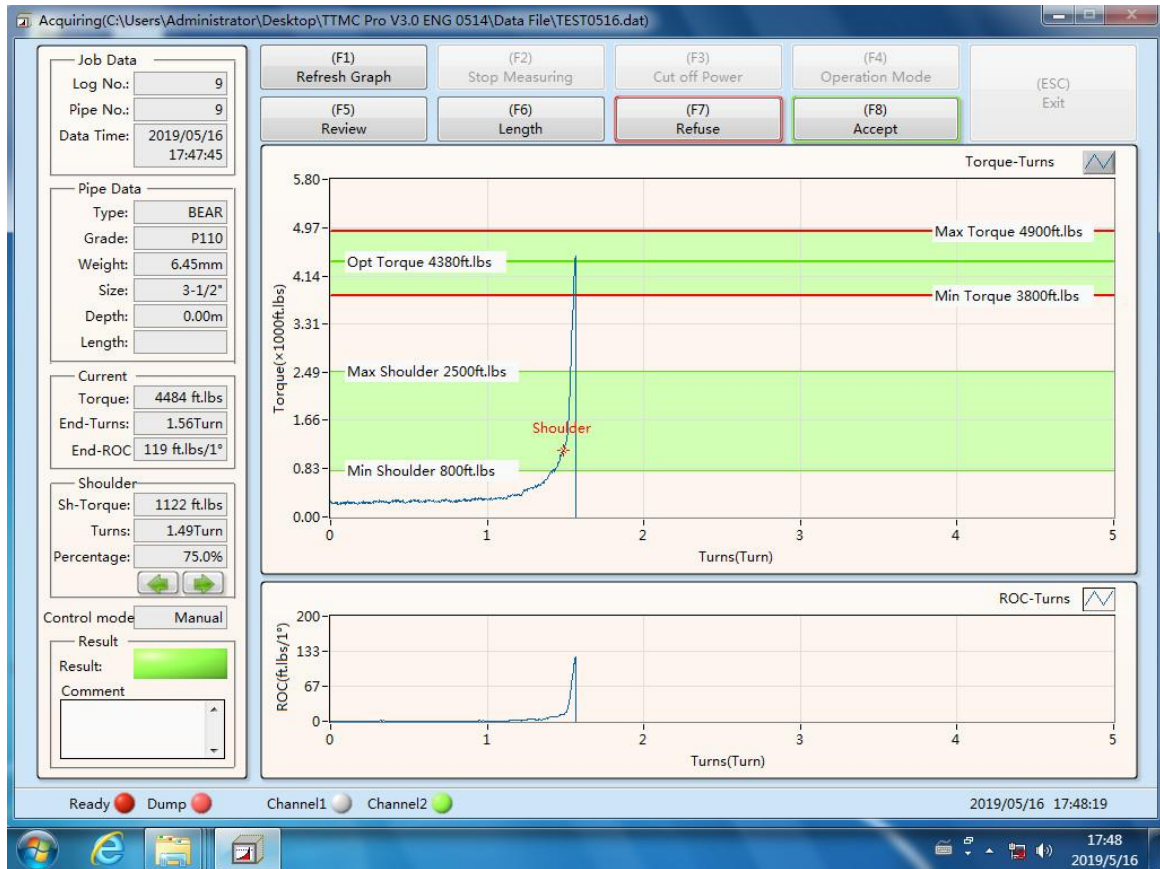


Figure19 Torque-turns-ROC real-time curve

3.7 Historical File Menu

1. Open the file and open the existing data file (see Figure 20):

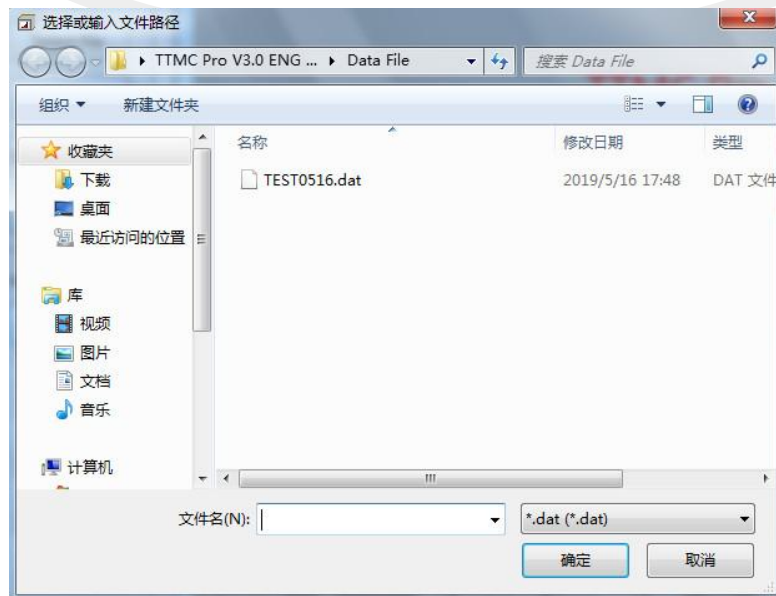
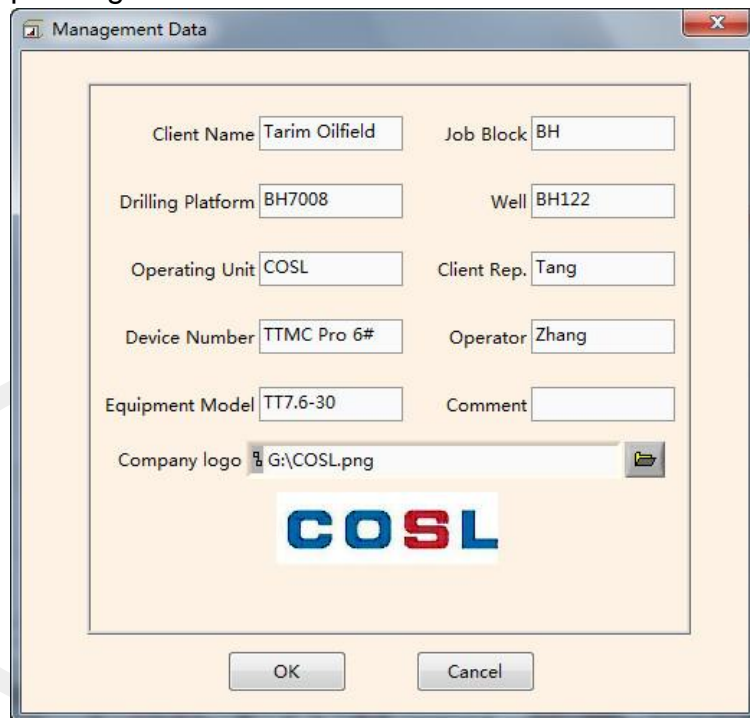


Figure 20 Historical file menu-open file window

2. Management Data

This item is to edit the home page parameters of the printed report. You can choose to add or change the company logo image and display it on the front page of the entire report file (see Figure 21). Select the data file, click the “Management Data” button, and the system will read the management data information saved in the data file ,then displayed in the management data form. If the operator does not enter management data information before saving the first graphic while doing the job, the corresponding text box is blank.



The screenshot shows a window titled "Management Data" with the following fields:

| | | | |
|-------------------|----------------|-------------|-------|
| Client Name | Tarim Oilfield | Job Block | BH |
| Drilling Platform | BH7008 | Well | BH122 |
| Operating Unit | COSL | Client Rep. | Tang |
| Device Number | TTMC Pro 6# | Operator | Zhang |
| Equipment Model | TT7.6-30 | Comment | |
| Company logo | G:\COSL.png | | |

Below the fields is a preview of the COSL logo. At the bottom of the window are "OK" and "Cancel" buttons.

Figure 21 Management data window

3.Data Report

Data report interface, edit data report file (see the figure below).

Form Display(C:\Users\Administrator\Desktop\FIMC Pro V3.0 ENG 0514\Data File\TEST0516.dat)

