5

Selection of Tightening Tools

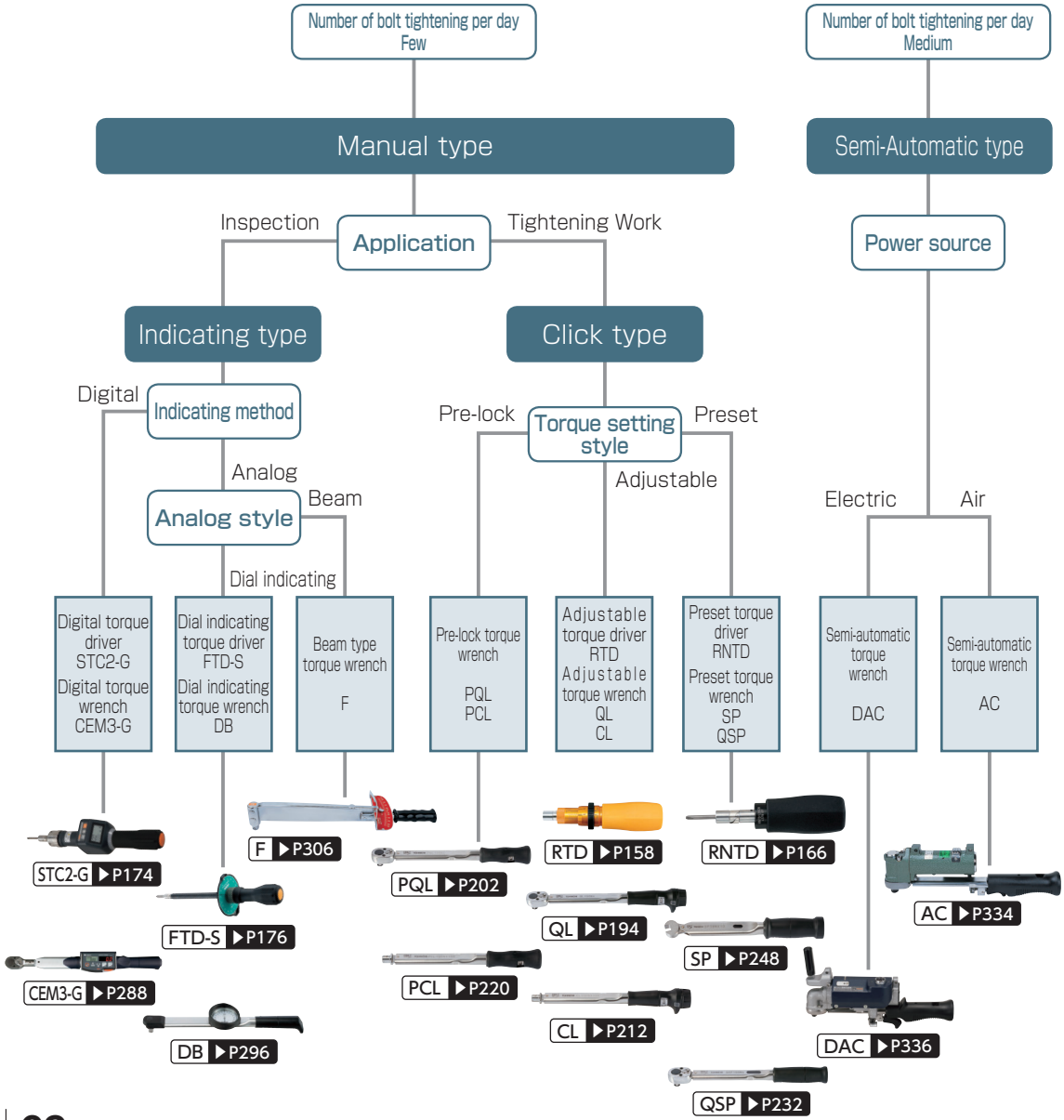
Tightening Control System

For the tightening torque, it is necessary to decide the accuracy of tightening control according to the importance of the tightening position, and to choose and to control the necessary torque tools.

Table 5-1. Bolt tightening control system

Class	Control system	Tightening tolerance	Application	Application example	Application tightening tool	Tightening tool control	Torque assurance system
A	Standard	±30%	Threaded joint for use in fixing parts subject to no external force	· Bolts tightened to static parts · Bolts fixing covers (Non air-tight)	Selection by model and capacity. (No torque control)	Periodical maximum performance measurement.	Periodical inspection by retightening method. (α=1.05)
B	Individual	±20%	Threaded joint with high safety margin in fixing, air-tightness and transfer against external force	· Bolts tightened to dynamic parts. (Bolt strength classification not specified) · Bolts for low pressure sealing.	Torque-controlled tightening device. (Indirect control device)	Periodical tightening torque measurement.	Daily inspection by retightening method. (α: measured values)
C	Individual	±10%	Threaded joint with low safety margin in fixing, air-tightness and transfer against external force	· Bolts tightened to dynamic parts. (Bolt strength classification specified) · Bolts for high pressure sealing.	Torque-controlled tightening device. (Direct control type)	Periodical tightening torque measurement. Daily tightening torque check.	Daily inspection by retightening method. Daily check of tightening device.
D	Individual	±5% (Angle method)	Threaded joint limitedly designed in fixing, air-tightness and transfer against external force	· Main bolt for connecting rod of engine. · High pressure hydraulic equipment.	Nutrunner with torque control. (with monitoring angle)	Periodical tightening torque measurement. Daily tightening torque check.	Monitoring. Daily check of tightening device.

