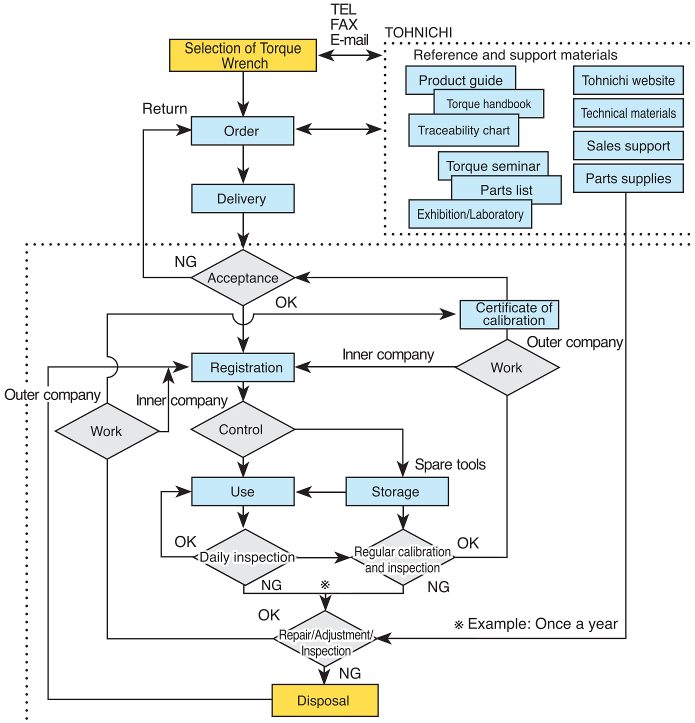
6-1. Torque Tools are Measurement Equipment

(1) Control of torque tools

The process for controlling torque tools (Figure 6-1) involves ascertaining the accuracy by adequately checking the measurement of the tools upon reception at the facility and on a daily basis. The decision of how to set up the process for the control should assess the following factors: importance, usage frequency, and usage torque capacity of the measuring instruments, by referring to the ISO standards (ISO 6789), JIS standards (JIS B 4652), and the manufacturer's nominal accuracies. The periodic calibration cycle depends on the same factors, but normally this is set between 3 months and a year. If possible this cycle should be readjusted as the tool ages to allow more effective control.

Figure 6-1. Control system for torque tools



(2) Calibration of torque tools

Because torque is expressed as Torque = Force x Length, it is required that the reference standard used in the calibration should use weights for the force and a scale or calipers for the length. The reference standard being used as the standard for testing other torque tools should be three times more accurate than the item being tested. Therefore, to calibrate a torque tool with a 1% accuracy rating, a better than ±0.3% rated reference standard must be used. The reference standard must then be periodically calibrated by an official organization to maintain their accuracy and traceability.

6-2. Traceability

(1) Traceability system

Torque can be resolved into length by the force. As the units of length and force are approved by official calibration laboratory respectively, the traceability is obtained through these units.

We invite you to use Tohnichi tools for your ISO 9000 torque control systems.
Tohnichi is producing a wide variety of torque tools based on the traceability system (Figure 6-2). Services, such as calibration and repair, are very important and necessary factors in the control process. All of these services required for internal company controls of torque tools, such as inspection sheets, calibration certificates, and traceability charts (Figure 6-3), are available upon request. Use the Traceability Issue Request forms from Tohnichi agents and included with the general product information for such traceability requests.

Figure 6-2. Traceability of Tohnichi products

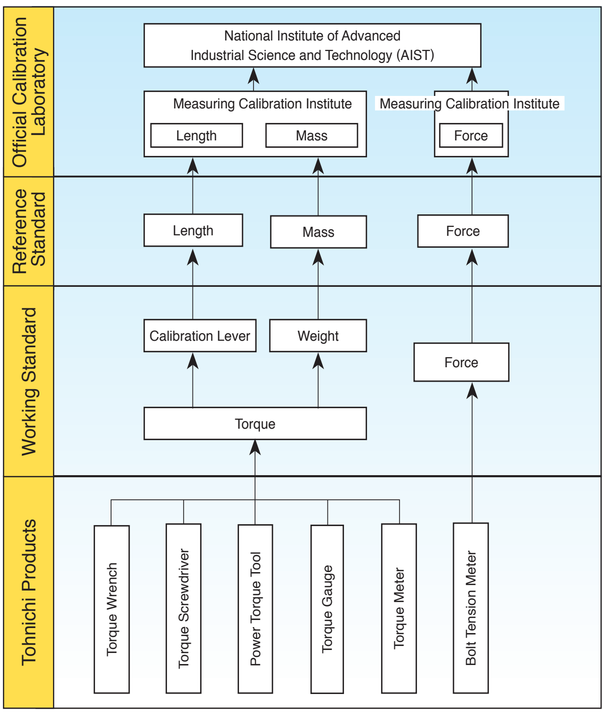
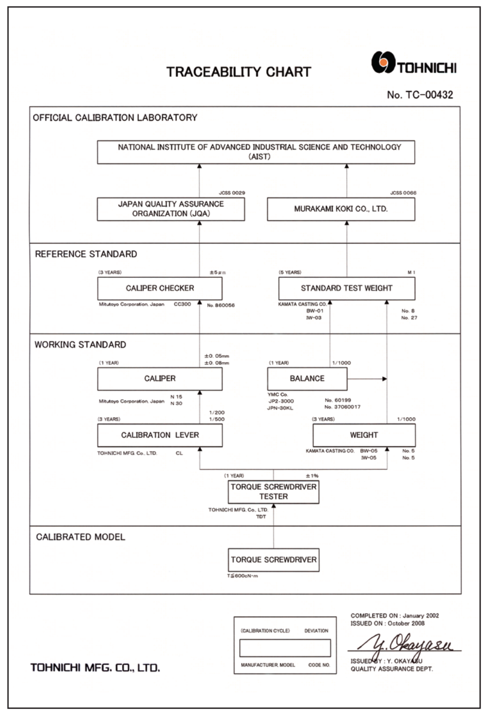


