

MBT-SERIES



MBT 2100

Roller Brake Tester

Original Operating Instructions

BA022401-en

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1 Safety

1.1 Introduction

Thoroughly read this manual before operating the equipment and comply with the instructions. Always display the manual in a conspicuous location.

Personal injury and property damage incurred due to non-compliance with these safety instructions are not covered by the product liability regulations.

1.2 Symbols



Important safety instructions. Failure to comply with instructions could result in personal injury or property damage.



Important information.

1.3 Intended Use

This equipment is to be used exclusively for the brake testing of motor vehicles. Observe the rated axle load.

The equipment shall not be modified without the express written consent of the manufacturer. In case of non-compliance the declaration of conformity becomes void.

Any use other than described is inappropriate.

1.4 Safety Instructions for Installation and Initial Operation

- The system shall only be commissioned by MAHA service technicians or authorized service partners.
- All parts of the electrical equipment must be protected from moisture and wetness.
- The system shall not be installed and operated in hazardous locations or wash halls.
- The operator must provide for optional safeguards (e.g. warn lamps, barriers, etc.) depending on local conditions.
- Wear safety shoes and gloves.
- Safeguard roller set with suitable means (e.g. cordon chains or strap).
- The display must be installed in a secure area and folded into the wall when not in use (wall hinges optionally available).

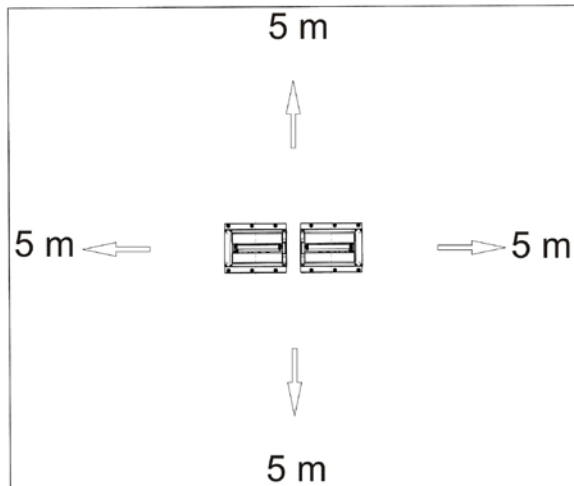
- When folding the display, grasp it on the edges. Danger of pinching!
- Ensure that a lockable emergency-stop main switch is installed based on installation instructions before connecting the feed line. Use motor protection switch and cable cross sections as per specification. Reference in circuit diagram (standard delivery), nameplate. Fuse max. X.X A (see nameplate).
- The main switch must be provided by the customer and installed on-site. It must be positioned in direct vicinity to the tester and takes over the emergency-stop function.

1.5 Safety Instructions for Operation

- The system shall only be operated within its performance limits.
- The system shall only be operated by trained personnel.
- The system and surrounding area must be kept clean.
- Switch off the system when not in use and secure the main switch against restart with a padlock.
- In emergency situations switch off system with main switch or emergency-stop switch.
- No persons shall be in the danger zone of the system. Rotating or moving parts (e.g. test stand rollers) are dangerous.
- Danger of carbon monoxide poisoning with running vehicle engine in closed rooms. The operator is responsible for providing sufficient air exchange.
- Avoid unnecessary strain on vehicle and tester.
- Drive the vehicle slowly on to the tester.
- Check the danger zone before driving the vehicle onto the tester.
- When the vehicle with the driven axle is on the roller set, exit only with running roller drive. Exiting with roller drive at standstill can destroy the motors due to extreme roller acceleration.
- The system shall not be operated without functioning slip monitoring. This can cause tire damage.
- Never jump start a vehicle with the system. This can lead to equipment damage.
- No 4 wheel-drive vehicles shall be tested on the standard roller set. Damage to vehicle and system are possible. When in doubt contact your responsible service representative.
- The vehicle must be closed during testing. If persons outside of the vehicle are endangered, use noise protection.
- The operator shall not leave the vehicle during testing.
- No vehicle shall be parked in/on the roller set or on the optional ramps.

1.6 Danger Zone

During brake tester operation no persons are allowed in the danger zone: **5 (five) meters** around the roller set in all directions.



1.7 Safety Instructions for Servicing

- Service work shall only be done by MAHA service technicians or authorized service partners.
- Work on electric parts of the system shall only be done by trained electricians.
- The main switch must be switched off and secured against restart before doing repair, maintenance and set-up work.
- Fire danger due to rubber abrasion on the roller set. Clean regularly. Remove abrasion before maintenance work.
- The main switch must be secured and if necessary the motor protection switch turned off when doing work in the roller set.
- When working on the control cabinet or on the roller sets pay attention to the heating (optional) or hot parts.
- Immediately turn off the tester when it starts up unintentionally. Contact the service department.

1.8 Safety Features

The safety features (partly optional) are to be inspected regularly by an authorized service technician. Official guidelines must be followed at all times. *The equipment shall not be operated when the safety features are defective!*

- **Lockable Main Switch**

Serves as normal On and Off switch for the equipment and as emergency switch. The switch can be padlocked to protect it against unauthorized usage.

- **Emergency Switch**

Is used for quick switch-off during operation. Interrupts the power supply to the equipment.

- **Startup Monitoring**

Prevents the rollers from starting up in case the wheels are blocked (seized bearings, jammed brake pads). This feature helps prevent the vehicle tyres from being damaged.

- **Sensor Rollers**

The RPM difference between equipment rollers and sensor rollers determines the slip. Both sensor rollers must be pushed down in order to start the roller brake tester.

- **Visual and Audible Warning Devices**

These must be positioned at a suitable location and must be easily seen or heard at all times. In the event that the warning devices are defective, the brake tester must be shut down until they are fully functional again.

- **Pit Safety**

Light barrier or infrared movement sensor. If any person enters the safety area, the brake tester is switched off.

- **Yellow-Black Marking Tape**

The yellow-black marking tape around roller set and pit serves to mark out the brake tester and must be replaced if defective. Part # 19 6014 (Ø 38 mm) / 19 6015 (Ø 50 mm).

- **Warning and Information Labels**

Warning and information labels are attached to the equipment. These must not be changed or removed and must be replaced if unreadable (see below for part numbers).



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1.9 Accessories

The equipment shall be operated only with accessories which have been approved or permitted by MAHA.

1.10 What to Do in the Event of an Accident

- The injured person is to be removed from the danger area. Find out where dressing and bandages are kept. Seek first-aid.

- Provide first-aid (stop bleeding, immobilise injured limbs), report the accident and seal off the accident site.
- Immediately report any accident to your supervisor. Make sure a record is kept of every occasion first-aid is provided, e.g. in an accident book.
- Remain calm and answer any questions that may arise.

2 Description

2.1 General Information

This brake tester belongs to the group of roller brake testers. This class includes two different measuring methods to record brake forces:

- the testing of drive torque or
- the testing of drive power

The former is applied in this brake tester. It consists of a proven roller set and an open-ended electronic system based on a processor board with an integral operating system.

General Information about Brake Testing

To avoid skidding it is important that the brake forces of the individual wheels of one axle are the same. Just as important is the minimum brake torque for each individual wheel, so that when braking no vehicle brake is overburdened. Consequently, each wheel is tested individually on the brake tester.

For measuring the brake force, a static and a dynamic method are available. Using the static method the force necessary to rotate a wheel which is positioned on a plate, with applied brakes is determined. The dynamic method is more practice orientated - whereby the wheel is brought up to a predetermined RPM by the motor driven roller set and then the brakes are applied. A sensor roller measures the wheel revolutions. A comparison of the drive roller RPM to the sensor roller RPM determines how large the slippage is. For safety reasons, all MAHA brake testers automatically interrupt the brake test at a slippage of approximately 30%.

The measurement principle is the same for both methods of testing. The drive motor is supported in a rotary fashion (motor housing not supported); without any additional support, the drive shaft and the housing would counter rotate when under load, depending on the force distribution. The additional support consists of a flexible beam, on which the housing rests. The steel beam bends corresponding to the torque produced by the motor, which the beam resists. The torque is zero at the beginning of the static test. With the dynamic test method, the torque is just high enough to set the drive rollers with the vehicle wheel in motion with the brakes not applied.

A strain gauge is mounted on the transverse beam which converts the brake force into a usable electrical value.

For this brake tester the dynamic test method is used. This method ensures the most accurate measurement. In addition, there is simply no alternative for 4 wheel drive brake testing.

Vehicles with *One Driven Axle*

Drive the wheel axle to be tested onto the roller set. This will push both sensors rollers down which measure the RPM of the wheels. Now both drive motors of the roller set will slowly accelerated to nominal speed turning both vehicle wheels

forward. When the drive motors have reached nominal speed a comparison is made between the nominal drive roller speed and the sensor roller speed in order to be able, at any time, to switch off the drive motors when a slippage of 30% is exceeded. (This is to protect the drive motors against overload and the tires against excessive wear.)

The READY indicator will light up, signaling that the test rig is ready to start the brake test. During brake tests the vehicle is decelerated to a point, that at least one sensor roller exceeds 30% slippage and the drive motors are switched off.

4-Wheel Drive Vehicles



On non-permanent 4-wheel drive vehicles the brakes are tested with the 4-wheel drive switched off, just like vehicles with only one drive axle.

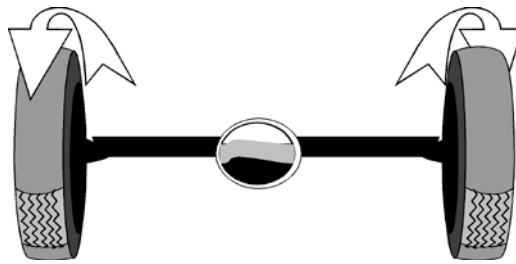
Principle of 4 Wheel Drive

On 4-wheel drive vehicles the torque applied to the drive shaft is evenly distributed to all four wheels, i.e. a quarter of the total torque will be applied to each wheel. The same applies for the brake torques that arise when braking. When testing 4 wheel drive vehicles it must therefore be ensured that no brake torque will be transferred from one vehicle wheel to the other. This is accomplished if no torque is applied to the drive shaft of the differential during the brake test.

The following example will explain this in detail:

In order to simulate a defective brake, one brake is disabled. Now only one brake of the axle to be tested is enabled. If the brake test is done on a standard test stand where the torque is not eliminated from the drive shaft, the same force applies to the strain gauges of both drive motors, i.e. the same brake torque will be indicated. This would lead to the false assumption that the brakes are fully intact. If the test was conducted correctly, no brake torque would be indicated for the wheel with the disabled brake and the actual brake torque applied to the other wheel would appear.

If both wheels of the axle to be tested are rotating forward during the brake test, the vehicle will be lifted out of the test rig, as torque is transferred by the drive shaft to the wheels of the other vehicle axle. To prevent this, the wheels counter rotate with the same RPM, one vehicle wheel is driven in forward direction and the other wheel in reverse direction. This eliminates the torque built-up in the differential against the drive shaft and transmission of torque to the other vehicle axle.



As the brake characteristics depend on the rotating direction of the wheels (the brake linings and brake drums are ground in forward direction), only the brake torque of the wheel rotating in forward direction is measured. For this reason, the brake test has to be done separately for each wheel.

In order to obtain a reliable comparison between the brake forces of both wheels of the same axle, the same pedal force will have to be applied at the brake test of the left and right wheel. To accomplish this, a pedal force meter can be connected to the vehicle's brake pedal.



It is also possible to measure the current pressure P_m of the hydraulic brake by means of a pressure sensor.

Testing of various 4-wheel drive types

There are three different types of 4-wheel drives:

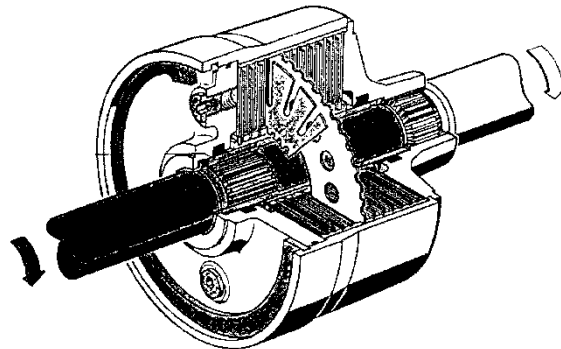
- Disengageable drive shaft leading to the differential
- Viscous clutch (VC) in the drive shaft leading to the differential
- Rigid drive shaft between the differentials

a) Disengageable drive shaft leading to the differential

On vehicles equipped with non-permanent 4-wheel drive, the brakes are tested with the 4-wheel drive switched off, just like vehicles with only one drive axle.

b) Viscous clutch (VC) in the drive shaft leading to the differential

There are two different viscous clutch types. The soft viscous clutch has a higher torsibility (viscosity) than the hard viscous clutch, therefore no torque is transferred to the other wheels when the drive shaft rotation is low.



As described above, brake tests on 4-wheel drive vehicles are feasible if both wheels on the same axle counter-rotate at the same speed. As, in practice, the circumference of the left and right wheel is not exactly the same due to different tire tread depths and uneven tire pressure, the RPM of the two drive motors is normally different. Therefore the drive motors must control their speed in order to obtain the same RPM for both wheels.

Approximately the same speed of the roller set drive motors will be sufficient for a 4-wheel drive vehicle having a soft viscous clutch in the drive shaft as no brake torque is transferred by the viscous clutch when the drive shaft rotation is low. Therefore the speed control of the drive motors alone will be sufficient in this case.