5-1 Flow Chart of Tool Selection



Number of bolt tightening per day
Large

Power type

Power source

Electric

Air

Portable

Fixed

Fixed or Portable

Portable

Pistol

Shape

Angle

Straight

Battery operated torque driver HAT
Electric torque wrench DAP

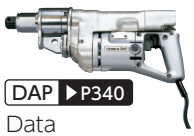
Multiple unit
ME
MC

Pneumatic torque driver AUR
Pneumatic torque wrench AP

Pneumatic torque driver
U

Fully-Automatic torque wrench
AS

HAT ▶P328



DAP ▶P340

ME ▶P356

MC ▶P356

AUR ▶P326

AP ▶P338

U ▶P330

AS ▶P342

5-2 Selection of Manual Torque Tools

(1) Selection process

Selection of manual torque tools

Type		Structure	Main applications	Type comparison					Model	
				Measuring torque	Tightening for multiple purpose	Continuous tightening for a same bolt	Accuracy	Ease of work	Torque wrench	Torque driver
Indicating type	Beam	Read the deflection of the beam spring directly from the graduated plate	General tightening work, testing and maintenance	○	○	×	○	△	◎F p306 SF p306 QF p310 QFR p310 CF p312	
	Dial	Read the torsion from the torsion bar, which is magnified by the dial	Precise tightening work, research and testing	◎	○	×	◎	◎	◎DB p296 DBE p298 T p304	(ATG) p390 MTD p180 FTD-S p176
	Digital	Read the digital display for the output of the strain gauge	Precise tightening work, research and testing	◎	△	×	◎	◎	CEM3-G p288	STC2-G p174
Click type	Adjustable	When the torque reaches the preset value, a click is heard and impulse is felt	General tightening work, Tightening for mass production	×	○	○	○	◎	◎QL p194 QLE2 p198 ◎CL p212 CLE2 p216 PQL p202 TIQL p228 TIQLE p228	◎LTD p160 MTD p180
	Preset	When the torque reaches the value set by the tester, a click is heard and impulse is felt	Particular bolt tightening, Tightening for mass production	×	×	◎	○	◎	SP p248 RSP p250 QSP p232 CSP p236 BQSP p240 BCSP p242	NTD p168
Rotary slip	Adjustable	Once torque set is achieved, even if more force is applied, this model does not add additional torque and prevent over torque.	tightening work of short tact time, tightening at low torque value	×	○	○	○	◎		RTD p158 AMRD p162 BMRD p162
	Preset	Once torque set is achieved, even if more force is applied, this model does not add additional torque and prevent over torque.	tightening work of short tact time, tightening at low torque value	×	×	◎	△ (○)	◎	QSPCA p234	RNTD p166

Tools marked with "◎" are standard torque wrenches or screwdrivers that are widely used.

(2) Selection of tools by application

Table 5-3. Selection of tools by application

Item / Application	Manual tools	
	Torque screwdriver	Torque wrench
General usage	RTD, LTD, AMLD, BMLD	QL, QLE, CL, CLE
Mass production	RNTD, NTD	SP, QSP, (PQL), CSP, BQSP
Error-proofing system	RTDLS, LTDLS	QLLS, PQLLS, QSPLS, SPLS, MPQL, FH256MC, QSPCALS, FHSLS
Insulated	RTDZ, RNTDZ	PQLZ, QSPZ
Inspection	MTD, FTD-S, STC2-G	DB, CDB-S, T, SF, F, CF, QF, CEM3-G
Semi-automatic	–	A, AC, DAC
Monitoring system	STC2-G-BT	Made to Order: with sensor CEM3-G-BT Torque wrench with Display

(3) Optimum capacity

Table 5-4. Optimum capacity

Tightening torque	Optimum usage range (Against max. capacity)	Note
Below 200 [N·m]	40～90%	Can be used at max. capacity if within 100 pcs. per day
Over 200 [N·m]	40～70%	

Note: The operator may feel fatigue if the wrench is used at close to the maximum capacity. Also, the weight of the wrench will be unnecessarily heavy when it is used at low ranges. The optimum capacity is to use under the target of around 70% of maximum capacity.