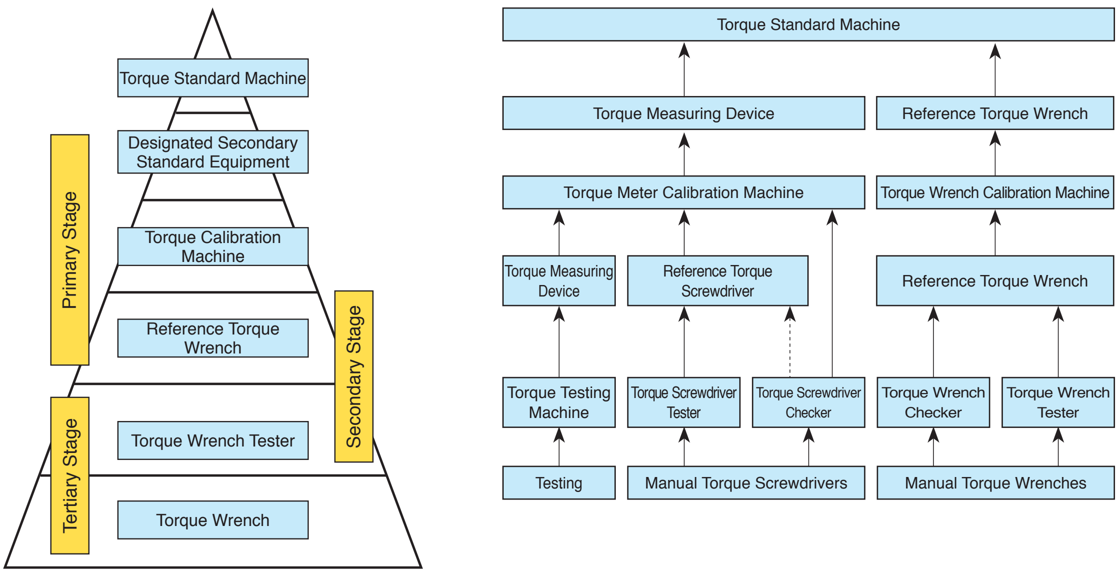
Figure 6-3. Traceability chart



(2) Movement to adopt new national torque standard traceability system

In order to secure traceability system using torque SI units, the establishment of calibration methods using national torque standards is quickening worldwide. In Japan, a supply system using national torque standards has been prepared, in which “torque meters” that measure pure torsion are already being supplied in a range of 5 N·m to 20 kN·m, and “reference torque wrenches” that occupy the top standard of torque wrench testers are being provided in a range of 5 N·m to 1kN·m. Items from the technical requirement application principles to the torque level structure for torque meters and reference torque wrenches disclosed by independent administrative company product evaluation framework organizations are as shown in the figure 6-4.

Figure 6-4. New Traceability System Diagram



Designated standard equipment (Torque standard Machine) · · · Equipment designated as the national standard that realizes the torque units.

Designated secondary standard equipment (Reference torque wrench) · · · · · · · · · · · Reference torque wrench calibrated using the designated standard equipment.In addition to realizing the reference standards relating to the calibration company's torque, this is used for maintenance and control of calibration equipment.

Working standard (Torgue wrench calibration Machine) · · · · · · · · · · · · · · · This is an actual loading type, load cell type, or build-up type torque wrench standard tool used for direct comparison calibration of the reference torque wrench, the calibration equipment, by the primary stage calibration company.

Regular reference standard (Reference torque wrench) · · · · · · · · · · · Among the torque measurement equipment, this indicates a tool with a torque wrench shaped sensor part (torque converter) provided with a lever that certainly conveys the torque together with the side force and bending moment.

Torque wrench tester · · · · · · · · · · · · This is a tool for calibrating (or testing) torque wrenches, and is equipment that realizes torque using a torque loading device. It is used for calibrating reference torque wrenches to higher standards.

