5 Selection of Tightening Tools

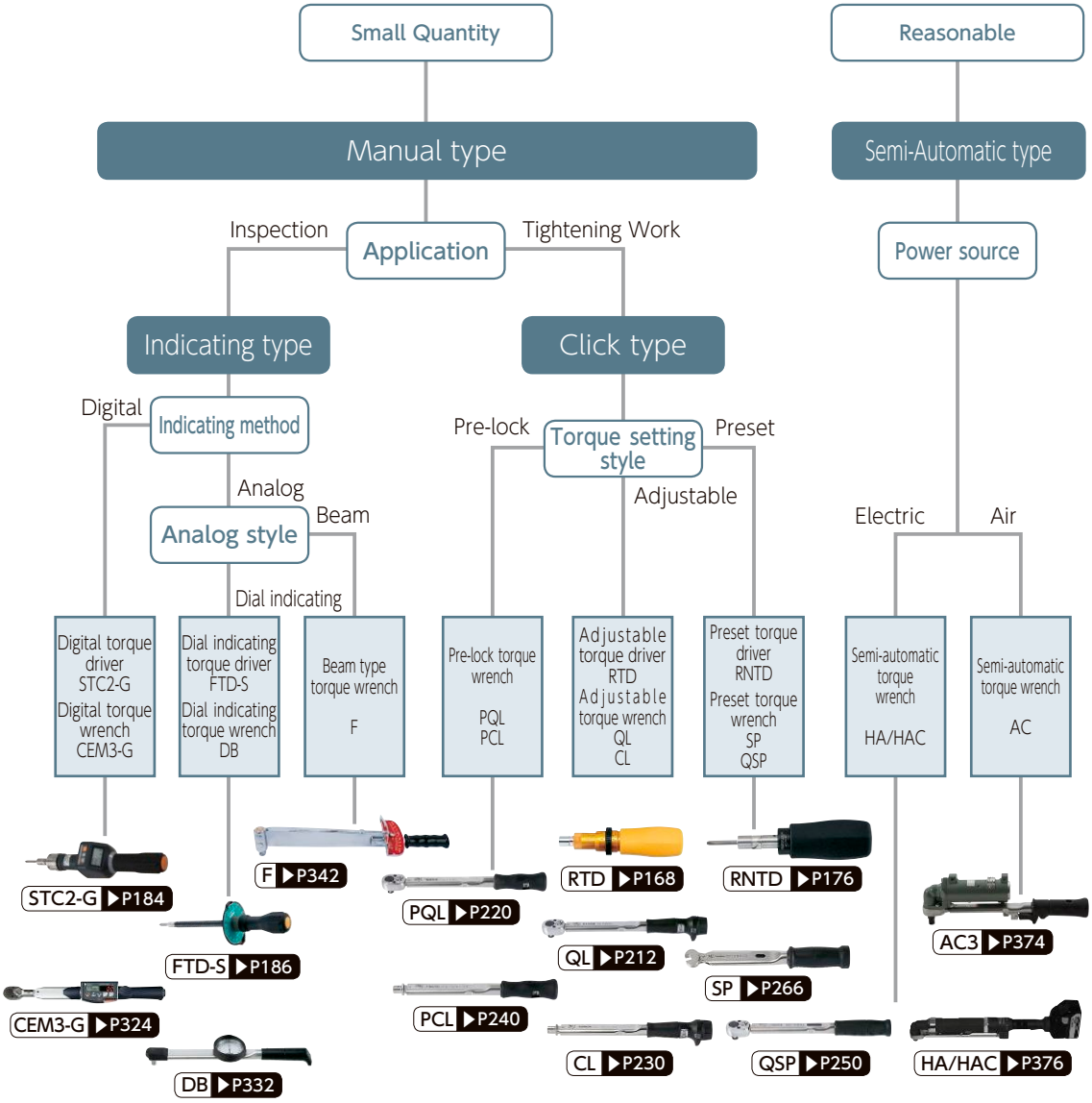
Tightening Control System

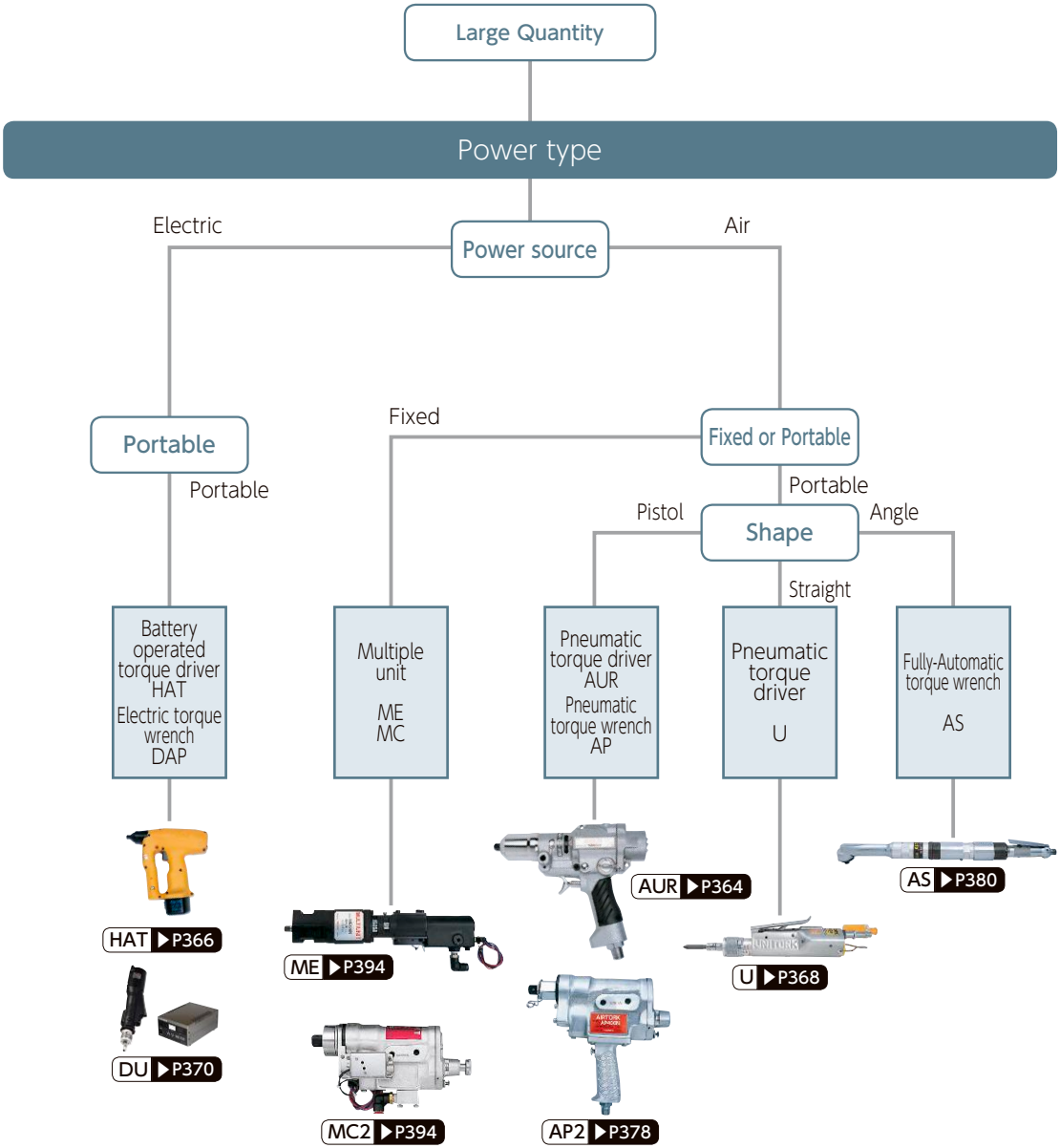
For the tightening torque, it is necessary to decide the accuracy of tightening control according to the importance of the tightening position, and to choose and to control the necessary torque tools.

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 Tool Selection Flowchart




Large Quantity
Power type
Electric
Power source
Air
Portable
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 ▶P366
DU ▶P370
ME ▶P394
MC2 ▶P394
AUR ▶P364
AP2 ▶P378
U ▶P368
AS ▶P380

5-2 Manual Torque Tools

(1) Selection process

Table 5-2. Selection of manual torque tools

Type		Structure	Main applications	Type comparison					Model		Shape of head (Reference)
				Measuring torque	Tightening for multiple purpose	Continuous tightening for a same bolt	Accuracy	Ease of work	Torque wrench	Torque driver	Page
Indicating type	Beam	Read the deflection of the beam spring directly from the graduated plate	General tightening work, testing and maintenance	○	○	×	○	△	◎F, SF, QF, FR QFR, CF		F p342 SF p342 QF p346 QFR p346 CF p348
	Dial	Read the torsion from the torsion bar, which is magnified by the dial	Precise tightening work, research and testing	◎	○	×	◎	◎	DB, DBE, T-S CDB-S	(ATG), MTD, FTD-S	DB p332 DBE p334 T-S p340 ATG p430 MTD p190 FTD-S p186
	Digital	Read the digital display for the output of the strain gauge	Precise tightening work, research and testing	◎	△	×	◎	◎	CEM3-G	STC2-G	STC2-G p184
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,QLE2, ◎CL,CLE2, PQL TiQL, TiQLE	◎LTD MLD	QL p212 QLE2 p216 CL p230 CLE2 p234 PQL p220 TiQL p246 TiEQL p246 LTD p170 MTD p190