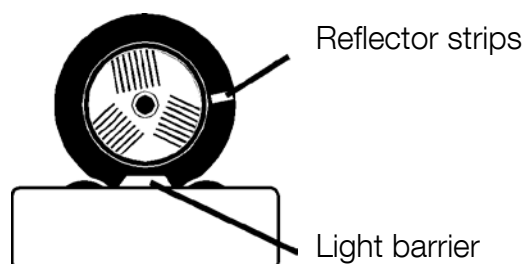
Contrary to the above, when testing the brakes of 4-wheel drive vehicle having a hard viscous clutch in the drive shaft, both wheels on the same axle must rotate synchronously during the brake test, as the clutch viscosity is so low that even the slowest rotation of the drive shaft will transfer brake torque to the other wheels.

c) Rigid drive shaft between the differentials

To perform a brake test on a 4-wheel drive vehicle having a rigid drive shaft, the wheel rotations must be exactly controlled in such a way that no brake torque can be transferred by the drive shaft.

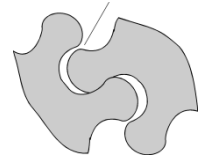
Controlling the synchronous rotation of the wheels

In order to control synchronous rotation of the wheels, reflector strips are fastened to the sides of the wheels which trigger a signal via two photo-electric cells, mounted on the side of the roller set.



On vehicles equipped with a rigid drive shaft or with a hard viscous clutch the wheels cannot be individually turned. If one vehicle wheel is turned forward in the roller set, the other wheel (on the same axle) will be turning backwards in a synchronous manner. If one wheel is turned slowly in forward or backward direction, one will note that the other wheel starts turning with a little delay. This slight delay in following the other wheel to turn is caused by the gear play (backlash of teeth) inside of the differential.

Tooth play



To perform a brake test on a 4-wheel drive vehicle having a rigid drive shaft, the wheel rotation must be controlled in such a way that no brake torque can be transferred by the drive shaft. This is achieved by staying within the gear play of the differential during the brake test. The differential will be in a "balance" state.

To be able to effectively use this, the exact backlash of teeth is assessed in a learning mode:

Initially the left drive motor will be switched on to accelerate the left vehicle wheel to nominal speed. As the right drive motor is switched off and thus running free, the left wheel is dragging the right wheel along. The flanks of a tooth in the differential touch each other on one side. Now the first limit position of gear play is measured by the reflector strips and the photo electric cells. The procedure is now reversed, the left drive motor of the roller set is switched off and the right vehicle wheel is accelerated to nominal speed. This time the left wheel is dragged along and in the differential the flanks of teeth touch each other on the opposite side. The second limit position of the gear play will now be measured. Out of the two measured limit positions the center of gear play is calculated. This "center of gear play" is used to control the rotation of wheels during the brake test.

During the brake test, both drive motors are accelerated to a speed where the "center of gear play" is reached. One vehicle wheel will rotate forward, the other in opposite direction. As soon as the nominal speed is reached by both wheels, and no brake torque is being transferred to the drive shaft, brake testing may be started.

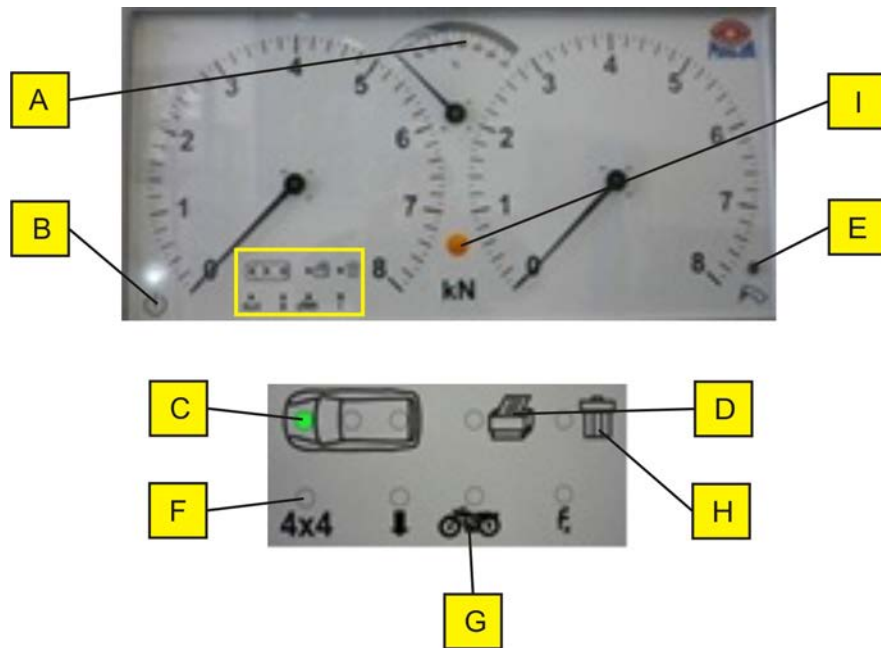
As with standard vehicles, the drive motors will be switched off if excessive slip occurs.

2.2 Specifications

			Standard	Option
Axle load (drive-over) max. [kg]			3000	4000 / 5000
Drive power [kW]			2 x 3	2 x 4
Test speed [km/h]			3	5
Measurement range [kN]			2 x 0...6	2 x 0...8
Display accuracy			2 % of the measurement range end value 2 % Difference left – right	
Track width min....max. [mm]			780...2200	780...2800
Roller diameter [mm]			202	
Test stand dimensions [mm]			Height	280
			Width	680
			Length	2320
Voltage supply [V]			3~ 400	3~ 230
Frequency [Hz]			50/60	50/60
Fuse (slow) [A]			16...25	
Roller friction	Dry	Steel / synthetic	ca. 0.9 / ca. 0.9	
	wet	Steel / synthetic	ca. 0.7 / ca. 0.8	

3 Operation

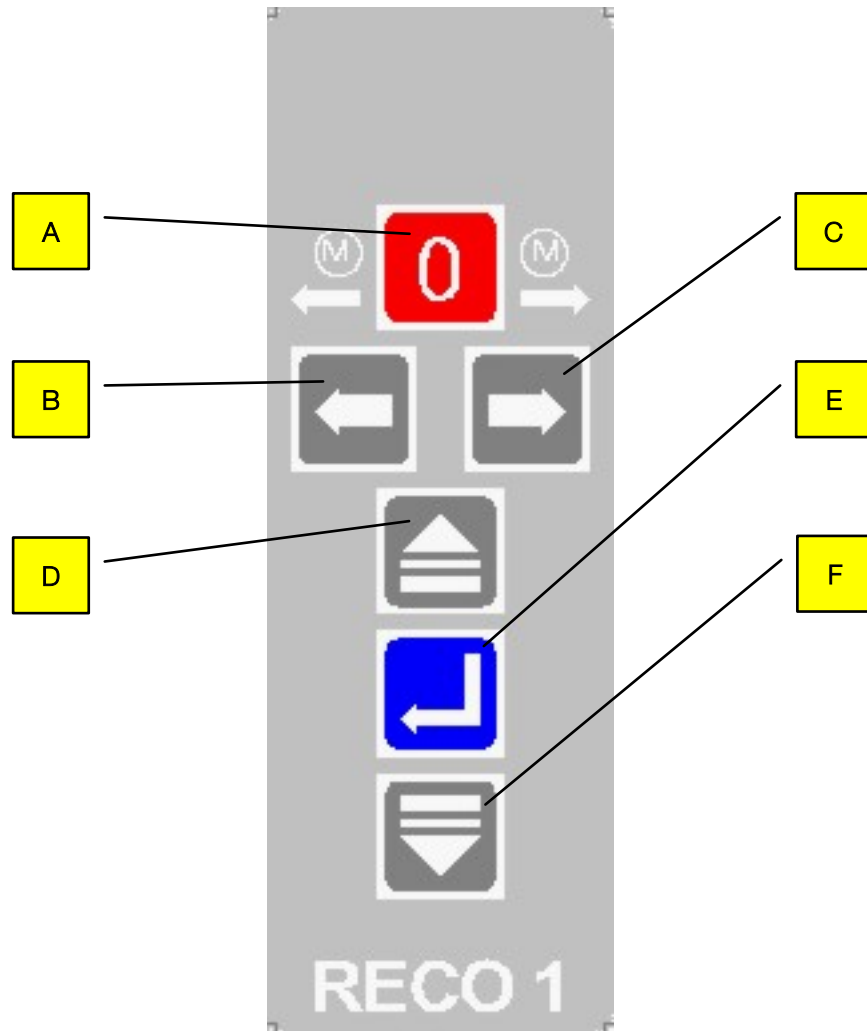
3.1 Display



A	Differential display	Read the difference between the right and left-hand brake value in % on the differential display. The differential display is only triggered after a fixed total brake force is exceeded.
B	Power on lamp	The test stand is active when the lamp above this symbol is lit.
C	Brake	Front Axle / Parking Brake / Rear Axle
D	Print	
E	Ready lamp	When the lamp above this symbol lights up, the brake pedal/parking brake can be operated.
F	Automatic 4WD recognition	
G	Motorcycle	
H	Delete	
I	Remote control (optional)	In course of the brake test with remote control the lamp shows the following signals: 1st-Interval → front axle; 2nd-Interval → parking brake; 3rd-Interval → rear axle; permanent light → Measurement value available, print possible; permanent blinking → New vehicle.

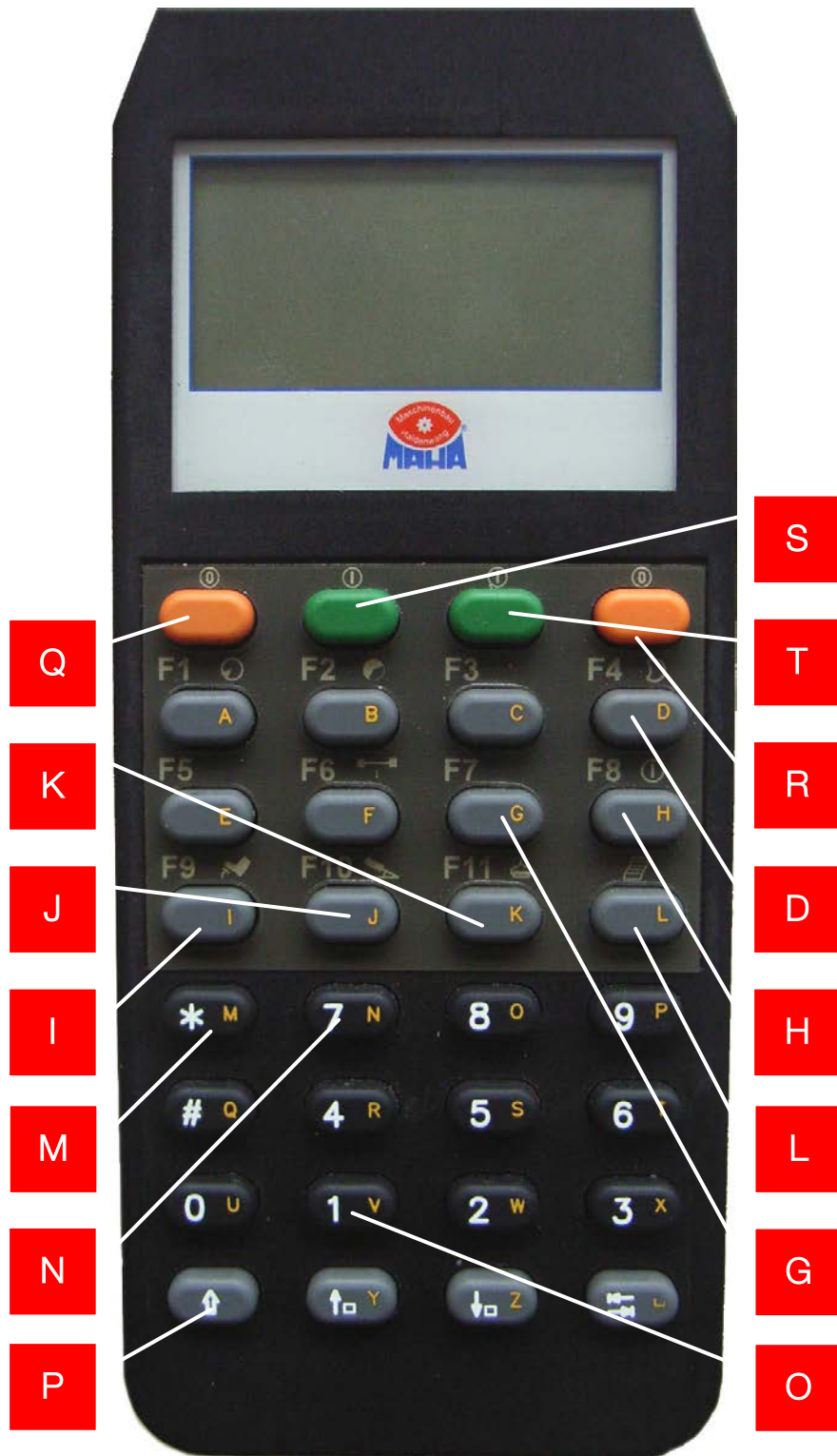
3.2 Remote Control

→ RECO 1



A	Motors Off
B	Start Motor left
C	Start Motor right / Start Ovality test
D	Menu item upwards
E	Confirm
F	Menu item downwards

→ IFB / FFB



	Key	Function
D	F4	Start Ovality test
H	F8	Pointer stop
I	F9	Store Front axle
J	F10	Store Parking brake Re-display MSD measurement value
K	F11	Store Rear axle
L	F12	Auto OFF
G	F7	Start Print menu
M	*	Confirm
N	#	Select Sensor Quit Noise detection
O	Program 1 key	
P	Shift key	
Q	Motor Off left	
R	Motor On right	
S	Motor On left	

3.3 Test Procedure

Following test procedures are available:

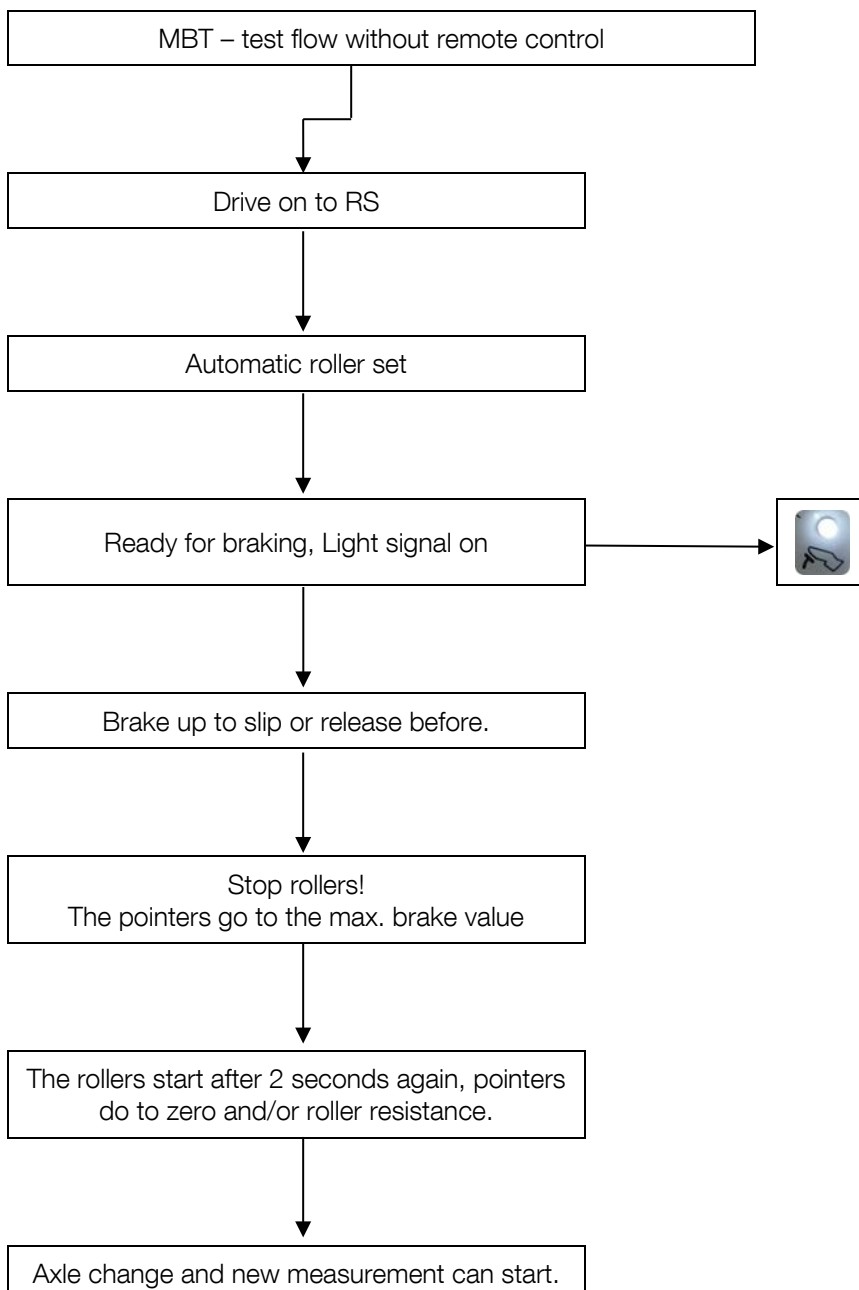
- Standard mode without remote control
- Standard mode automatic 4 wheel-drive recognition
- Standard mode blink mode
- Standard mode Reco 1-procedure
- Standard mode Reco 1-4 wheel drive procedure
- Standard mode motorcycle procedure
- Standard IFB mode with motorcycle
- Standard IFB mode with 4 wheel drive
- Standard IFB mode procedure
- NL mode with IFB
- NL mode with Reco 1
- NL mode without remote control

- NL mode wheel circumference

3.3.1 Standard Mode without Remote Control



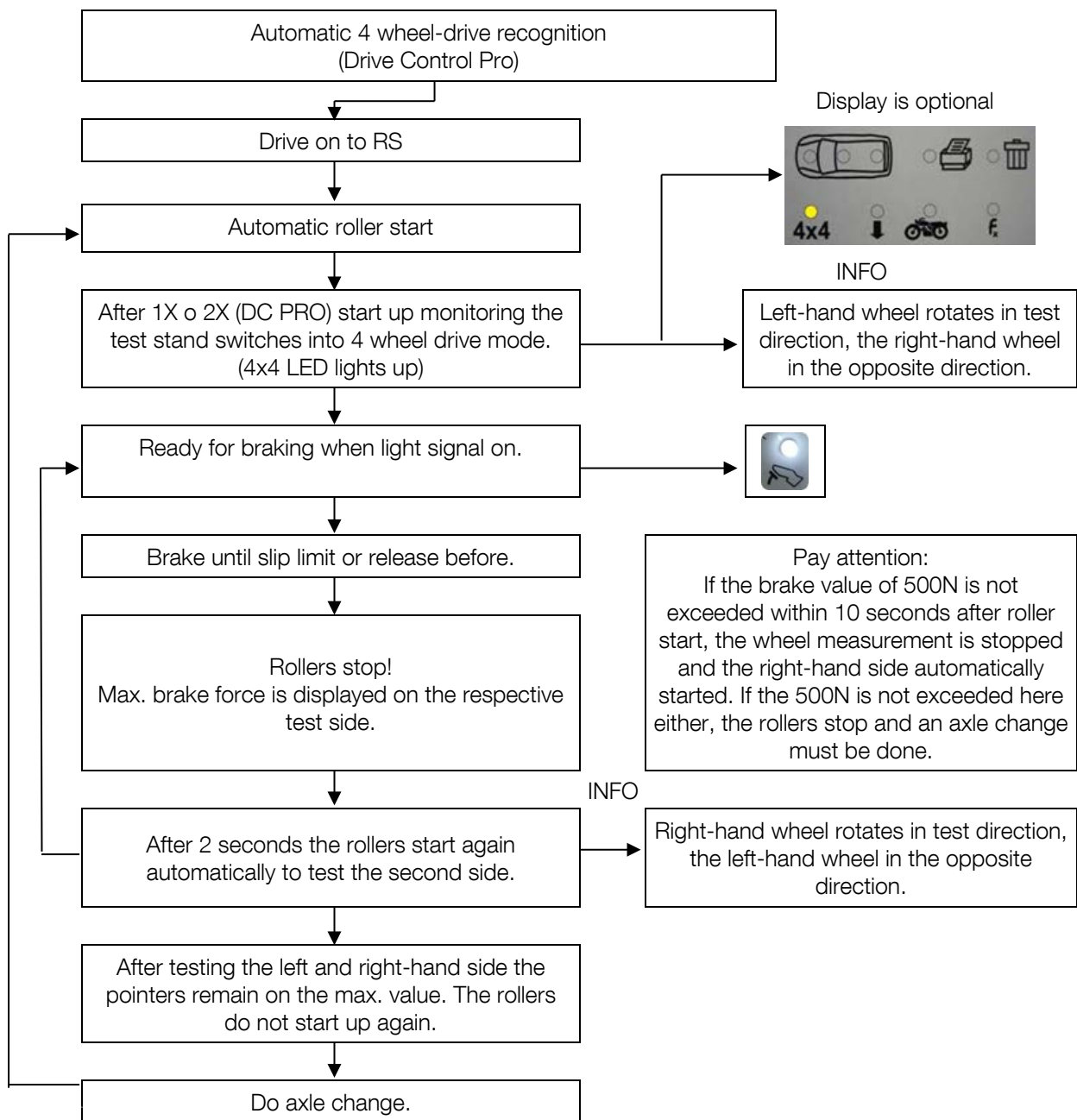
Without remote control



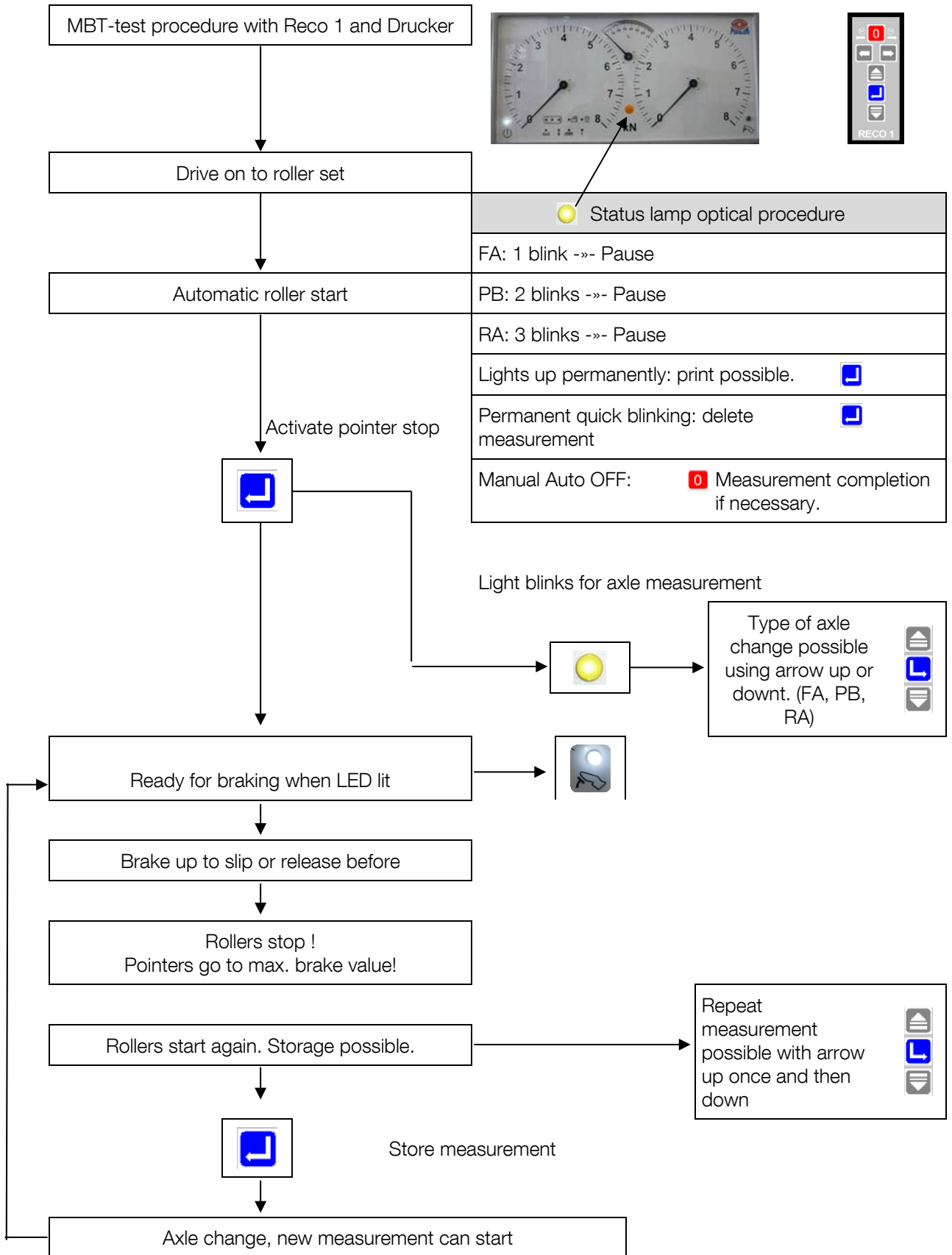
3.3.2 Standard Mode Automatic 4-Wheel Drive Recognition

