

# User manual for ML2000

## Maintenance

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## 6 Maintenance

### 6.1 Introduction

This chapter describes how to maintain the ML2000 system. It is important to follow the directions in this chapter in order to keep the system in a condition to meet the requirements also after a period of use. In general the precision of the shot detection is dependant upon the tightness of the sound chamber and the thermal isolation of the sound chamber for outdoor targets.

Maintenance will also extend the durability of the system in addition to sustain the level of precision. In total this will increase the level of satisfaction for the users.

Some organisations have defined requirements for logging the maintenance activities. We have included a simple example of a protocol for maintenance tracking (appendices).

#### 6.1.1 Use and storage in low temperature

*Temperature below -25 °C can damage the LCD screen in the display unit (this can happen both during use and storage)!*

If the targets are not used during a cold winter season, it would be an advantage to store the target unit, target connection cabinet, power supply and display units in a tempered storage. Remember to mark the equipment to simplify remounting.

If the target unit is stored outdoor it should be placed under a roof or covered. The sensor unit should be left in the target.

The battery must be kept charged in order to avoid damage if it is stored in a non-freezing location,

We will not recommend use of the equipment below -10° C, since the wearing of rubber increases and the LCD gets very slow. By accepting higher rubber cost and installing heating on the shooting stand this limit can be exceeded.

#### 6.1.2 Sound pressure values

The most important factor to sustain the precision of detection is the tightness of the sound chamber. With increasing wearing of the rubber sheets the propagation of the sound waves will be influenced negatively. Megalink has patented a technique for measurement on the sound waves in order to indicate the pressure level of the sound wave that hits the sensors. This measurement has in practice proven its value to assist in the evaluation of the quality of shot detection.

In particular we can see that cal. .22 and air weapons require even values in order to achieve precise detection. If during a series there can be observed values deviating from the acceptable range, the rubber or paper band needs additional advance and/or inspection. If this maintenance is not respected, the system can give significant faults in detection.

Keep in mind that the pressure values can be acceptable for a single shot that has a significant fault in detection. The sound chamber wearing should still be obvious when the pressure values for the rest of the series are evaluated. The reason for this phenomenon is that the detection fault is caused by one sensor detecting a strong sound wave number two or three instead of the first weakened wave.

### 6.1.3 Guidelines for evaluating sound pressure levels

The following guidelines could help in evaluating the sound pressure values:

Target/Calibre	Normal: Average within	Normal: Value within	Possible fault: Average outside	Possible fault: Value outside
3U490 Big bore	26-37	20-45	19-45	0-90
3U490 Small bore	22-33	20-35	17-39	0-90
3U650 Big bore	26-37	20-45	19-45	0-90
4K300 Small bore	28-41	25-45	18-50	10-70
4K300 Air weapon	22-29	20-35	10-40	10-55
4K187 Small bore	28-41	25-45	18-50	10-70
4K187 Air weapon	28-41	25-45	18-50	10-70
4K560 Small bore	24-45	11-55	15-60	3-75
4K560 Big bore	24-45	11-55	15-60	3-75

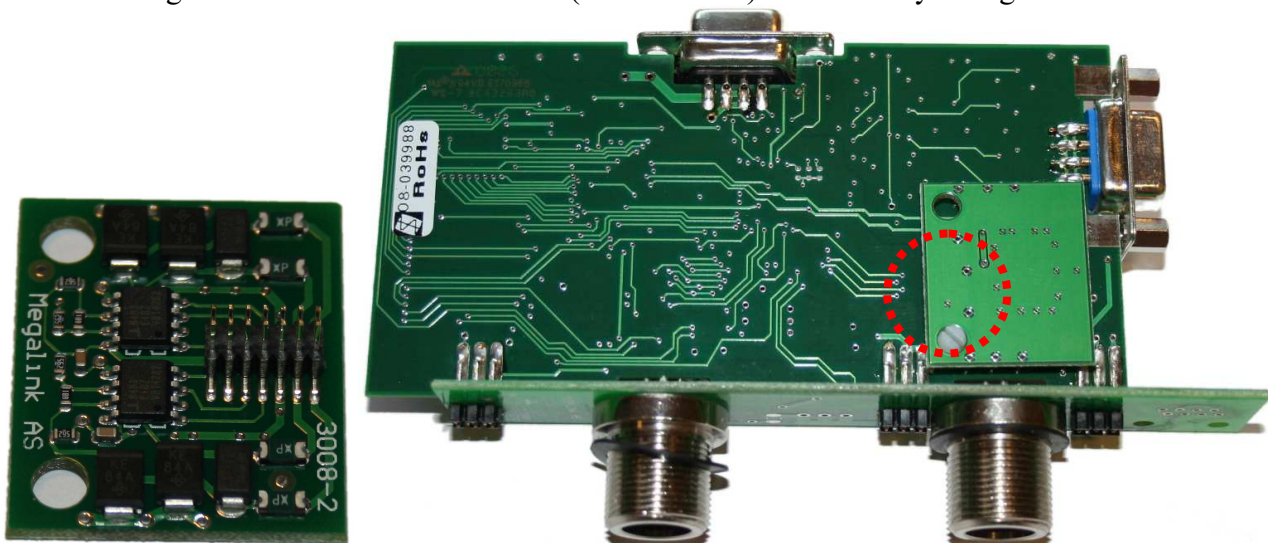
Planned versions of MLRange (the range management software) will be embedded with more analysing functionality to assist in the evaluation of detection quality.