	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	×	×	◎	○	◎	SP2, RSP2, QSP, CSP, BQSP, BCSP	NTD	SP2 p268 RSP2 p272 QSP p250 CSP p254 BQSP p258 BCSP p260 NTD p178
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 AMRD BMRD	RTD p168 AMRD p172 BMRD p172
	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	×	×	◎	△	◎	QASPCA		QSPCA p252 RNTD p176
				×	×	◎	○	◎		RNTD	

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, QLE2, CL, CLE2
Mass production	RNTDFH, RNTD, NTD	SP2, QSP, (PQL), CSP, BQSP
Error-proofing system	RTDFH, RTDLS, LTDLS	QLLS, PQLLS, QSPLS, SP2LS, 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	–	A3/AC3, DAC3
Monitoring system	STC2-G-BT	Made to order : FD, FDD, CEM3-G-BT (Wireless) Sensor type torque wrench + CD5 (Wired)

(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.198)

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 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
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
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
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	○	○	◎	○
	Price	◎	○	△	○
Model		U,AUR	AP2	MG,MF,ME,MC2	DU,HAT

(2) Tightening times of tools

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

Screw joint			Manual		Power + Manual		
Screw, tightening torque	Number of thread ridges	Simultaneous tightening [pieces]	Indicating type (DB50N)	Click type (QL50N)	Impact wrench + click type (QL50N)	Semi automatic (Air motor + click type in a body)	
						AC50N3	AC100N3
M8 (P1.25) T=22 [N·m] (e=10)	10	1	9.6	8.0	5.4	4.0	3.5
	10	4	7.2	6.5	3.0	2.3	2.3
	16	1	14.6	12.6	7.3	6.7	5.6
	16	4	12.5	10.6	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 Criteria

Table 5-8. Selection Criteria Template

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( )