Using these, through the establishing of a torque supply system by JCSS, a traceability system for torque will be established similar to that for other units.
However, outside the torque ranges provided, local calibration will be required using [Force x Length = Torque] (Assembly unit) as before. In addition, because the level provided by JCSS is only up to the secondary level, it will basically only cover up to torque wrench testers and torque screwdriver testers.
It is expected that torque wrenches and torque screwdrivers will be transferred and have their calibration based on the JIS B 4652 standard as described below.

Establishment of Hand Torque Tools - Requirements and Test Methods (JIS B 4652) Standard

Following the progress in establishing the torque supply system described above, it was required to prepare standards for manual torque tools because the contents of the previously used JIS B 4650 standard for manual torque wrenches mainly gave stipulations regarding torque wrench product specifications, resulting in the following problems:

1) The standard only covered torque wrenches, with no stipulations for torque screwdrivers.
2) There were many specifications relating to manufacturing according to models and materials, and the method of calibration was unclear.
3) The standards had not been agreed to conform with international standards.

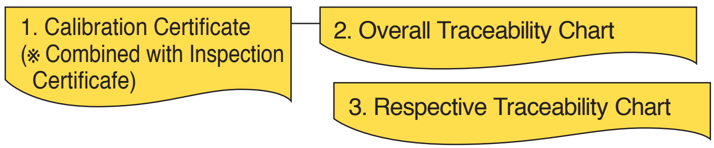
Here, the international standard ISO 6789: 2003 (Assembly tools for screws and nuts. Hand torque tools. Requirements and test methods for design conformance testing, quality conformance testing and recalibration procedure) was translated and submitted by the Japan Measuring Instruments Federation as the Japanese industrial standards, and this was established as JIS B 4652 on April 20, 2008.

(3) ISO 9000-related documents

Torque equipment is also required to be controlled, calibrated and have traceability with national standards as a measurement instrument according to ISO 9000.

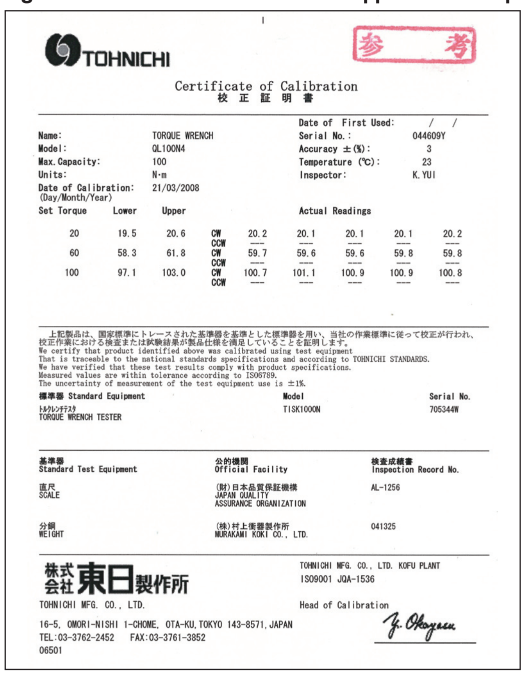
Tohnichi provides customers who have acquired and are maintaining ISO 9000 certification with the required documents shown in Figure 6-5. The documents available are as follows.

Figure 6-5. ISO 9000-related documents issued by Tohnichi



Tohnichi has been providing a documentation service related to ISO 9000 accreditation since 1991. In general, the documents required for accreditation are the inspection certificate and the calibration certificate. However, upon the customer's request, we also issue a traceability chart. Further, calibration certificates are provided with torque wrenches. Tohnichi stores the histories of these issued documents for the request period for customers, and helps them maintain their ISO 9000 certification.

Figure 6-5. Certificate of calibration supplied with torque wrenches



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参　考

Certificate of Calibration
校　正　証　明　書

		Date of First Used:	/ /
Name:	TORQUE WRENCH	Serial No.:	044609Y
Model:	QL100N4	Accuracy ±(%):	3
Max.Capacity:	100	Temperature (℃):	23
Units:	N·m	Inspector:	K.YUI
Date of Calibration: (Day/Month/Year)	21/03/2008		

Set Torque	Lower	Upper		Actual Readings				
20	19.5	20.6	CW	20.2	20.1	20.1	20.1	20.2
			CCW	---	---	---	---	---
60	58.3	61.8	CW	59.7	59.6	59.6	59.8	59.8
			CCW	---	---	---	---	---
100	97.1	103.0	CW	100.7	101.1	100.9	100.9	100.8
			CCW	---	---	---	---	---

上記製品は、国家標準にトレースされた基準器を基準とした標準器を用い、当社の作業標準に従って校正が行われ、校正作業における検査または試験結果が製品仕様を満足していることを証明します。
We certify that product identified above was calibrated using test equipment
That is traceable to the national standards specifications and according to TOHNICHI STANDARDS.
We have verified that these test results comply with product specifications.
Measured values are within tolerance according to ISO6789.
The uncertainty of measurement of the test equipment use is ±1%.