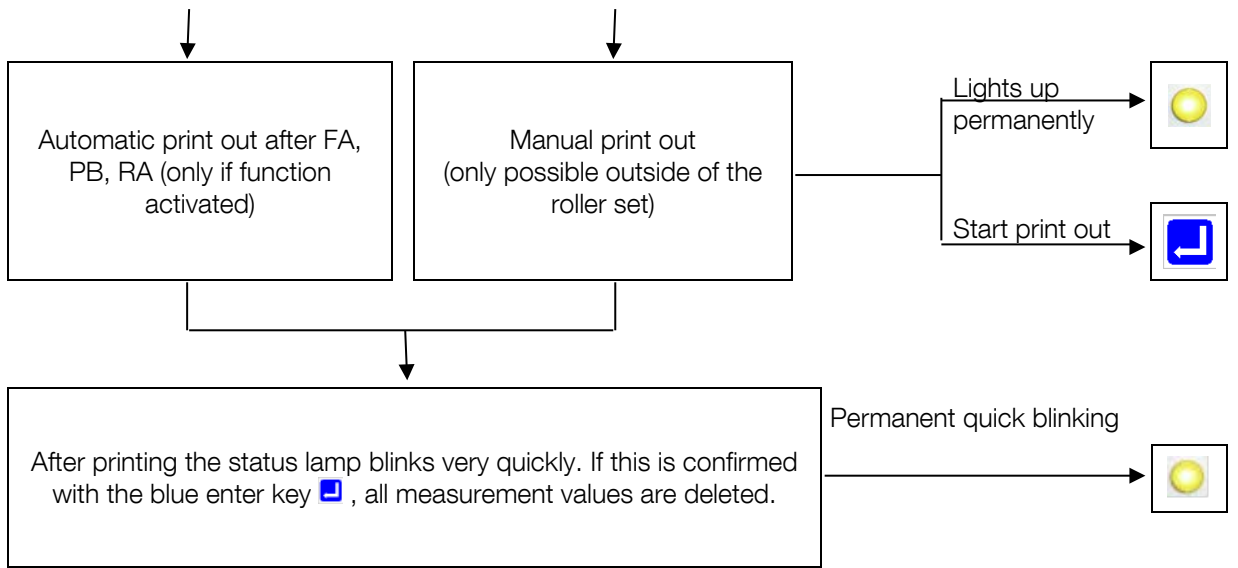


Without remote control

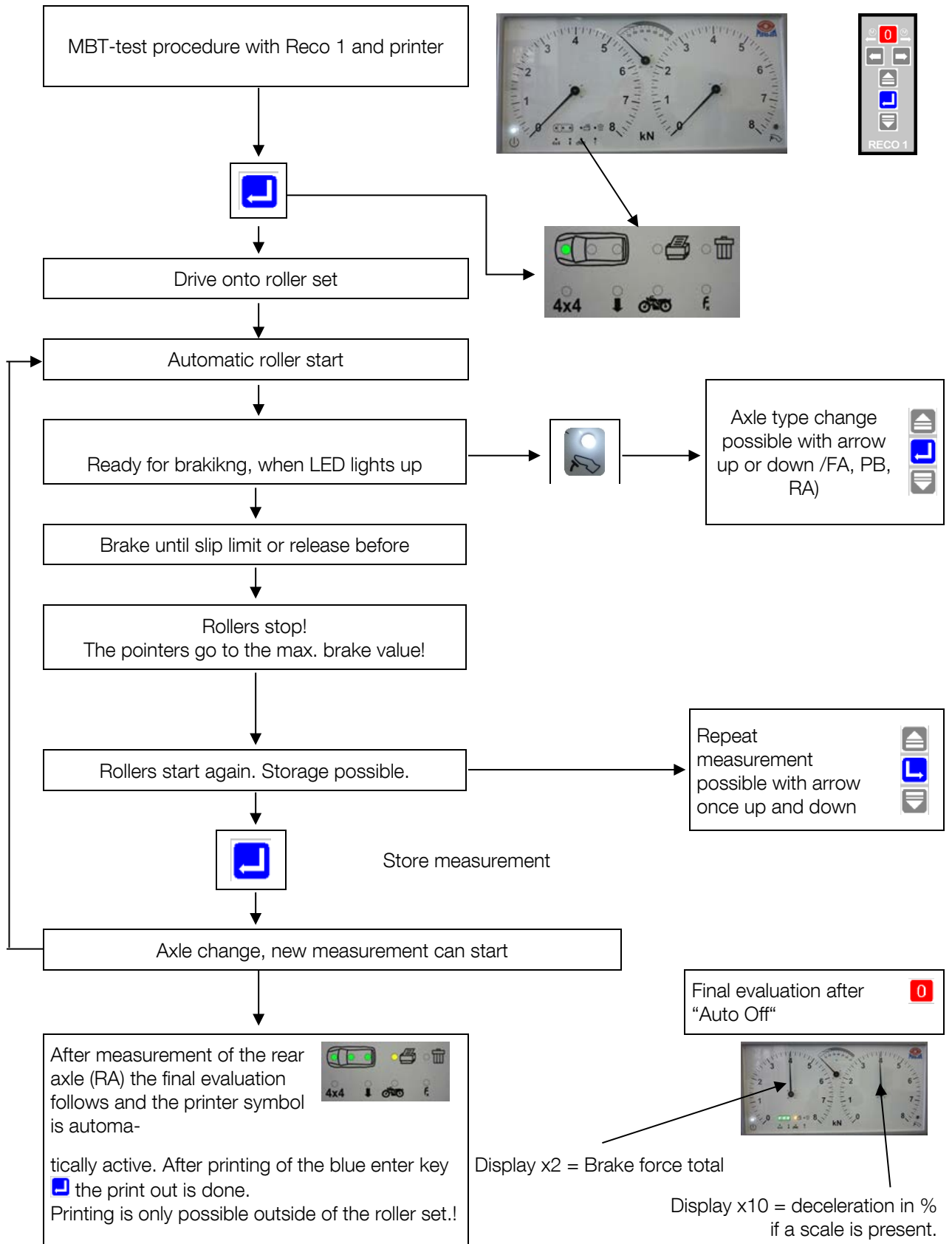


3.3.3 Standard Mode Blink Mode

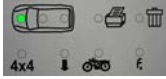





3.3.4 Standard Mode Reco 1-Procedure



If only one axle should be printed out, do a "Auto Off"






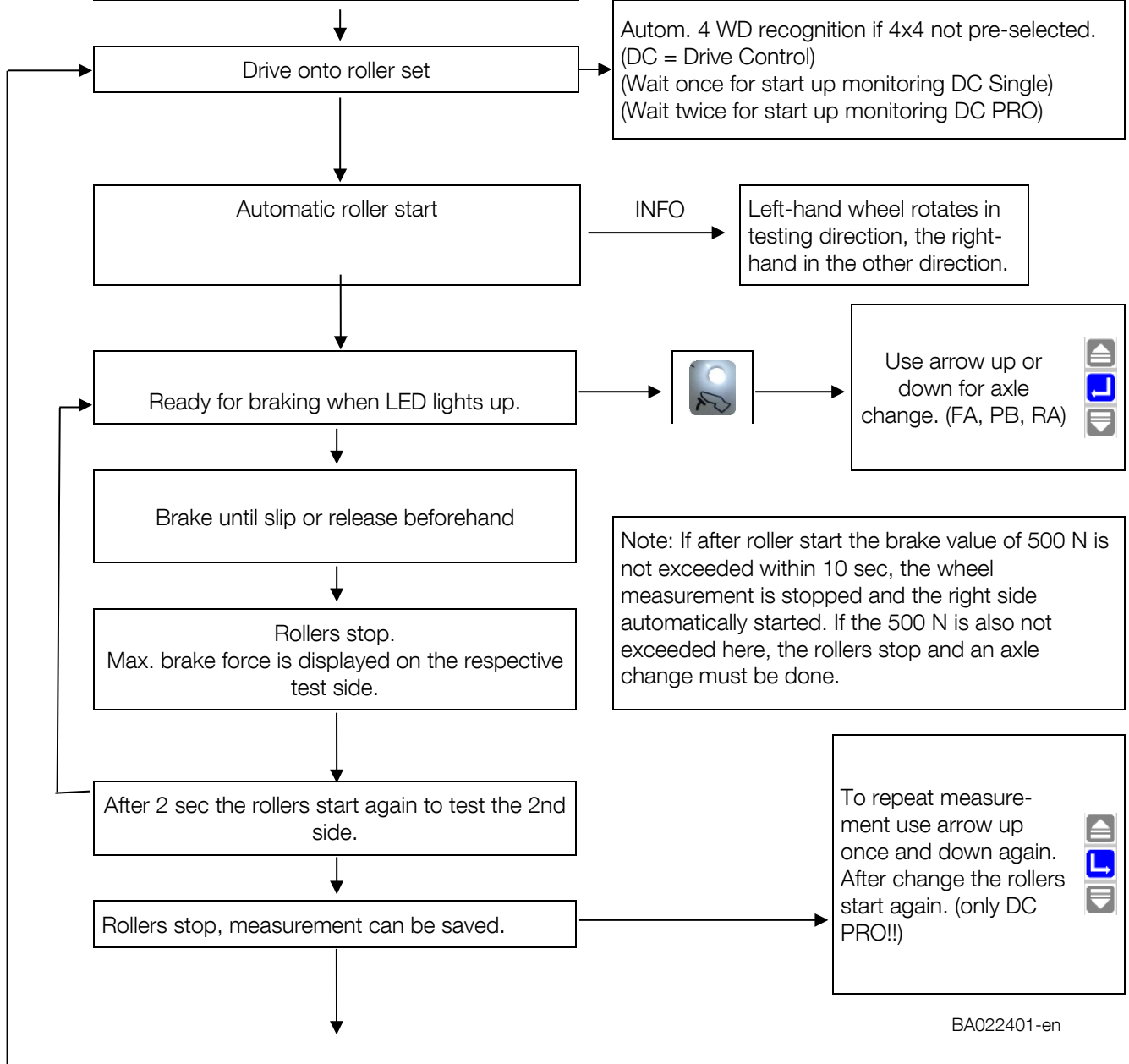
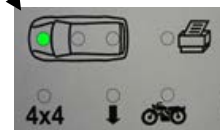
The final evaluation is done. Printing is now possible.

3.3.5 Standard Mode Reco 1-4-Wheel Drive

MBT 4 WD Test Procedure with Reco 1 and Printer




Select 4WD: (only possible outside of RS)
 Scroll to 4x4 with the Motor On key. .
 Confirm the mode with the enter key. .
 Press again to activate the measurement (FA blinks) .
 Note: If the RS is not occupied within 30 sec, there is a reset to the standard mode!




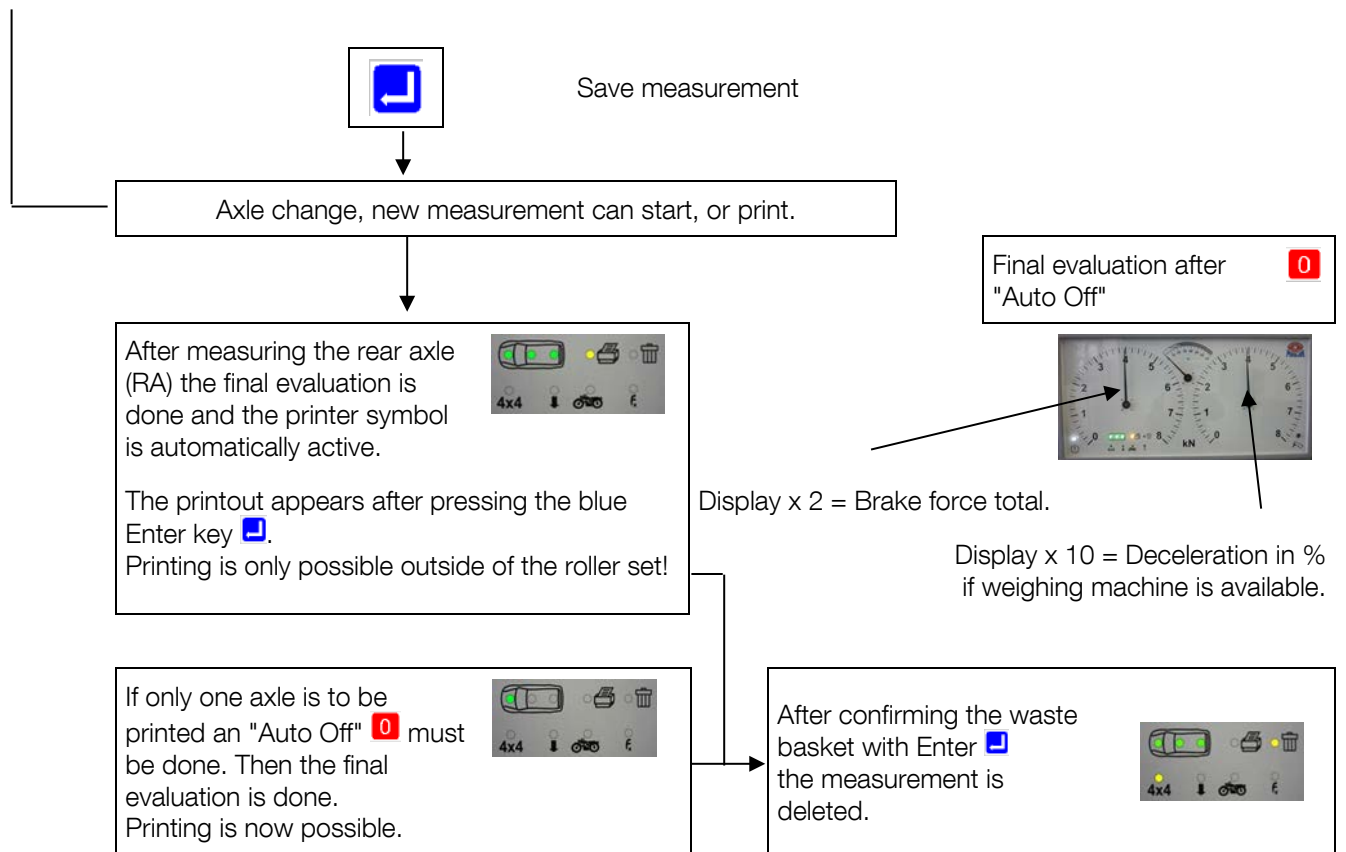
Autom. 4 WD recognition if 4x4 not pre-selected.
 (DC = Drive Control)
 (Wait once for start up monitoring DC Single)
 (Wait twice for start up monitoring DC PRO)

INFO
 Left-hand wheel rotates in testing direction, the right-hand in the other direction.