NB! Observe the following comments!!

- The values in the table above is only a temporary guideline (more accurate values will be defined after further testing)
- A firm conclusion can never be made based on values for a single shot
- There are certain overlapping pressure characteristics between correct and faulty detected shots.
- The reasons for deviations in sound pressure levels can amongst other reason be due to:
  - wearing of sound chamber (interference, leakage of sound pressure, uneven propagation in different directions etc.)
  - faulty sensors or electronics
  - shot in the target frame
  - ricocheting bullet or particles
  - two shots simultaneously in the same target

### 6.1.4 Changing the communication circuits

On newer targets the communication circuit (art.nr.3008-2) can be easily changed.



Use a flat-nosed pliers to loosen the card from the target circuit.

Older target circuits must be sent to Megalink for service.

## 6.2 Maintenance for 3U490/3U650/3U650E

### 6.2.1 Rubber band

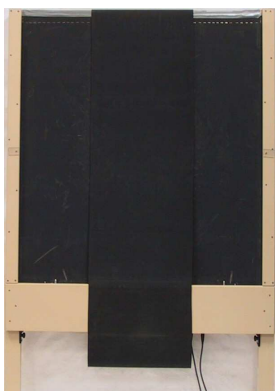
The following table indicates the expected number of shots before rubber belt should be mounted or moved. The numbers are strongly dependent upon bullet type and scattering pattern. For this reason the sound pressure values could be a better indicator for the need of maintenance.

**NB! Remember to move the rubber band up in front in order to remove the worn area from where the sound waves propagates.**

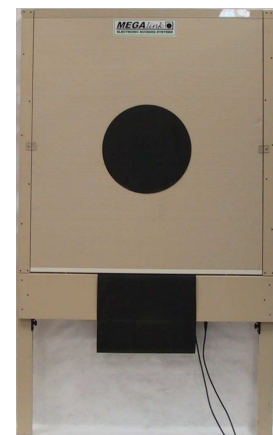
Range	Bullet types	Shooting	Shots without rubber band	Shots before moving	Distance to move
300m	6.5mm-7.62mm Type A	DFS/FSR/ISSF	1500 (-3000)	1500 (-3000)	15cm
200m	6.5mm-7.62mm Type A	DFS	1000 (-2000)	1000 (-2000)	10cm
100m	6.5mm Type A	DFS	300 (-400)	300 (-400)	6-8cm
100m	6.5mm Type B	DFS	150 (-200)	150 (-200)	6-8cm
100m	Only ca. .22	DFS	250 (-400)	250 (-400)	6-8cm
100m	Cal. .22 and 6.5mm Type B	DFS	0	1)	6-8cm
100m	Solid jacket or Lead point	Hunting test	500 (-1000)	500 (-1000)	10cm (-20cm)
100m	Solid jacket after NJFF rules	NJFF	3000-4000	3000-4000	30cm

- The shot count is given for shooters with normal high precision. With more scattering, the interval can be increased to the level given in parenthesis. The sound pressure values will always be a safer guide for evaluating the need for maintenance.
  - Type A: Bullets with small holes in the point of the jacket (e.g. Sierra bullets)
  - Type B: Bullets with large holes in the point of the jacket
- 1) When starting with cal.. .22 after 6.5 with large holes, the rubber band should be moved. Otherwise the ordinary interval for each calibre should be followed.

### 6.2.2 Installing rubber band with manual advance



- Remove the top cover, front and back target
- Place the rubber band over the target as shown on the picture to the left
- The belt joint should be placed at the back of the target and in the height of the target centre
- Mount the back target
- Mount the front target and ensure that the band is slightly stretched by the front target and that the front target provides a slight pressure on the band towards the main



rubber sheet (the tightness in the front is critical)

- Mount the top cover
- Test the target. Even sound pressure levels should be achieved.