標準器 Standard Equipment	Model	Serial No.
ﾄﾙｸﾚﾝﾁﾃｽﾀ TORQUE WRENCH TESTER	TISK1000N	705344W

基準器 Standard Test Equipment	公的機関 Official Facility	検査成績書 Inspection Record No.
直尺 SCALE	(財)日本品質保証機構 JAPAN QUALITY ASSURANCE ORGANIZATION	AL-1256
分銅 WEIGHT	(株)村上衡器製作所 MURAKAMI KOKI CO., LTD.	041325

株式会社東日製作所
TOHNICHI MFG. CO., LTD.
16-5, OMORI-NISHI 1-CHOME, OTA-KU, TOKYO 143-8571, JAPAN
TEL:03-3762-2452　FAX:03-3761-3852
06501

TOHNICHI MFG. CO., LTD. KOFU PLANT
ISO9001 JQA-1536
Head of Calibration
Y. Okayasu

6-3. Accuracy and Uncertainty

(1) Accuracy

Accuracy is the overall favorable condition including the correctness and precision of values shown by measuring equipment or measurement results. Further, correctness is the condition where there is little deviation, while precision is the condition where there is little dispersion.

Accuracy = Deviation + Dispersion

Deviation: In graduated torque measuring devices, this is the difference between the graduated values and the measured values. In torque measuring devices without graduation (preset type), this is the difference between the set torque value and the measured torque value.

Dispersion: The standard for the dispersion is taken as 2σ or 3σ.

Figure 6-6. Relation between deviation and dispersion

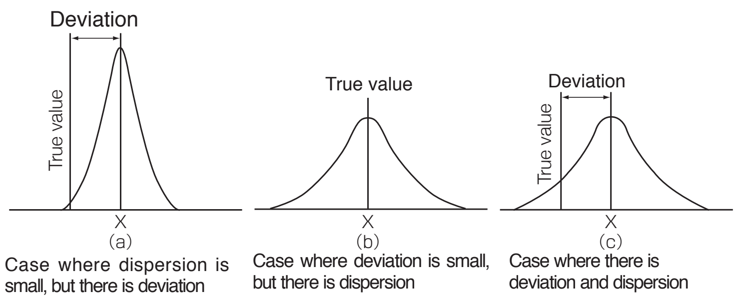


Figure 6-7

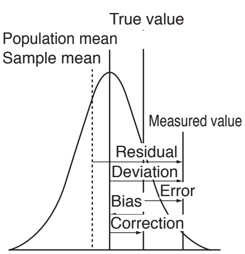


Table 6-1. Glossary of terms used in measurement (Extracted from JIS Z 8103, Glossary of terms used in measurement)

Term	Definition
True value	Value consistent with the definition of a given particular quantity. (refer to Figure 6-7) Remarks: Excluding particular cases, this is an ideal value it is unattainable practically.
Measured value	That value which has been obtained by a measurement. (refer to Figure 6-7)
Error	That value subtracted by the true value from a measured value. (refer to Figure 6-7) Remarks: The ratio of an error to the true value is called the relative error. However, in the case where it is not liable to be confused, it may also be called simply an error.
Bias	A subtracted value of population mean of measured value by a true value. (refer to Figure 6-7)
Deviation	A subtracted value by population mean from a measured value. (refer to Figure 6-7)
Residual	A subtracted value by sample mean from a measured value. (refer to Figure 6-7)
Correction	Value added algebraically to the uncorrected result of a measurement to compensate for systematic error. (refer to Figure 6-7) Remarks 1: The correction is equal to the negative of the estimated systematic error. 2: The ratio of the correction to the read out value or calculated value is called the correction rate, and the value of correction rate expressed in percentage is called the correction percentage. 3: For the purpose of compensating the presumable systematic error, the factor to be multiplied to the measured result before correction is called the correction factor.
Dispersion	Unevenness of the magnitudes of measured values. Otherwise, the degree of irregularity. Remarks: In order to express the magnitude of dispersion, for example a term of “standard deviation” is used.

(2) Uncertainty

Without assuming the conventional concept of the true value (which is generally unknown), the uncertainty is obtained from the data dispersion (already known) in the data range, using the measured results themselves. (P.75 Figure 6-6) The methods of evaluating uncertainty are classified under the following two types:

(1) **Evaluation method by statistical analysis from a series of measured values.**
(Uncertainty type A)

(2) **Evaluation method by a means other than statistical analysis from a series of measured values.**
(Uncertainty type B)

Further, for both of type A and type B, the standard uncertainties and the standard deviations (or similar values) are estimated from the normal distribution, rectangular distribution and trapezoid distribution. Finally, these are combined by the propagation rule of errors. (The combined standard uncertainty)
Under these procedures, the overall uncertainty is indicated as the Extended Uncertainty.