| Job Time | Log No. | Pipe No. | Pipe Length (m) | Accumulate Depth (m) | Final Torque (ft.lbs) | Final Turns (Turn) | Final Time (s) | Shoulder Torque (ft.lbs) | Shoulder Time (s) | Rate of change (ft.lbs/1°) | Resu |
|---------------------|---------|----------|-----------------|----------------------|-----------------------|--------------------|----------------|--------------------------|-------------------|----------------------------|------|
| 2019-05-16 17:29:54 | 1 | 1 | 0.000 | 0.000 | 4818 | 10.87 | | 938 | 9.59 | | Acce |
| 17:31:50 | 2 | 2 | 0.000 | 0.000 | 4680 | 11.15 | | 1006 | 9.81 | | Acce |
| 17:32:34 | 3 | 3 | 0.000 | 0.000 | 4367 | 10.71 | | 877 | 9.39 | | Acce |
| 17:33:28 | 4 | 4 | 0.000 | 0.000 | 4379 | 10.54 | | 933 | 9.45 | | Acce |
| 17:44:06 | 5 | 5 | 0.000 | 0.000 | 4162 | 1.70 | | 1026 | 1.60 | | Acce |
| 17:44:52 | 6 | 6 | 0.000 | 0.000 | 4422 | 1.76 | | 1125 | 1.66 | | Acce |
| 17:45:37 | 7 | 7 | 0.000 | 0.000 | 4538 | 1.51 | | 856 | 1.41 | | Acce |
| 17:47:39 | 8 | 8 | 0.000 | 0.000 | 4666 | 1.63 | | 959 | 1.51 | | Acce |
| 17:48:24 | 9 | 9 | 0.000 | 0.000 | 4484 | 1.56 | | 1122 | 1.49 | | Acce |

Left Panel: Edit Length (checkbox), Pipe No. (1), Pipe Length (0 m), Import Length, Save. Select Function: Delete Record, Save As, Export Excel, Print, Exit.

Figure 22 Data report interface

Description:

Edit Length: Select this box to input the length. After inputting, press Enter button to enter the next number.

Import Length: Save the file after importing it through a dedicated template without input the single length manually.

Save: Save the file after entering the length or importing the length. .

Delete Record: Double-click to select any row of data that needs to be deleted. After clicking Delete, the serial number is automatically accumulated. (You must "save as" other files after deletion, the original file cannot be saved)

Save as: Generate and create new data files. After deleting the data, it must be saved as another file, and the original file has no permission to change. The default file name is "****Copy". During the process of generating a new file, the deleted records in the data list are automatically deleted, and the record number and the casing number are rearranged in

natural order.

Export Excel: Export the entire report to an excel format file.

Data print: Print the entire data report as a PDF file.

Exit: Exit the report display interface.

5. Graphic Display

Display the graphic data, edit and print(see the below figure).