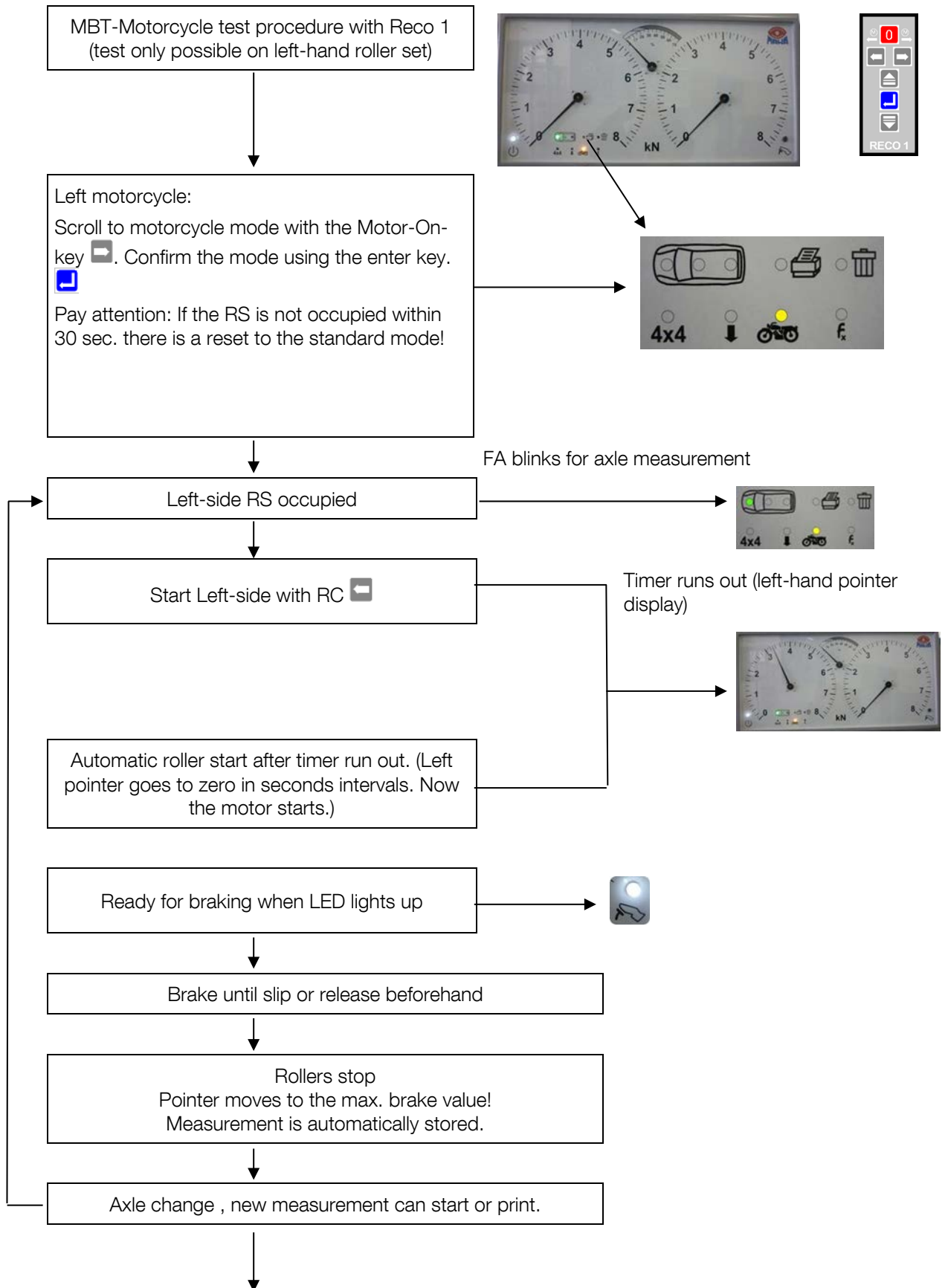
Use arrow up or down for axle change. (FA, PB, RA) 

Note: If after roller start the brake value of 500 N is not exceeded within 10 sec, the wheel measurement is stopped and the right side automatically started. If the 500 N is also not exceeded here, the rollers stop and an axle change must be done.


To repeat measurement use arrow up once and down again. After change the rollers start again. (only DC PRO!!) 

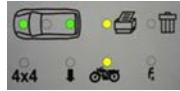



3.3.6 Standard Mode Motorcycle Procedure





↓

After measuring the rear axle (RA) the final evaluation is done and the printer symbol is automatically active. The print out appears after pressing the blue Enter key . Printing is only possible outside of the roller set!

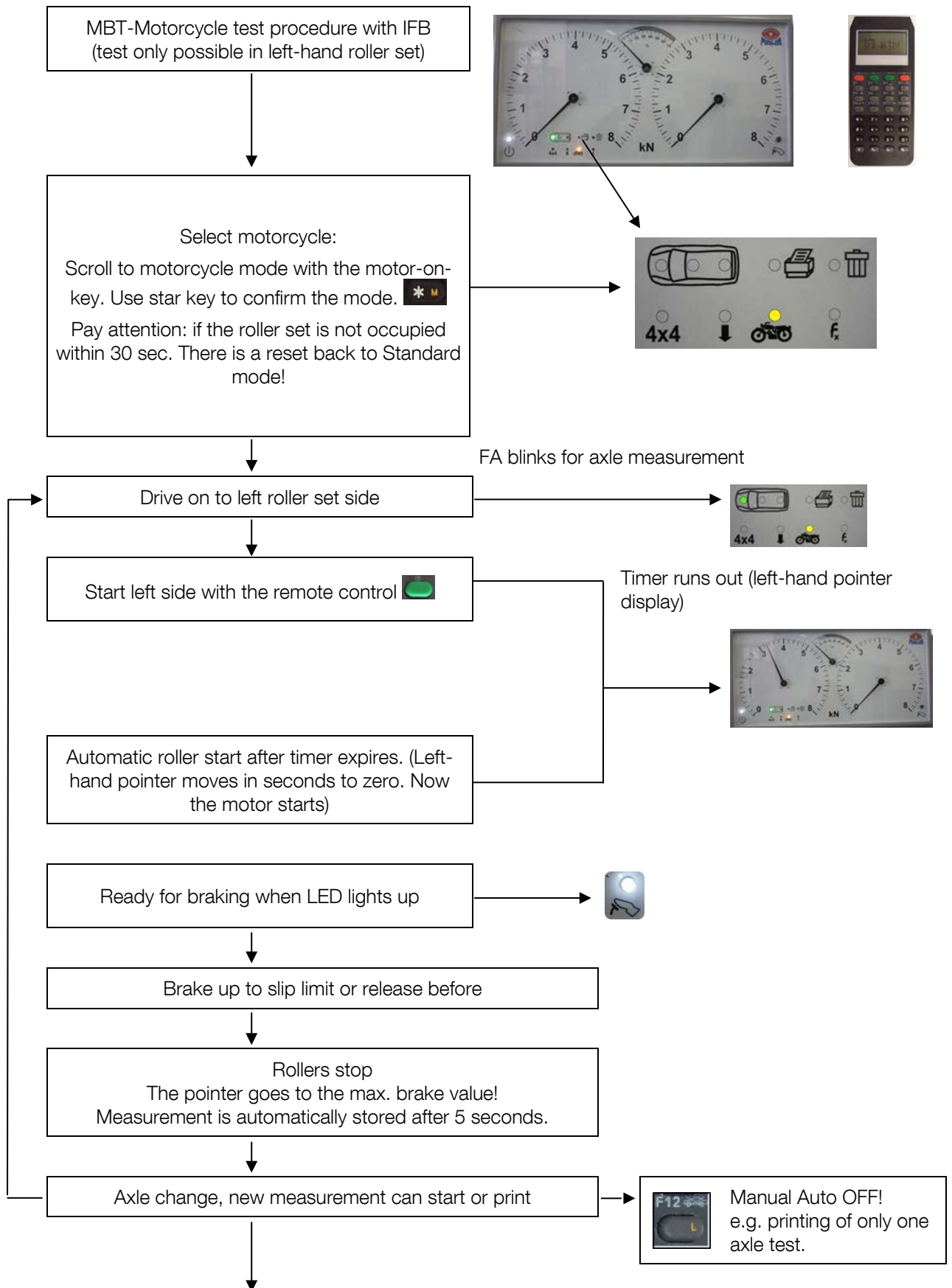


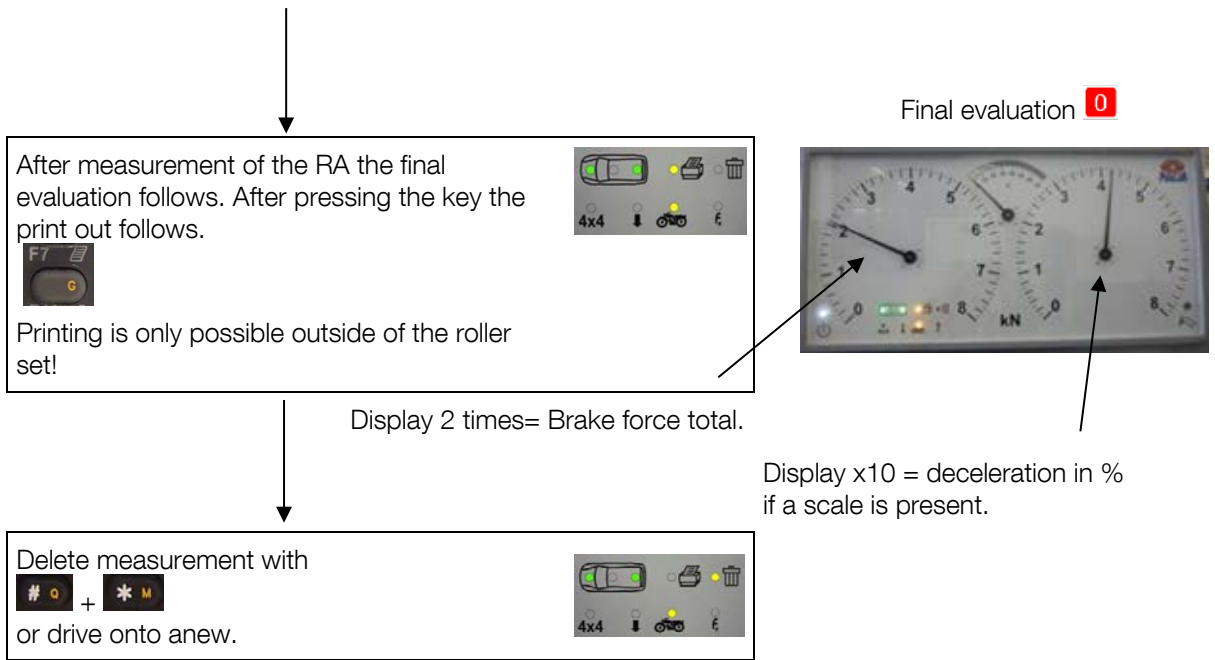


After confirming the waste basket with Enter  the measurement is deleted.