Table 6-8. Factors for uncertainty in general measurements

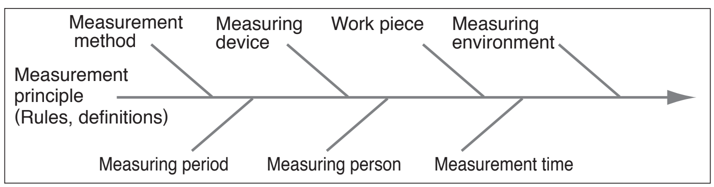


Table 6-9. Uncertainty

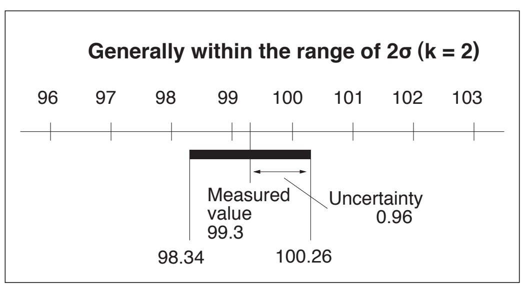
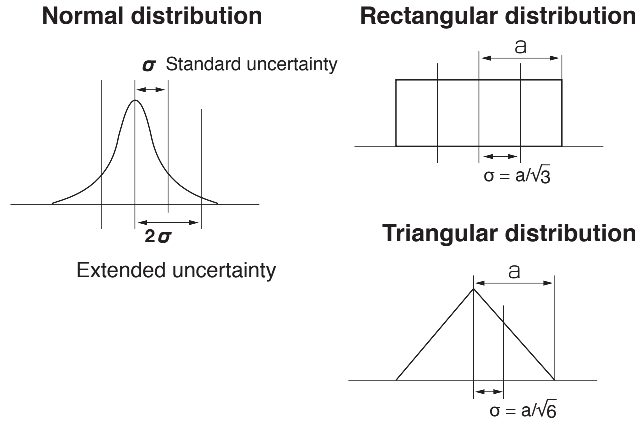


Table 6-10. How to estimate the uncertainty



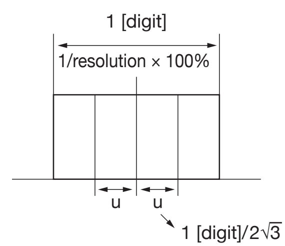
In normal distribution, σ (standard error) equals the standard uncertainty and generally, 2σ equals the extended uncertainty. In rectangular distribution, dividing the half width of distribution (a) by √3 equals the extended uncertainty (a/√3). In triangular distribution, dividing the half width of distribution by √6 equals the standard uncertainty (a/√6).

Table 6-11. Example of estimating the uncertainty from the rectangular distribution

Resolution of digital display

Uncertainty for 1 [digit] (Udigit)
Resolution Nmin at Tmin
Udigit = 1/(Nmin × 2√3) ×100%
1/resolution × 100%

Nmin	Udigit
100	0.29%
200	0.14%
400	0.07%



To obtain the resolution of a digital display for the uncertainty of 1 [digit], dividing 0.5 [digit] (half the width of 1 [digit]) by √3 equals the standard uncertainty (1 [digit]/2√3). For example, if the resolution (Nmin) using the minimum torque capacity (Tmin) is taken as 100, 1 [digit] equals 1% and the uncertainty of its resolution (Udigit) equals 0.29%.

(3) Analysis procedure for uncertainty in measurements

(1) **Setting the method of measurement and calibration. (Describe the procedure concisely.) Describe the principles and measuring methods, measuring devices and instruments concisely.**

(2) **Construction of the mathematical model (Write the formulas or state the principal factors.)**

a) Describe the formulas if they can express the uncertainty.

b) If the uncertainty cannot be expressed by numerical formulas, indicate the factors of the uncertainties and combine them by adding.

c) Execute the test of significance through experiments based upon the design of experiments and factor analysis. Then estimate the uncertainties of each factor.

(3) **Correction of values (Describe the correction items and the methods, if any.) If corrections are made, the estimation of uncertainties should be carried out after the data correction.**

(4) **Analysis and estimation of uncertainty elements (Including type A and type B classification) Point out and classify the uncertainty elements, and estimate the standard deviation (or similar values) per element as follows:**

a) Uncertainty of standard. (Described as the standard uncertainty.)

b) The uncertainty compared to the standard. Uncertainty resulting from factors such as the calibration equipment, calibration environment, calibration period, work piece, etc. (Described in the standard uncertainty; show the basis of the method of determination).

(5) **Calculation of combined standard uncertainty (Square root of sum of squares)**

$$uc = \left(\sum_{i=1}^{n} ui^2\right)^{1/2} = \sqrt{u1^2 + u2^2 + \cdots un^2}$$

(The apparent differences between type A and type B will disappear.)

(6) **Calculation of extended uncertainty**

$$U = k \cdot uc$$

k: Coverage factor

(Generally, k = 2 is taken. If not, describe the reason for this.)