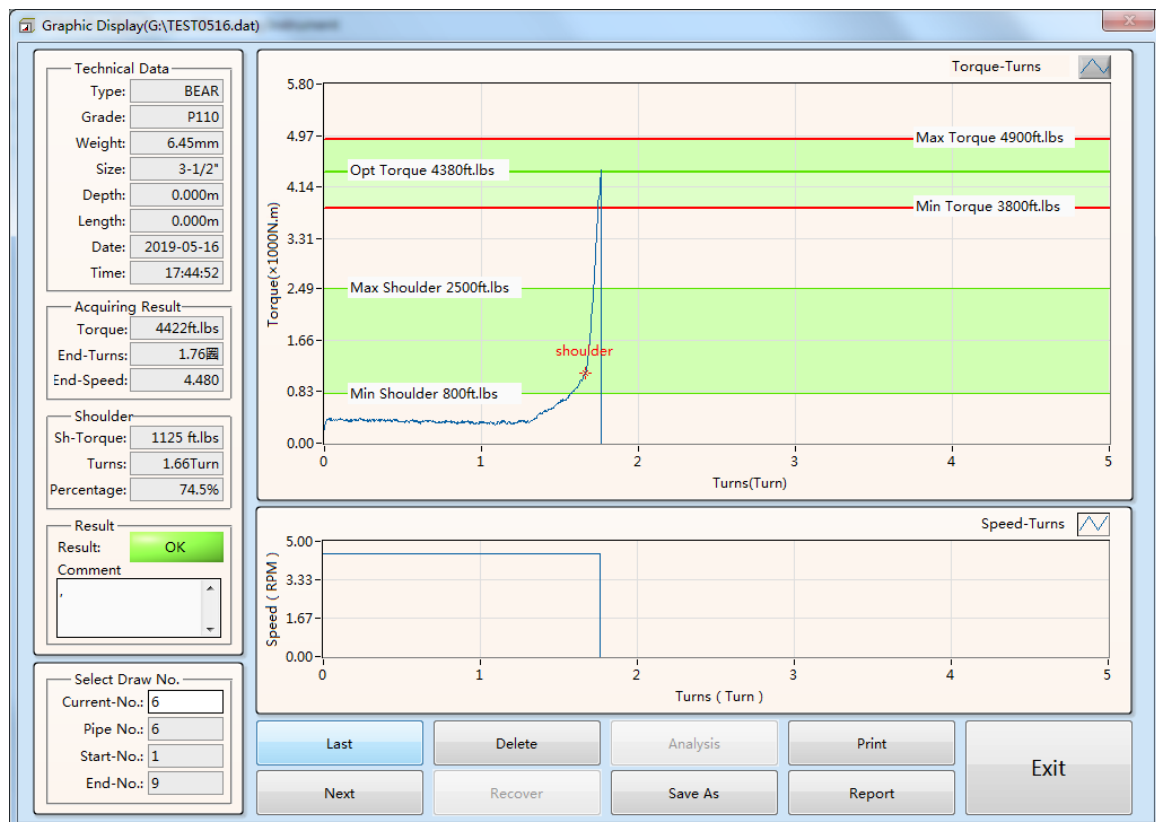


Figure 23 5.Graphic Display Interface

Function key description:

Last: Display the previous graphic of the current drawing.

Next: Display the next graphic of the current drawing.

Delete: Delete the current graphic. After deleting, you must "save as" other files. The graphic serial number automatically changes.

Recover: Recover deleted graphics.

Analysis: This feature is for the subsequent development modules.

Save As: Save as the graphic after deleting . The default file name is "**** copy"

Print: Print the currently displayed graphic in PDF format.

Report : Pop up the dialog window to select the print range and print all or part of the graphic.

Exit: Exit the graphic display interface.

6.Report Print

Print all data files of the current file as standard version of the job report, including management data, torque parameters, data reports, graphic display, save format is PDF.

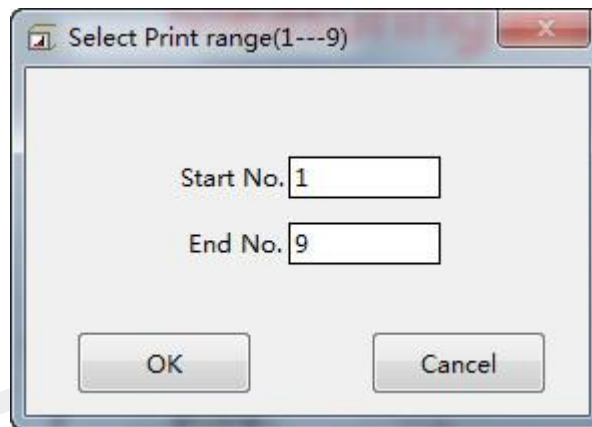


Figure 24 print selection window

The print range selection window appears (Figure 24), select the start number and default number, and click “Confirm” to print the report.

The printed report consists of three parts: the report home page, the data report, and the job report. The first part shows the contents of the Manage Parameters in the Setting Parameters interface (see Figure 25).

Work Report

Well :

Job Block :

Creation time : 2019-05-16 17:29:54

End-Time : 2019-05-16 17:47:39

Operator :

Client Name :

Client Rep :

Drilling Platform :

Comment :

Figure 25 the front page of the report

The second part is shown as a data report for the data file (see Figure 26).

Data Form

| Job Time | Log No. | Pipe No. | Pipe Length (m) | Accumulate Depth (m) | Final Torque (ft.lbs) | Final Turns (Turn) | Final Time (s) | Shoulder Torque (ft.lbs) | Shoulder Time (s) | Rate of change (ft.lbs/1") | Result | Comment |
|------------|---------|----------|-----------------|----------------------|-----------------------|--------------------|----------------|--------------------------|-------------------|----------------------------|--------|---------|
| 2019-05-16 | | | | | | | | | | | | |
| 17:29:54 | 1 | 1 | 0.000 | 0.000 | 4818 | 10.87 | | 938 | 9.59 | | Accept | |
| 17:31:50 | 2 | 2 | 0.000 | 0.000 | 4680 | 11.15 | | 1006 | 9.81 | | Accept | |
| 17:32:34 | 3 | 3 | 0.000 | 0.000 | 4367 | 10.71 | | 877 | 9.39 | | Accept | |
| 17:33:28 | 4 | 4 | 0.000 | 0.000 | 4379 | 10.54 | | 933 | 9.45 | | Accept | |
| 17:44:06 | 5 | 5 | 0.000 | 0.000 | 4162 | 1.70 | | 1026 | 1.60 | | Accept | |
| 17:44:52 | 6 | 6 | 0.000 | 0.000 | 4422 | 1.76 | | 1125 | 1.66 | | Accept | |
| 17:45:37 | 7 | 7 | 0.000 | 0.000 | 4538 | 1.51 | | 856 | 1.41 | | Accept | |
| 17:47:39 | 8 | 8 | 0.000 | 0.000 | 4666 | 1.63 | | 959 | 1.51 | | Accept | |