### 6.2.3 Rubber band with automatic advance

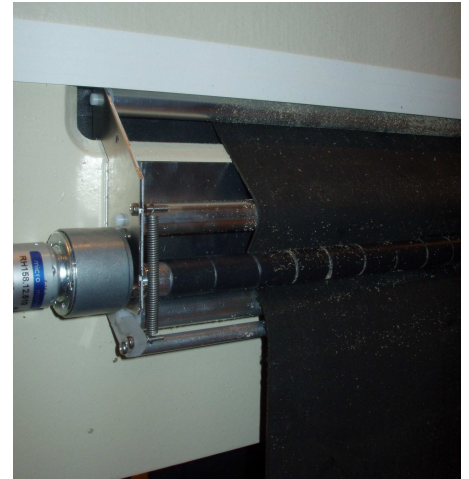
The automatic rubber band advance for 3U490 and 3U650 is controlled by the software in the target unit. The following table gives an overview of recommended values for configuration of the advance. Remember that very good or poor shooting will give other values for optimal advance.

Range	Bullet types	Shooting	Frequency	Advance
200m	6,5mm-7,62mm Type A	DFS	60	10
100m	Kal. .22 og 6,5mm Type A	DFS	20	10
100m	Jacketed/Hollow point 2)	Hunting	20	10

- The shot count is given for normal high precision shooting. The best guide for the parameter setting is the sound pressure values.
- Type A: Bullets with small opening in hollow point bullet (e.g. standard Sierra bullets)
- Type B: Bullets with large opening in the hollow point bullet (e.g. hunting ammunition)

### 6.2.4 Installing rubber band for automatic advance

- Remove top cover, front- and back targets
- Press down the grip rod and remove it
- Remove the old band carefully
- Insert a new rubber roll in the holder under the target and thread the band through the guiding rollers in the front of the target.
- Lead the band over top rollers and down to the motor unit at the back
- The band is threaded behind the upper guiding roller and into the motor mechanism. The band should follow the rubber coated driving roller. Insert the pressure roller again. The band should pass in front of the grip rod.
- Remount the front and back targets and the top cover
- Push the test button on the motor unit and verify that the band moves behind the front and back targets. This will also prepare the target for shooting by stretching the band.
- Test shoot the target and verify the sound pressure values.



### 6.2.5 Maintenance of main rubber sheet

Holes after ricochets that are not covered by the rubber band should be patched with 50mm tape or rubber patch.

When the main rubber sheet is heavily worn in the centre, there is a risk for rubber pieces to fall down or hang inside the sound chamber. To avoid this there should be cut a circular hole in the main rubber sheet at the front and back of the sound chamber. We recommend doing this when the rubber bands are mounted on the target.

- Cut a hole with 24cm diameter on 100m and 200m
- Cut a hole with 35cm diameter on 300m

### 6.2.6 Rubber in aiming area

The rubber in the aiming area should be patched to reduce rain penetration, sound isolation and temperature isolation against the sound chamber. Avoid holes that are larger than 5 cm.

There is a high risk of faulty detection if there is a large hole in the front target and also heavily worn out rubber band. One peculiar result of this could be that high shots in a straight line above the target centre will be marked in the centre of the target.

### 6.2.7 Isolation in front and back targets

The Styrofoam in the front target needs to be kept intact. We recommend to replace a square in the centre of the target with a foamed plastic plate. Megalink can deliver these in formats 30x30 cm or 40x40 cm. The foamed plastic can also be used in the back targets (skip glass fibre wallpaper and aiming rubber in the description below)

The following procedure can be used for repairing the front targets:

1. Cut a square of 30x30cm (or 40x40cm).
2. Insert the 20mm foamed plastic plate (or Styrofoam)
3. Brush glue on the foamed plastic and 10cm into the old front area. Use water based wallpaper glue for damp rooms (e.g Bostik 78)
4. Put on new glass fibre wallpaper and let it dry
5. Paint with water-based acrylic masonry paint (Colour code OK024, RE007, SV029)
6. Mark the centre and draw a circle with the same diameter as the aiming area. The height from the bottom of the front target to the centre is 550mm for 3U490/3U650E and 805mm for 3U650. The aiming area should be centred sideways on the front target.
7. Brush on water-based contact-glue within the circle and on the rubber. Avoid spilling and wasting since the glue can be coloured in sunlight.
8. Allow the glue to dry well. In humid weather a warm air dryer should be used.
9. Put two transparent plastic films over the glued area and put the rubber in the right position
10. Pull out one of the plastic films and squeeze the aiming rubber onto the glue
11. Pull out the other plastic film and squeeze the rubber firmly onto the glue

### 6.2.8 Cleaning the microphones

The ML2000 system is not very sensitive to dust and dirt on the microphones. Even a fairly thick layer of dust will not influence on the detection. The sound pressure values will also provide valuable feedback if dirt or particles are interfering the detection.

We will still recommend removing dust and dirt at least once a year or more often in case of intensive use.