(4) Example of uncertainty

1) **Theoretical formula**

Torque [N·m] = Mass of dead weight [kg] x Gravitational acceleration [m/s²] x Effective length of calibration lever L [mm]

2) **Hypothetical models**

- Torque calibration kit DOTCL100N
- Torque wrench tester DOTE100N

3) **Uncertainty of calibration of torque wrench tester**

- Extended uncertainty of torque calibration kit: UIA
- Extended uncertainty of torque calibration work: UIB
- Extended uncertainty of measured torque: UIT ($UIT^2 = UIA^2 + UIB^2$)
- Extended uncertainty of torque wrench tester: UC
- Extended uncertainty of calibration of torque wrench tester: UT ($UT^2 = UIT^2 + UC^2$)

4) **Uncertainty of torque calibration kit**

Factors	Standard uncertainty
· Mass (standard dead weight)	0.0004%
· Mass for measurement	0.01%
· Gravitational acceleration	0.005%
(∗Refer to P. 23, "Acceleration of gravity")	
· Corrections of specific gravity	0.015%
· Vertical/horizontal conversion	0.014%

Combined standard uncertainty for force

$$uf = \sqrt{0.0004^2 + 0.01^2 + 0.005^2 + 0.015^2 + 0.014^2} = 0.023\%$$

Factors	Standard uncertainty
· Scale (calibration)	0.006%
· Length of lever (process tolerance)	0.02%
· Diameter of wire	0.02%
· Elongation of lever	0.014%

Combined standard uncertainty of length of lever

$$ul = \sqrt{0.006^2 + 0.02^2 + 0.02^2 + 0.014^2} = 0.032\%$$

Combined standard uncertainty of torque calibration kit

$$ua = \sqrt{uf^2 + ul^2} = \sqrt{0.023^2 + 0.032^2} = 0.04\%$$

Extended standard uncertainty of torque calibration kit (k = 2);

$$UIA = 2 \times ua = 0.08\%$$

Chapter 6-3 Torque Tools are Measurement Equipment

5) **Uncertainty of torque calibration**

Factors	Standard uncertainty
· Horizontality of wire	0.06%
· Inclination of lever (horizontality)	0.06%
· Length of lever (angle of drive)	0.03%
· Newton conversion	0.03%
· Repeated uncertainty	0.1%

Combined standard uncertainty of torque calibration work:

$$ub = \sqrt{0.06^2 + 0.06^2 + 0.03^2 + 0.03^2 + 0.1^2} = 0.14\%$$

Extended uncertainty of torque calibration work:

$$UIB = 2 \times ub = 0.28\%$$

Extended uncertainty of calibration torque:

$$UIA = \sqrt{UIA^2 + UIB^2} = 0.29\%$$

6) **Uncertainty of calibration of torque wrench tester**

Factors	Standard uncertainty
· Resolution of torque wrench tester (zero point)	0.06%
· Resolution of torque wrench tester (display)	0.06%
· Friction of axis bearing area	0.005%
· Uncertainty of gauge	0.14%
· Uncertainty of display	0.14%

Combined standard uncertainty of torque wrench tester:

$$uc = \sqrt{0.06^2 + 0.06^2 + 0.005^2 + 0.14^2 + 0.14^2} = 0.22\%$$

Extended uncertainty of torque wrench tester:

$$UC = 2 \times uc = 0.44\%$$

Extended uncertainty of calibration of torque wrench tester:

$$UT = \sqrt{UIT^2 + UC^2} = 0.52\%$$

7) **Traceability of torque tools**

The extended uncertainty of the torque wrench tester is required to be below ±1% (k = 2).
The extended uncertainty of the torque of the torque calibration kit should be below ±0.3% (k = 2).
Therefore, the standard uncertainty of the calibration kit is expected to be below 0.15%.
Each standard uncertainty of inferior characteristics that is below 0.015% can be ignored.

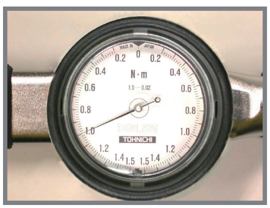
(5) Accuracy of torque tools

Situation where calibration of a torque wrench or torque screwdriver is being carried out using a measuring instrument.
Match the indicated value on the index of the graduated scale of the measuring instrument being calibrated with the measuring point, and read the numbers on the measuring instrument.

$$A_s\,(\%) = \frac{(\chi_a - \chi_r)}{\chi_r} \times 100$$

As (%): Torque tool deviation measured value
χ_a: Torque tool indicated value
χ_r: Reference value (Determined using the calibration equipment)

Torque tool deviation = $\dfrac{\text{Torque tool indicated value – Reference value (Calibration equipment)}}{\text{Reference value (Calibration equipment)}}$ x 100