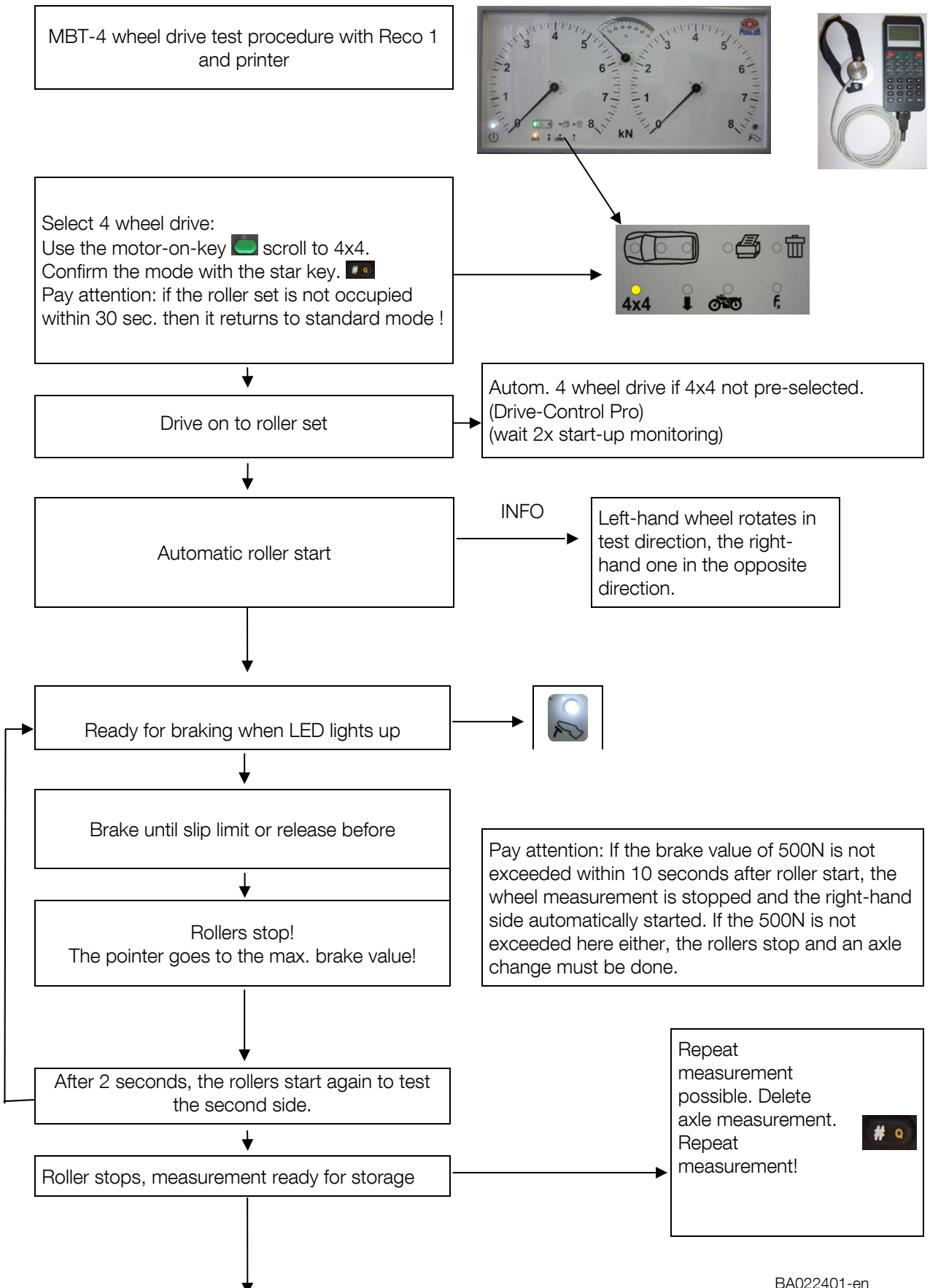


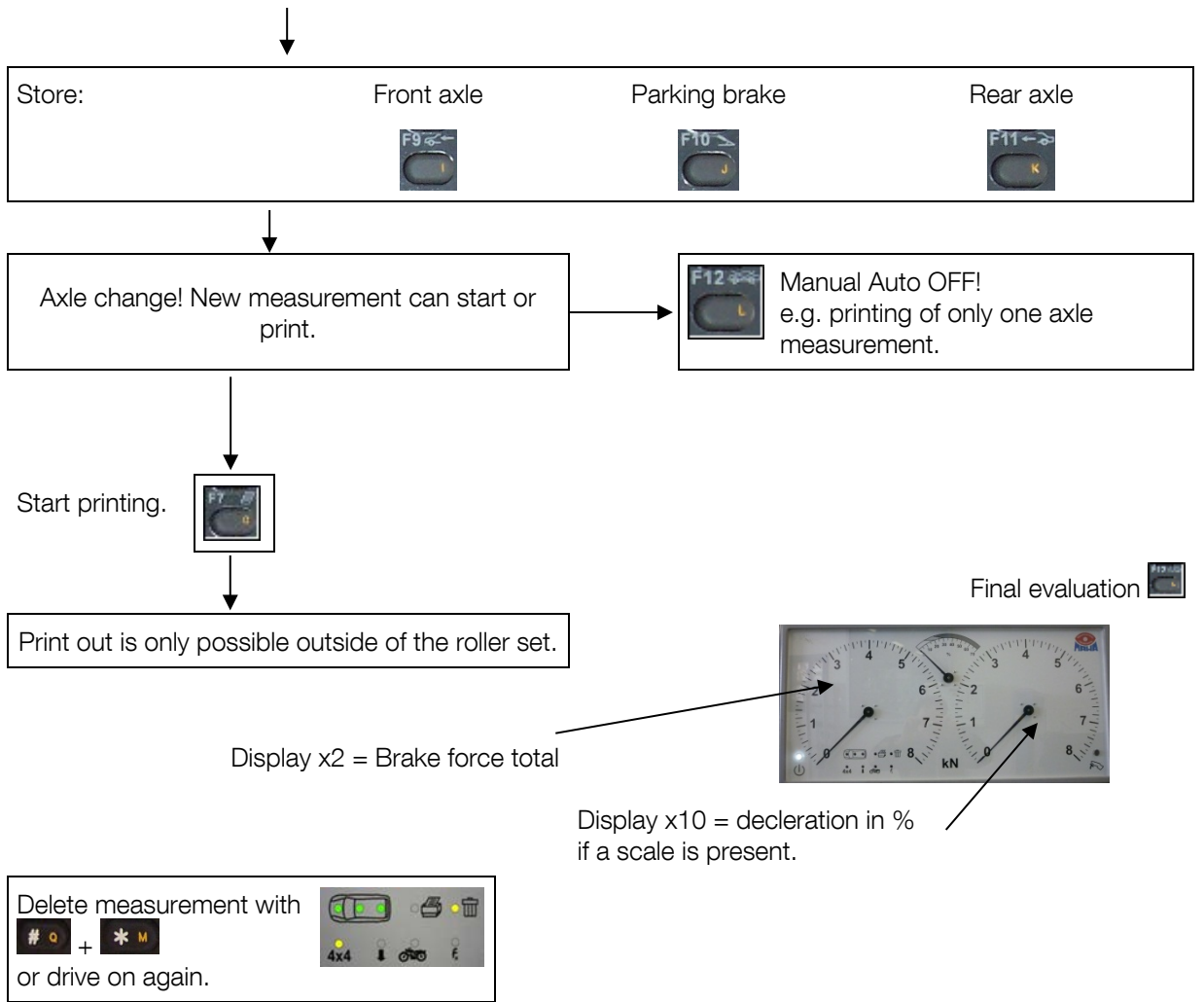
3.3.7 Standard IFB Mode Motorcycle



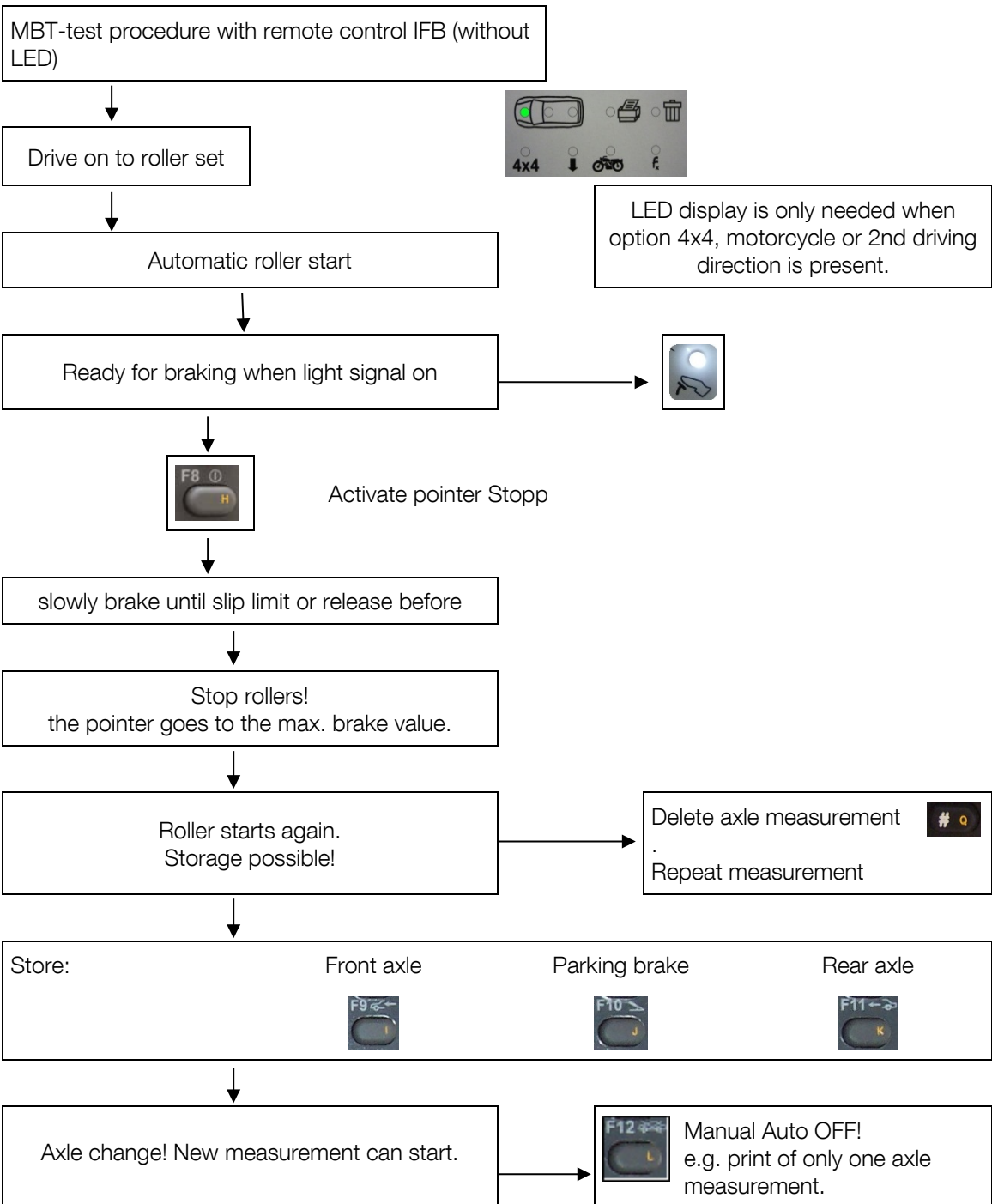
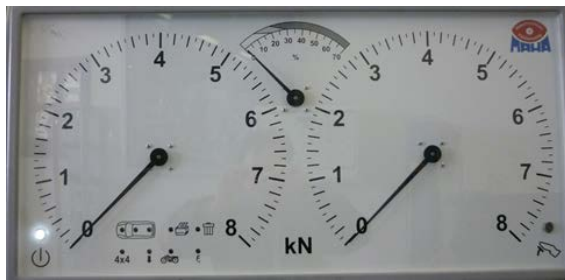


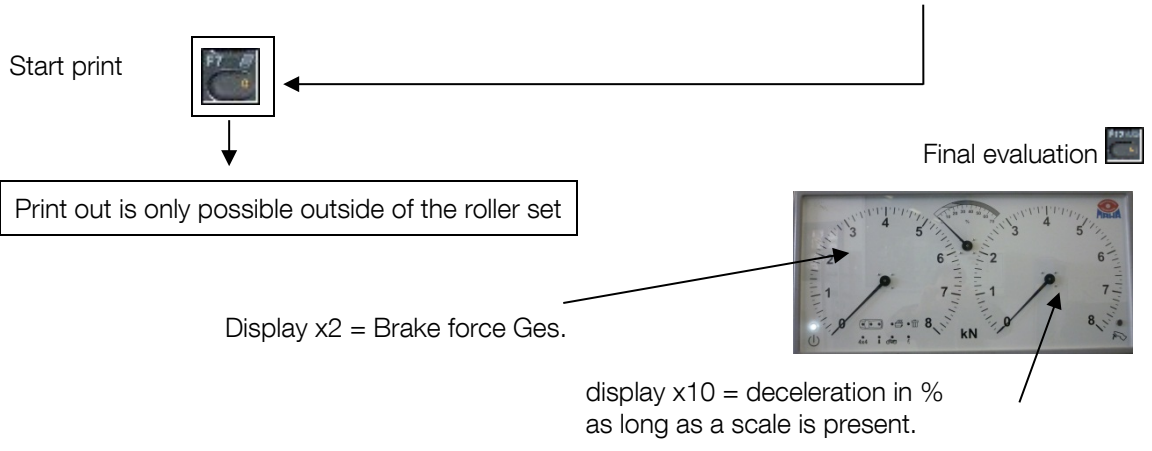
3.3.8 Standard IFB Mode with 4-Wheel Drive