Example: When QL200N4 and the setting torque T = 80 [N·m], then

$$P\ (\text{Hand force}) = \frac{\text{Setting torque}}{\text{Effective length}} = \frac{80}{400 \div 1000} = 200\,[\text{N}]$$

Table 5-5. Case of tightening torque: 80 [N·m]

*Refer to effective length of QL model (P.196)

Suitability	Torque wrench to use	Mass	Hand force	Result
△	QL200N4	1.40 [kg]	200 [N]	Heavy
○	QL140N	0.78 [kg]	250 [N]	Good
△	QL100N4	0.68 [kg]	308 [N]	Large hand force required
◎	TiLQL180N	1.00 [kg]	160 [N]	Light, small hand force

5-3 Selection of Power Torque Tools

(1) Selection process

① **Power** (air, electric, hydraulic)
② **Shape** (hand-held, fixed, head shape, reaction force support)
③ **Capacity** (tightening torque value, tightening accuracy)
④ **Tightening time** (rotations)

Table 5-6. Selection of power torque tools

		Air			Electric	
		Hand-held		Fixed	Hand-held	
		Without reaction	With reaction		Without reaction	With reaction
Structure		Auto stop by toggle mechanism Driven by pneumatic motor	With reaction arm to absorb reaction during tightening Auto stop by toggle mechanism	Built-in to automatic equipment Auto stop by toggle mechanism Tightening completion signal by LS	Auto stop by toggle mechanism Driven by electric motor	With arm to absorb reaction during tightening
Main applications		General tightening of small screws	Tightening of medium and large screws	Auto tightening of many units, or multiple axis tightening	General tightening of small screws	Tightening of medium and large screws
Type comparison	Small screws	◎	×	○	◎	×
	Medium screws	△	○	◎	△	○
	Large screws	×	◎	◎	×	◎
	General multi-purpose tightening	○	○	×	○	○
	Same screw large quantity tightening	△	△	◎	△	△
	Rotation (auto speed change)	◎	○	◎(○)	○	△
	Weight	◎	○	○	○	△
	Noise	○	△	○(△)	◎	○
	Accuracy	○	○	○(◎)	○	○
	Operation	○	○	◎	○	○
Model		U, AUR, AS	AP	MG, MF, ME, MC	HAT	DAP

(2) Tightening times of tools

Table 5-7. Tightening time of various tools [sec. / piece]

Screw joint			Manual		Power	Power + Manual		
Screw, tightening torque	Number of thread ridges	Simultaneous tightening [pieces]	Indicating type (DB50N)	Click type (QL50N)	Full automatic direct control (ASH40N)	Impact wrench + click type (QL50N)	Semi automatic (Air motor + click type in a body)	
							(AC50N)	(AC100N)
M8 (P1.25) T=22 [N·m] (e=10)	10	1	9.6	8.0	3.2	5.4	4.0	3.5
	10	4	7.2	6.5	1.9	3.0	2.3	2.3
	16	1	14.6	12.6	4.6	7.3	6.7	5.6
	16	4	12.5	10.6	2.5	4.0	4.0	3.6

In the test conditions, the screw is inserted into the tapped hole and the tool is placed on the table.
The time interval is measured from the start of tightening until the tightening has been completed and the tool has been returned to the table. For manual tools, you may tighten the screw with your fingers.

5-4 Selection Standards of Tightening Tools

Table 5-8. Selection standards of tightening tools

Ⅰ. Screw joint Name	
Number, Degree of importance	●Important screw ●General screw
Specification of screw	●Nominal ( ) Class of strength
	●Head shape( ) ●Number of tightening threads( )Screw thread (P=)
Limit of strength	●Male screw ／ Female screw ●Number of bolts tightened (Tmax=)
Tightening torque	( )N·m
Tolerance	●Class, ±( )% ●T=( )～( )
Washer	●None／ Flat washer, Spring washer (Strong, Normal)
Surface treatment	●None ／ Parkerizing ／ Plating (Zn、Cr、)
Lubrication	●None ／ machine oil ／ Wax-based oil, molybdenum disulfide
Number of bolts tightened	●( )Pieces/day (Time limit Sec/piece, None)
Number of bolts tightened simultaneously	●( )Pieces
Coefficient of joint	●Hard ／ Medium ／ Soft (e=)
Tightening space	●Socket Usable ／ Not usable
	●On the bolt( )mm ●Around the bolt( )mm ●Swing( ) ●otal length( )mm
Direction of tightening	●From the top ／ From the side ／ From the bottom
Ⅱ. Tightening Tool Type	●Manual ／ Powered ／ Manual + Powered
Manual type Model	●Click type ／ Indicating type ／ Adjustable type, Preset type
Head type	●Square drive ／ Open end head ／ Ring head ／ Fixed ratchet ／ Interchangeable head
Capacity (Ease-of-use)	●T( ) ●weight( )kg ●Overall length( )mm ●Hand force( )N
Power Power source	●Compressed air Pressure( )Mpa or above ●Electric( )V ●Hydraulic
Type	●Portable ／ Fixed ●Single Axis ／ Multiple Axes
Number of rotations	( )r.p.m(at)
Torque control method	●Direct control(Graduations Non／scaled) ●Indirect control ●Maximum capacity ●No control
Capacity, shape	●T( ) ● Straight ／ Pistol ／ Angle
Tightening tool Type	
Time required for tightening	●( )sec／piece
Cost of tightening	●( )$／piece
Accessories	●Socket(×) ●Bit
	●Hose diameter( )