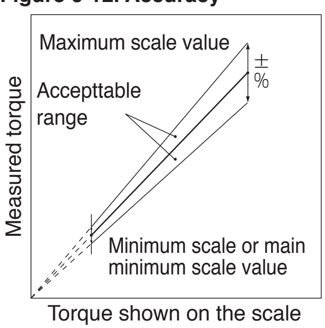
Torque tool indicated value

Reference value (Calibration equipment)

Calculation example **As (%) χ_a = 100 χ_r = 104**

$$A_s = \frac{(100 - 104)\times 100}{104} = -3.85\%$$

Figure 6-12. Accuracy



Chapter 6-3 Torque Tools are Measurement Equipment

Table 6-2. List of torque equipment accuracies

Equipment Name	Model Name	Accuracy
Digital torque wrench tester	TF, TCC, DOTE	±1% + 1digit
Digital torque meter	TME	
Digital torque screwdriver tester	TDT	
Digital torque wrench checker	LC	
Digital torque screwdriver	STC	±1%
Digital torque wrench	CEM, CTA, CTA-P, CTB	
Analog torque meter	TG, TM	±2%
Analog torque wrench tester	DOT	
Manual torque screwdriver	FTD-S, FTD, MTD, RTD, LTD, NTD, RNTD, AMLD	±3% *±5% (*repaired)
Manual torque wrench	F, DB, CDB, QL, CL, YCL, QSP, SP	
Semi-automatic torque wrench	A, AC	
Power torque tool	U, AUR, AS, AP, MC, DAP, HAT	±5%

(6) Durable accuracy of torque tools (Tohnichi standards)

- **Manual torque tools** · · · · · 100,000 cycles (operation at maximum torque value) or one year.
For click type torque wrenches, by measuring and adjusting each 100,000 cycles, it will be possible to use for up to around 1,000,000 cycles for a capacity of 420 N·m or less, 500,000 cycles between 550-1000 N·m, and 250,000 cycles for 1400 N·m or more.
- **Power torque tools** · · · · · 500,000 ~ 1,000,000 cycles (operation at maximum torque) or one year.

6-4. Control Method

(1) Control method

Every torque tool will operate in error at some time. To prevent this, daily checking and regular calibration are required
Daily check (Regular) : To prevent the occurrence of a large quantity of defects.
Periodic calibration : To control the accuracy of torque tools (For traceability)

Table 6-3. Individual control and centralized control

		Individual control	Centralized control
Torque wrench accuracy inspection		Daily inspection by the worker	Regular inspection in the tool room
Degradation of torque		Earlier detection to prevent the occurrence of a large number of defective products.	Can be detected only during a regular inspection. Linked to the discovery of a large number of defective products.
Torque wrench breakdown		Can prevent occurrence beforehand.	In case of breakdown, this will be the first time to discover it.
Applicable torque wrenches		Click-type torque wrench. Powered-type torque wrench.	Indicating type (All types when individual control is not being carried out.)
Torque wrench tester		Torque wrench checker (LC)	Torque wrench tester (DOT, DOTE, TF, TCC)
Control of torque wrench	**Worker**	Precision check, and replacement only of defective components of torque wrenches.	Replacement of defective torque wrenches.
	Tool room	Checking of testers in the field and readjustment or arranging the repair only of defective torque wrenches.	Checking of all normal and defective torque wrenches and arrangement of repairs or readjustment of defective torque wrenches.

(2) Selection of testers

Checker (for daily check) ……
- Dead weight correction is necessary because the dead weight of the torque wrench will be added in the vertical direction. (LC, etc.)
- Loading is not stable all the time because it is loaded by hand, not with loading equipment. (Speed, position, direction, etc.)

Tester (for calibration) ……
- Loading is not affected by gravitational acceleration (g) because the torque wrench is loaded in the horizontal direction.
- The speed, loaded position, and direction can be constant because loading is applied by loading equipment.

Table 6-4. Selection of testers

Spec.	Checker / Tester model	Checker		Tester			
		For wrenches	For rotating equipment	Torque range 1:30 (Digital)	Torque range 1:10 (Mechanical)	Torque range 1:10 (Digital)	Torque range Wide (Digital)
		LC	ST	TDT	DOT	DOTE	TF,TCC
Measured instrument		Torque wrench	Power tool, Torque wrench	Torque screwdriver	Torque wrench	Torque wrench	Torque wrench
Accuracy		±1% + 1digit	±1% + 1digit	±1% + 1digit	±2%	±1% + 1digit	±1% + 1digit
Capacity		Small, medium large	Small, medium, large	Small	Small, medium	Small, medium, large	Small, medium, large
Analog display		x	x	x	○	x	x
Digital display		○	○	○	x	○	○
Manual (handle driven)		○	○	○	○	○	○ (TCC)
Powered (motor driven)		x	x	x	○ (DOT-MD)	○ (DOTE-MD)	○ (TF)
Measurement direction		Right	Right / left	Right/left	Right	Right/left	Right/left
Price		◎	◎	○	◎	○	△