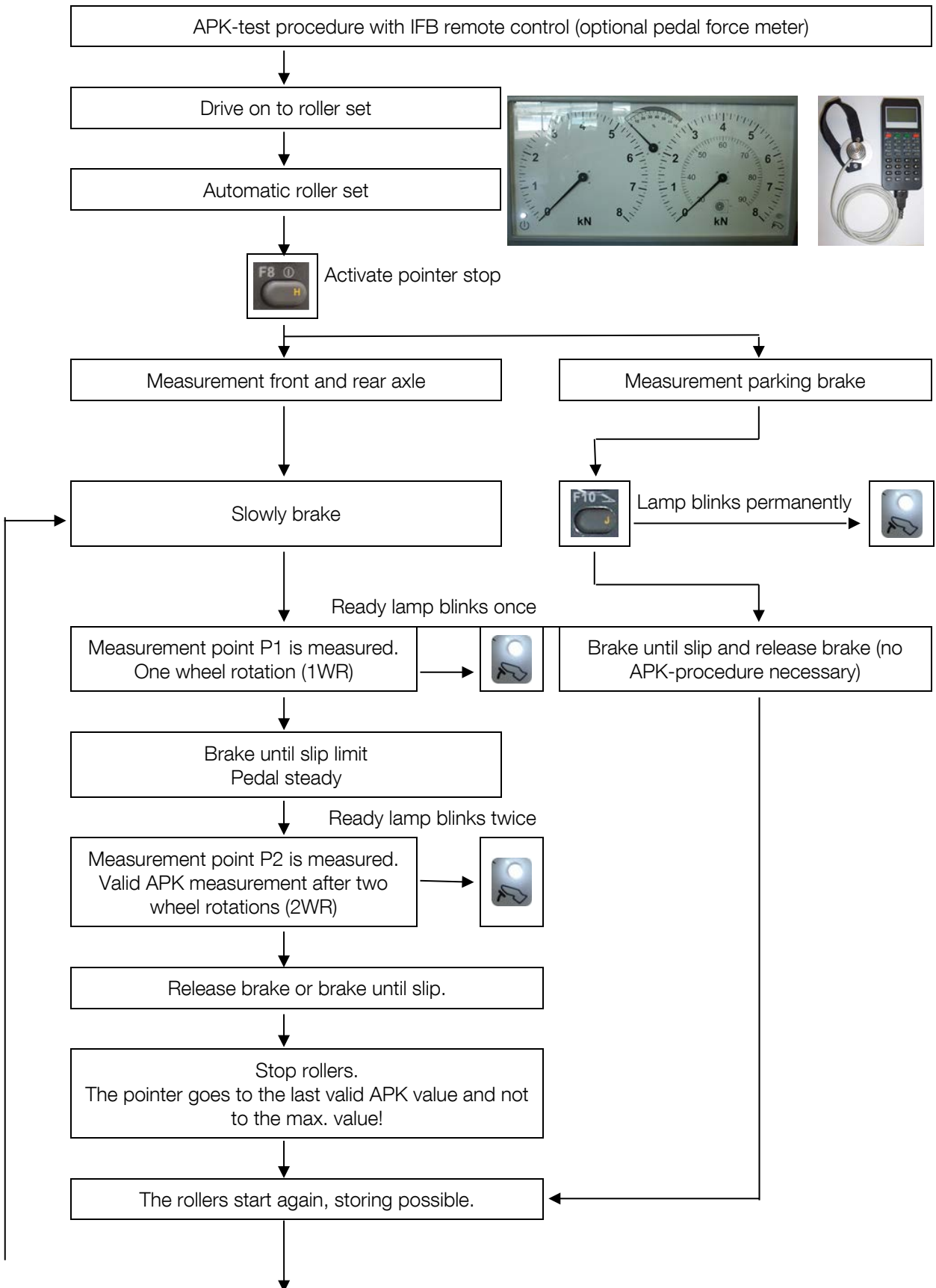


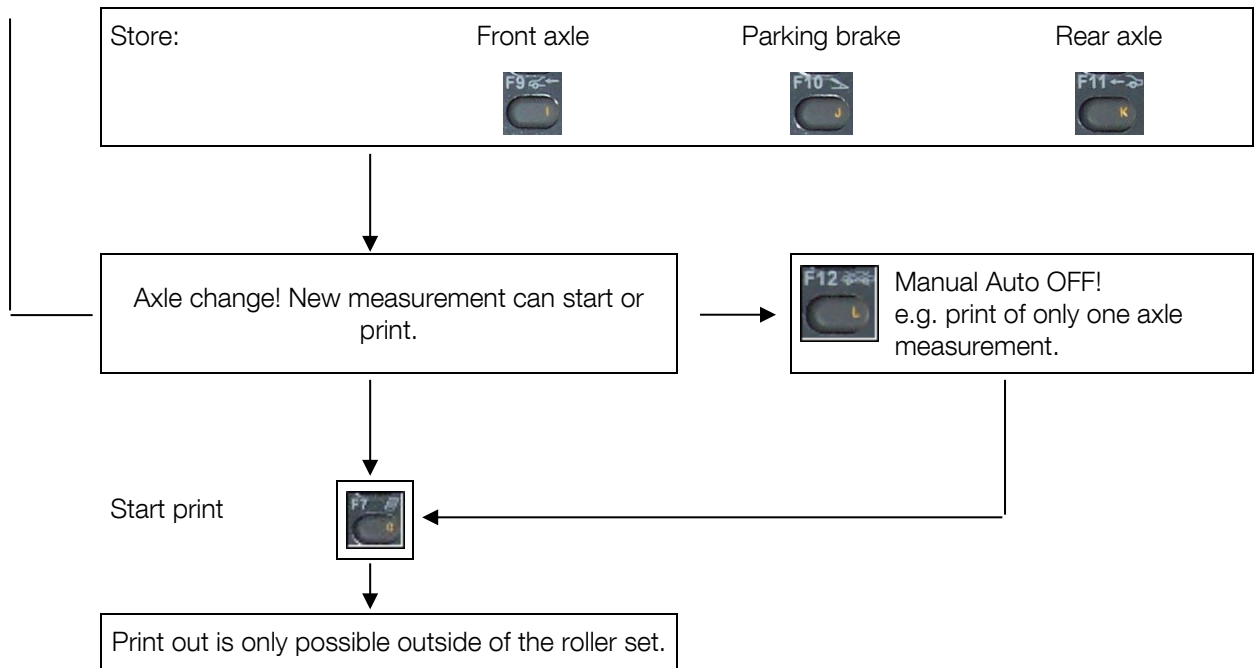
3.3.9 Standard IFB Mode Procedure



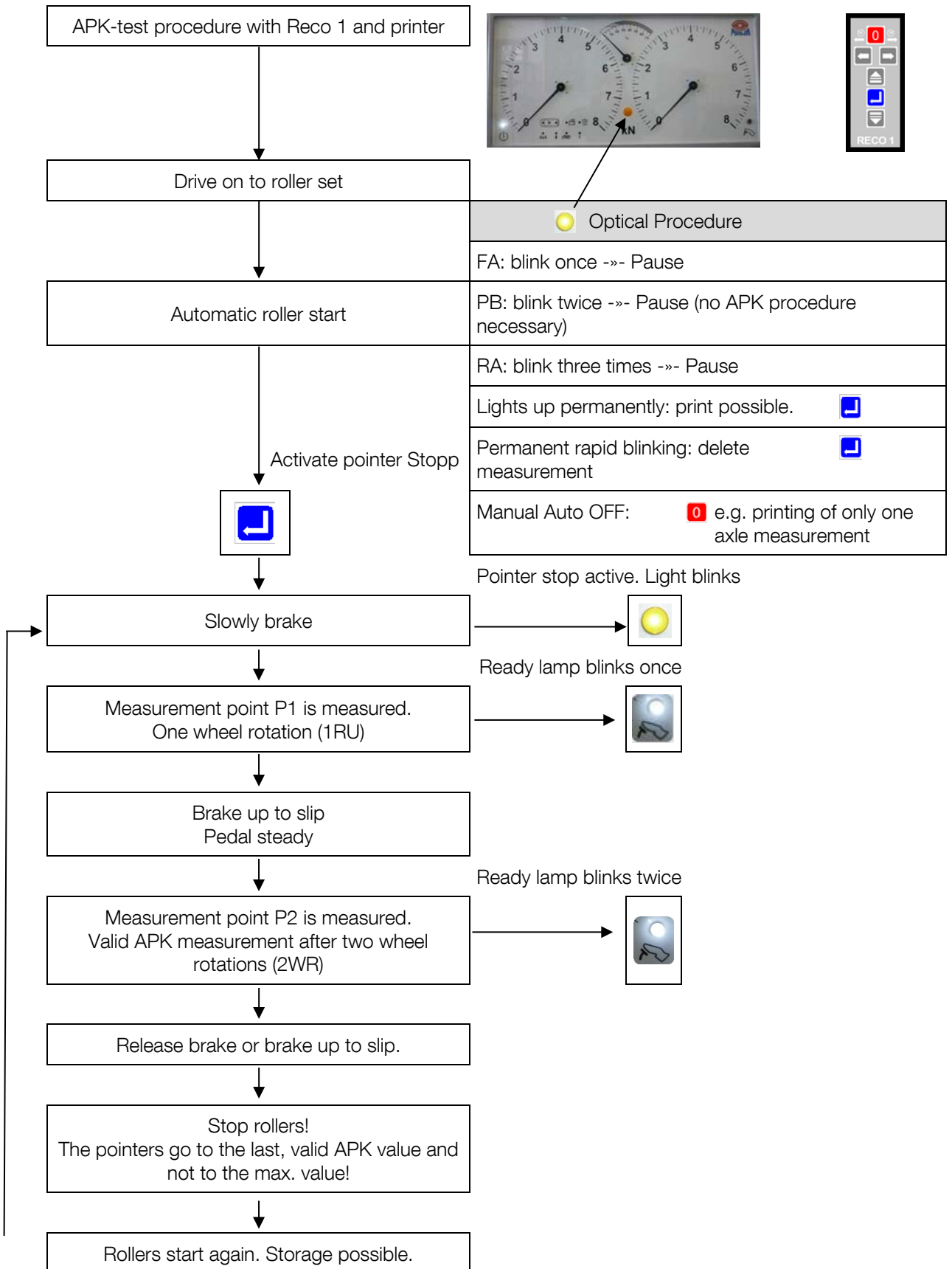


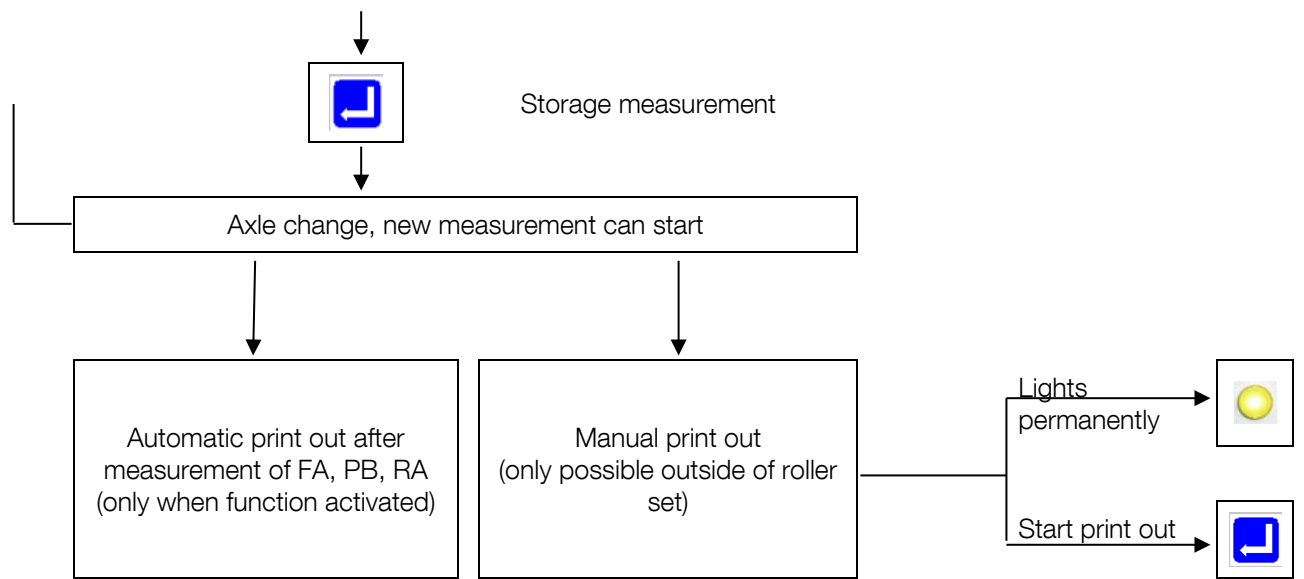
3.3.10 NL Mode with IFB



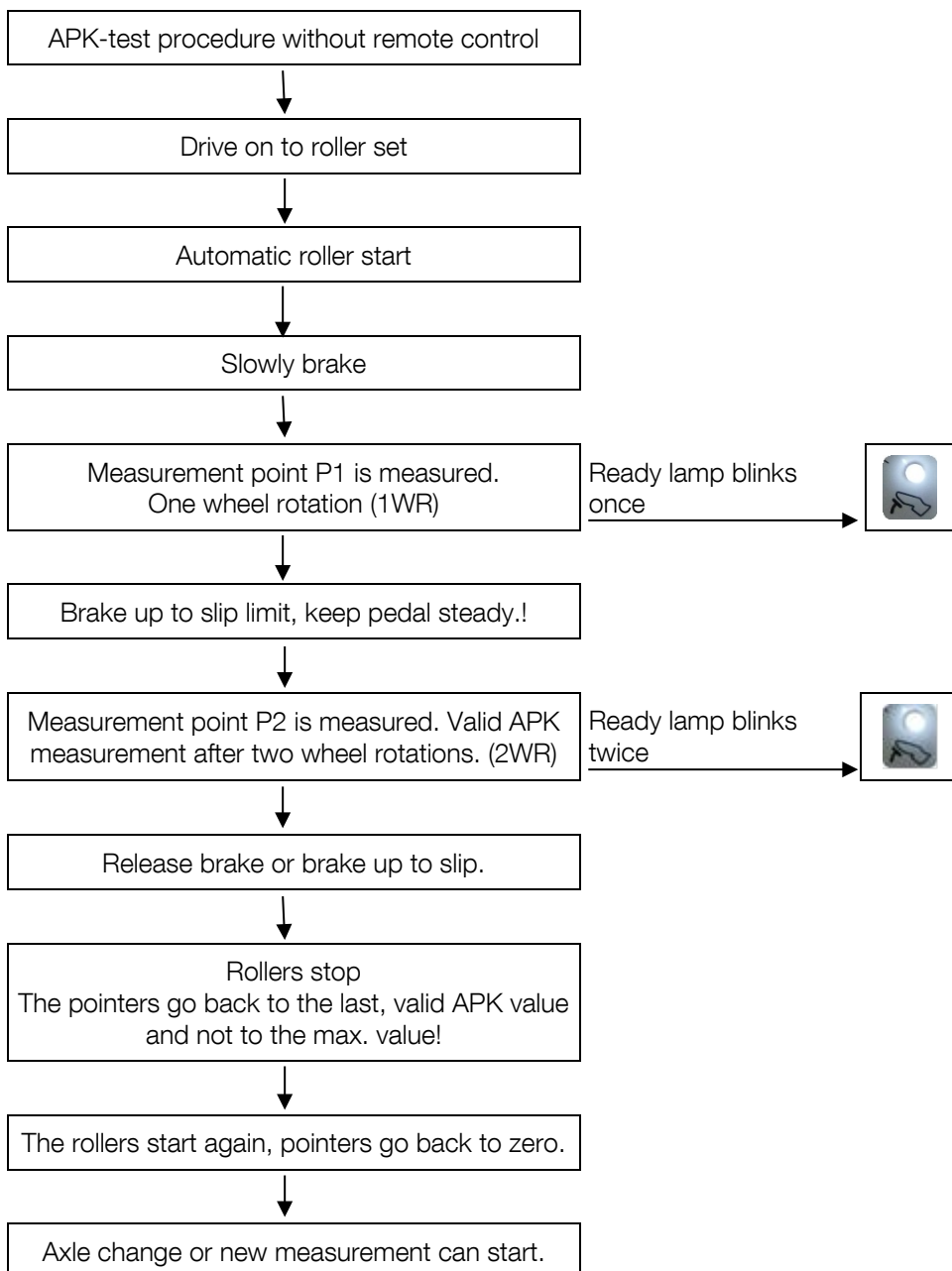


3.3.11 NL Mode with Reco 1

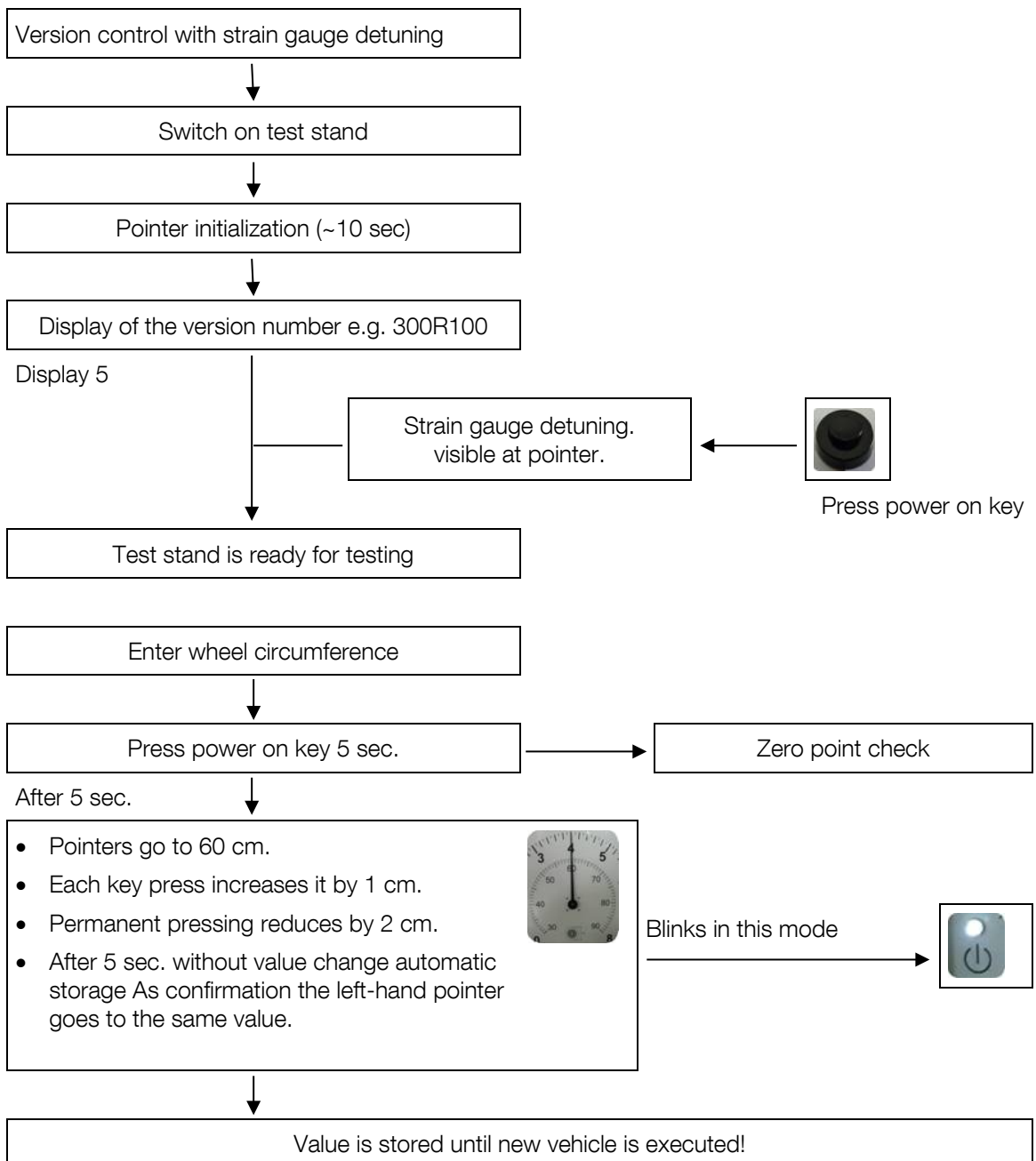




3.3.12 NL Mode without Remote Control



3.3.13 NL Mode Wheel Circumference



3.4 Deceleration Chart

Permiss Axle Load in kg	Axle Brake Force in kN															
200	50	100														
300	33	67	100													
400	25	50	75	100												
500	20	40	60	80	100											
600	17	33	50	67	83	100										
700	14	29	43	57	71	86	100									
800	13	25	38	50	63	75	88	100								
900	11	22	33	44	56	67	78	89	100							
1000	10	20	30	40	50	60	70	80	90	100						
1100	9	18	27	36	45	55	64	73	82	91	100					
1200	8	17	25	33	42	50	58	67	75	83	92	100				
1300	8	15	23	31	38	46	54	62	69	77	85	92	100			
1400	7	14	21	29	36	43	50	57	64	71	79	86	93	100		
1500	7	13	20	27	33	40	47	53	60	67	73	80	87	93	100	
1600	6	13	19	25	31	38	44	50	56	63	69	75	81	88	94	100

Deceleration in %

4 Maintenance



Danger! Electric shock hazard!

Before doing any maintenance work, turn off the main switch and protect it against tampering.

4.1 Annual Inspection



- The maintenance interval prescribed by the manufacturer is **12 (twelve) months**. This maintenance interval refers to normal workshop usage. If the equipment is used more frequently or under severe operating conditions (e.g. outdoors), the interval must be reduced accordingly.



- Maintenance work shall be done only by authorized and trained service technicians provided by the manufacturer, licensed dealers or service partners.
 - In case of non-compliance the manufacturer's warranty becomes void.
-

4.2 Maintenance by the Operator

4.2.1 Checking the Chain Tension



Maintenance interval: Monthly

Check the chain tension for the first time 14 working days after initial operation, then monthly:

- 1 Remove cover plates from roller set.
- 2 Grease the chain (A) well with multi-purpose grease along its entire length. While greasing, turn the rollers by hand.
- 3 Check that the chain has a slack of approx. 5 mm in either direction.

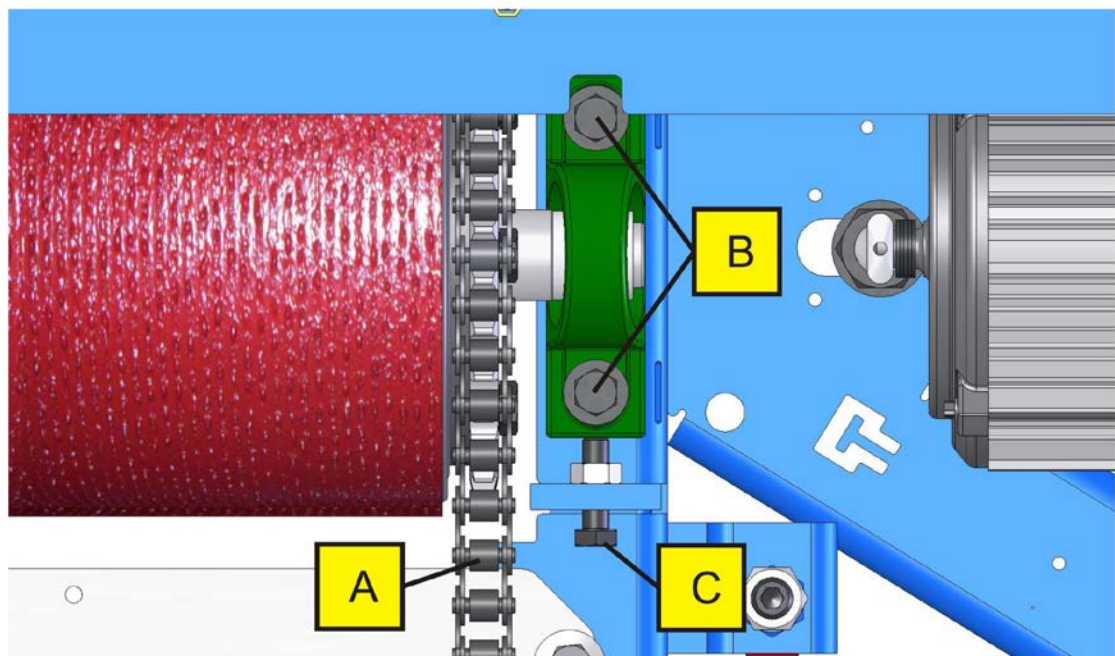
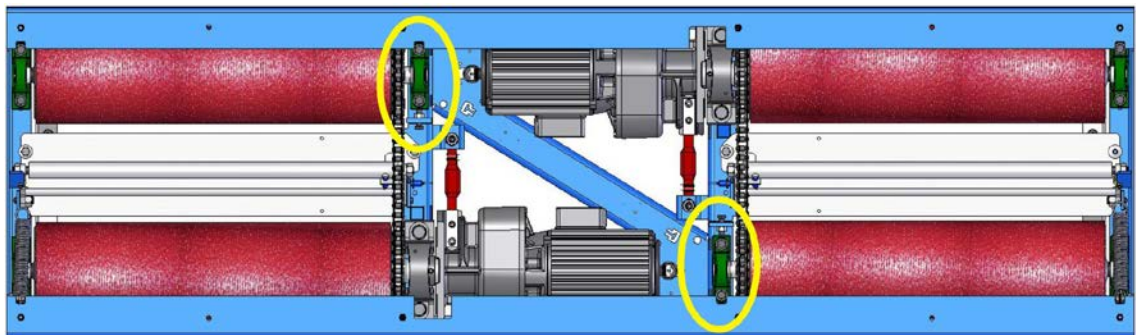
If the chain does not have enough tension, proceed as follows:

- 4 Open the fastening screws (B).
- 5 Tighten the tensioning screw (C) until the chain has the proper tension.
- 6 Retighten the fastening screws.



Brake testers with elevated roller sets: Tightening torque 500 Nm

- 7 Recheck the chain tension.
- 8 Reinstall the cover plates to the roller set.



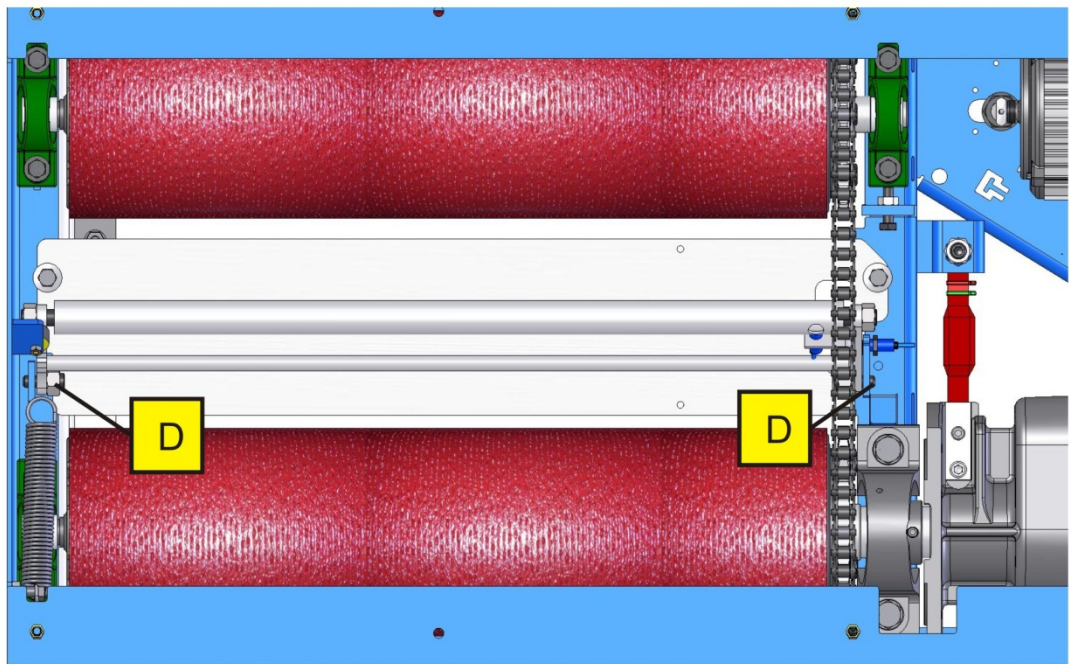
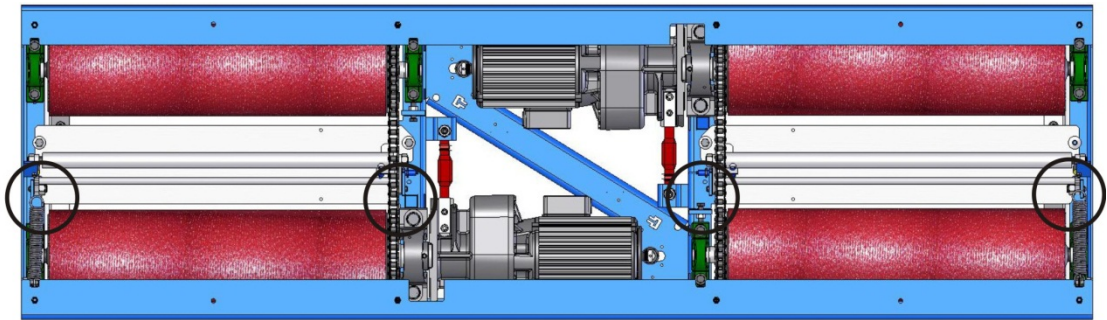
4.2.2 Greasing the Sensor Roller Hinges



Maintenance interval: 200 hours / 12 months