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Figure 26 Data Form

The third part is displayed as the “Graphic Parameters” and the corresponding torque graph in the “Setting Parameters” option. If there are multiple graphic parameters under the data file, they will be displayed in order (see Figure 27).

Job Report

Pipe Parameter Info

Number:1

Name:

Type:BEAR

Size:3-1/2"

Grade:P110

Weight:6.45mm

Torque Range

Max Torque:4900ft.lbs

Opt Torque:4380ft.lbs

Dump Torque:4200ft.lbs

Min Torque:3800ft.lbs

Reference Torque:200ft.lbs

Max Shoulder Torque:2500ft.lbs

Min Shoulder Torque:800ft.lbs

Figure 27 Job report- graph parameters information



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Figure 28 graph curves

4. Peripheral accessories

4.1 Signal line

The signal line and power control line adopt the German imported LAPPKABEL brand cable. The inner copper tinned shielding layer has a braiding density of more than 85%. It is equipped with American military standard alloy aviation plugs and protective caps. It is excellent in acid and alkali resistance, as well as cold and oil resistance to provide customers with stable signal transmission in different harsh field environments. (See below)



Figure 29 Signal lines

4.2 Torque Transmitter

It adopts aerospace-grade torque transmitter, fully sealed structure, wide measuring range, stable and reliable performance, easy to install and use.

| Main Technical Parameters | | |
|---------------------------|-------------|------|
| Measuring Range | 0~120 | KN |
| Output sensitivity | 1.5~2.0 | mV/V |
| Straightness L | ±0.05; ±0.1 | %F.S |
| Lagged H | ±0.05; ±0.1 | %F.S |
| Repetitive R | ±0.05; ±0.1 | %F.S |
| Working temperature | -35~+80 | °C |



Figure 30 Pull torque transmitter



Figure 31 Disc torque transmitter

4.3Turns Sensor

Features:

1. The thread is made of stainless steel chrome plating, which is high in strength and more durable;
2. Shielded sense amplifiers have a larger sensing distance than normal models, effectively protecting the probes from damage;
3. According to the different equipment used, the length of the polished rod is reserved at the front end of the screw to improve the practicality at the rig;
4. It is equipped with American military standard aviation plugs and protective caps to effectively protect seawater and salt spray.



Figure 32 Turn Sensors

4.4 Stainless Steel Explosion-proof Keyboard



Figure 33 Stainless Steel Explosion-proof Keyboard

The stainless steel explosion-proof keyboard is IP65 dust-proof and waterproof, anti-corrosion, explosion-proof, and can work normally under harsh environment;

Electrical parameters:

Working voltage: DC +5V +/- 5%

Working current: $\approx 30\text{mA}$

Environmental adaptability:

Working temperature: $-20\text{ }^{\circ}\text{C}$ to $+60\text{ }^{\circ}\text{C}$

Storage temperature: $-30\text{ }^{\circ}\text{C}$ to $70\text{ }^{\circ}\text{C}$

Relative humidity: 100%

4.5 Ground Clamp



Figure 34 Ground Clamp

5. Troubleshooting

5.1 TTMC Pro software can not start or shuts down immediately after startup

If the TTMC Pro monitoring software crashes before closing, or does not exit properly, this program may have an program running in the background, although the program window has been closed. This will cause the software to fail to start or shut down immediately after start-up.

If this error occurs, press the [Ctrl]-[Shift]-[Delete] keys to call up the Task Manager.



Select the "TTMC Pro v3.0.exe" task and click on "End Process".



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