Chapter 6-4 Torque Tools are Measurement Equipment

(3) Testers for torque tools

Table 6-5. Torque tools and Testers / Checkers

Torque tools	Tester / Checker
Pneumatic screwdriver	TCF + TP + CD42
Semi-automatic airtork	DOT, DOTE, LC, TF, TCC Torque Wrench Tester
Fully automatic airtork	TCF + TP + CD42, ST
Multiple unit	TCF + TP + CD42, ST
Manual torque screwdriver	TDT
Manual torque wrench	DOT, DOTE, TCC, LC, TF Torque wrench tester
Torque meter	Calibration kit (dead weight + calibration lever)

(4) Standards of Tohnichi, ISO, JIS (ISO 6789, JIS B 4652)

Table 6-6. Permissible deviation of torque value

A. Dial indicating type	1. Tohnichi standard	Wrench / Screwdriver	±3%	
	2. ISO standard	Wrench	Below 10 N·m ±6%	Above 10 N·m±4%
		Screwdriver	±6%	
	3. JIS standard	Wrench	Below 10 N·m ±6%	Above 10 N·m±4%
		Screwdriver	±6%	
B. Adjustable type	1.Tohnichi standard	Wrench / Screwdriver	±3%	
	2. ISO standard	Wrench	Below 10 N·m ±6%	Above 10 N·m±4%
		Screwdriver	±6%	
	3. JIS standard	Wrench	Below 10 N·m ±6%	Above 10 N·m±4%
		Screwdriver	±6%	
C. Preset type	1.Tohnichi standard	Wrench / Screwdriver	±3%	
	2. ISO standard	Wrench	Below 10 N·m ±6%	Above 10 N·m±4%
		Screwdriver	±6%	
	3. JIS standard	Wrench	Below 10 N·m ±6%	Above 10 N·m±4%
		Screwdriver	±6%	

Table 6-7. Measurement procedure

A. Dial indicating type	1. Tohnichi standard	Preliminary loading at maximum capacity → Release loading → Zero adjustment → Measure 5 times at each measuring point
	2. ISO standard	
	3. JIS standard	
B. Adjustable type	1. Tohnichi standard	5 times preliminary loading at maximum capacity → Measure 5 times at each measuring point
	2. ISO standard	
	3. JIS standard	
C. Preset type	1. Tohnichi standard	5 times preliminary loading at torque set value → Measure 5 times
	2. ISO standard	
	3. JIS standard	

Table 6-8. Measurement point

A. Dial indicating type	1. Tohnichi standard	20%, 60%, 100% of maximum torque value
	2. ISO standard	
	3. JIS standard	
B. Adjustable type	1. Tohnichi standard	
	2. ISO standard	
	3. JIS standard	
C. Preset type	1. Tohnichi standard	Torque set value
	2. ISO standard	
	3. JIS standard	

(5) Naming of torque tools

Table 6-9. Naming of torque tools

Type I	Indicating type torque tool (ISO, JIS)	Tohnichi equivalent model
Class A	Twisting or deflection beam type wrench	F, CF, T
Class B	High rigidity housing type wrench with scale, dial, or display unit	DB, CDB
Class C	High rigidity housing type wrench with electronic indicator	CEM
Class D	Screwdriver with scale, dial, or display unit	FTD
Class E	Screwdriver with electronic indicator	STC

Type II	Adjustable type torque tool (ISO, JIS)	Tohnichi equivalent model
Class A	Variable torque type wrench with graduations or display unit	QL, CL, PQL
Class B	Fixed torque type wrench	QSP, CSP
Class C	Variable torque type wrench with no graduations	-
Class D	Variable torque type screwdriver with graduations or display unit	LTD, RTD
Class E	Fixed torque type screwdriver	NTD, RNTD
Class F	Variable torque type screwdriver with no graduations	-
Class G	Deflection beam / variable torque type wrench with graduations	-

(6) Cautions for calibration of torque tools

Common items

- Calibration equipment: The maximum permissible uncertainty of the calibration equipment: measurement should be ±1% of the indicated value. (including coefficient k = 2)
- Calibration temperature: Should be in the range of 18 to 28°C and should have a temperature variation of less than ±1°C. (The maximum relative humidity should be 90%)

Type I Indicating type torque tools

- Setting: within ±3%, applied force within ±10°, screwdriver gradient within ±5°.
- Preliminary loading: Carry out preliminary loading one time up to the maximum value in the working direction, and set to zero after releasing the load.
- Loading method: Load gradually with increasing force until the indicated torque value is reached.

Type II Adjustable type torque tools

- Setting: within ±3%, applied force within ±10°, screwdriver gradient within ±5°.
- Preliminary loading: Carry out loading five times to the maximum capacity (torque tool nominal capacity) in the working direction, and carry out averaging.
- Loading method: After loading gradually with increasing force up to 80% of the target torque value, slowly apply a final loading evenly over 0.5 to 4 seconds to reach the target torque value.