Grease the sensor roller hinges every 200 (two hundred) operating hours or once annually.

- 1 Remove the cover plates from the roller set.
- 2 Treat the greasing points (D) using a spray lubricant. Move the sensor roller up and down.
- 3 Reinstall the cover plates to the roller set.



4.3 Error Codes

Error code	Description	Remedy
12	Connection to multi-function display missing	Contact service
32	Left sensor roller impulse sensor defective	Check motor protection switch. If o.k. contact service.
33	Both sensor roller impulse sensors defective	Check motor protection switch. If o.k. contact service..
34	Right sensor roller impulse sensor defective	Check motor protection switch. If o.k. contact service.
40	Zero point of the brake force strain gauge outside of range	Contact service
41	Only left-hand sensor roller pressed	Drive onto both sides of test stand.
42	Only right-hand sensor roller pressed	Drive onto both sides of test stand.
50	Scale zero point outside of range	Roller set may not be occupied when switching on.
51	Test stand is already occupied when switching on.	Exit test stand with vehicle and switch main switch off/on.

4.4 Care Instructions

- Periodically clean the equipment and treat it with a care product.
- Repair damage to the paintwork immediately to prevent corrosion.
- Usage of caustic cleaning agents or high pressure and steam jet cleaners may lead to equipment damage.



Regular care and maintenance is the key condition for functionality and long life expectancy of the equipment!

4.5 Spare Parts

To ensure safe and reliable operation, only use original spare parts supplied by the equipment manufacturer.

5 Dismantling

Decommissioning and dismantling of the equipment may be done only by specially authorized and trained personnel provided by the manufacturer, licensed dealers or service partners.

6 Contents of the Declaration of Conformity

MAHA Maschinenbau Haldenwang GmbH & Co. KG

herewith declares as a manufacturer its sole responsibility to ensure that the product named hereafter meets the safety and health regulations both in design and construction required by the EC directives stated below.

This declaration becomes void if any change is made to the product that was not discussed and approved by named company beforehand.

Model:	MBT 2100 / 2110 / 2120 / 2130
Designation:	Roller Brake Tester Rated Axle Load 3000 kg (4000 / 5000 kg optional) Motor Power 2 x 2.25 kW (2 x 4 kW optional)
EC Directives:	2006/42/EC; 2014/30/EU
EN Standards:	EN 12100-1/-2; EN 13850; EN 13857; EN 349; EN 60204-1; EN 61000-6-3, EN 61000-6-2

7 Company Information

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The contents of this edition have been checked with great care. However, errors cannot be fully excluded. Subject to technical change without notice.

Document

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