### 6.2.9 Changing the microphones

Newer targets are delivered with changeable microphones, (art.nr.5032). The pins on the microphone are placed in the metal slits in the rubber holder.



**Make sure the white font is facing the red cable.**

### 6.3 Maintenance of 4K300/4K187/4K560

**NB! Never pull hard in the rubber or paper band. This could result in damage to the gear in the motor. Be careful to release the advancing mechanism completely before the band is moved manually.**

#### 6.3.1 Parameters for advance of rubber or paper band

NB! Remember always to use:

- Paper band for air weapon
- Rubber band for small bore (cal .22) or big bore

The advance can be further increased in competition. The rubber band can then be pulled back and reused for practice later. We would like to recommend use of new or little used bands for competition to secure proper tightness for correct detection. This will also reduce the risk of jamming the bands during competition.

For practice the advance can be lowered significantly at the cost of higher risk of faulty detection and jamming of the advance.

Range	Ammunition	Shooting type	Frequency Shots/Advance	Advance in mm
10m	Air	ISSF air rifle	1	20
10m	Air	ISSF air pistol	1	45
15m	Air	NSF/DFS rifle	1	30
15m	Cal. .22	NSF rifle	5	10
15m	Cal. .22	DFS rifle	5	5
25m	Cal. .22	ISSF Pistol	5	10
25m	Cal. .32-.38	ISSF Pistol	5	10
50m	Cal .22	ISSF rifle	5	5
50m	Cal .22	ISSF pistol	10	5
50m	Cal. .32-.38	ISSF pistol	10	5

#### 6.3.2 Mounting rubber or paper on spindle

Rubber band:

- The end of the rubber sheet is inserted into the opening of the spindle. Centre the rubber band on the spindle.

Paper band:

- The spindle is placed in the paper reel. The reel is fastened on the spindle with rings of foamed plastic. Check that the paper reel is fastened fairly tight to the spindle and that the paper is centred sideways.

#### 6.3.3 Mounting the spindle on the target unit

The spindle with paper or rubber band is mounted on the target as follows::

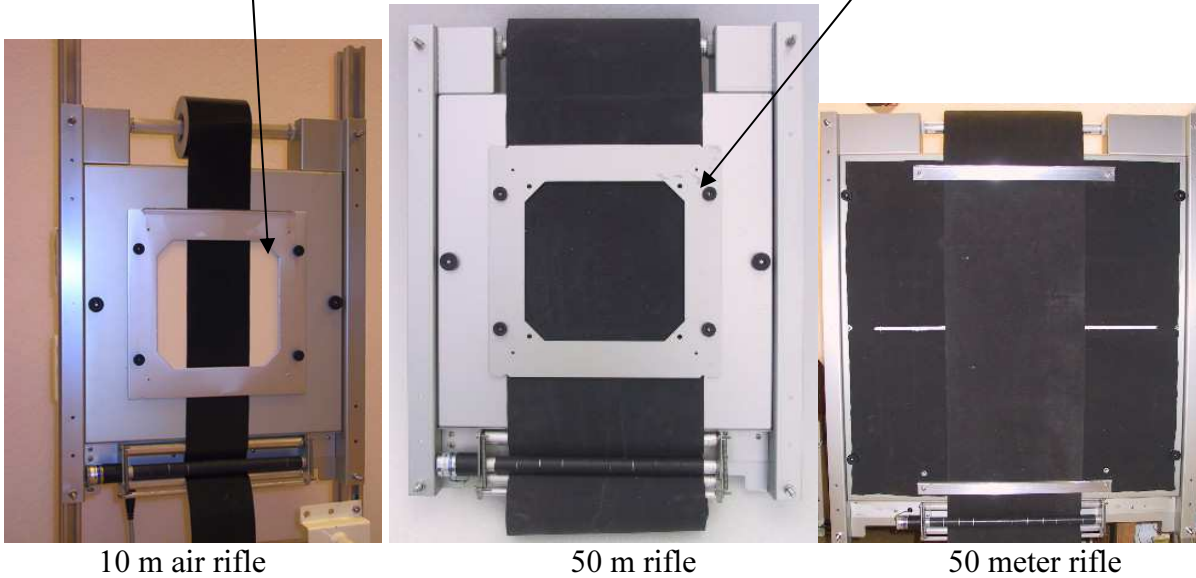
- Bushing nipples are inserted on the thin shafts on each side of the spindle
- The threaded end of the bushing nipples should be put in the notches of the aluminium frame of the target. The small plastic nuts should be tightened until the bushing nipple is fastened to the aluminium frame.
- Adjust the friction by tightening the large nut at the end of the bushing nipple. The friction should be low enough to allow the motor to advance the roll. On the other hand the roll should not move without the motor to advance the band. Note that the pistol targets needs a very harder tightening for big bore calibre.



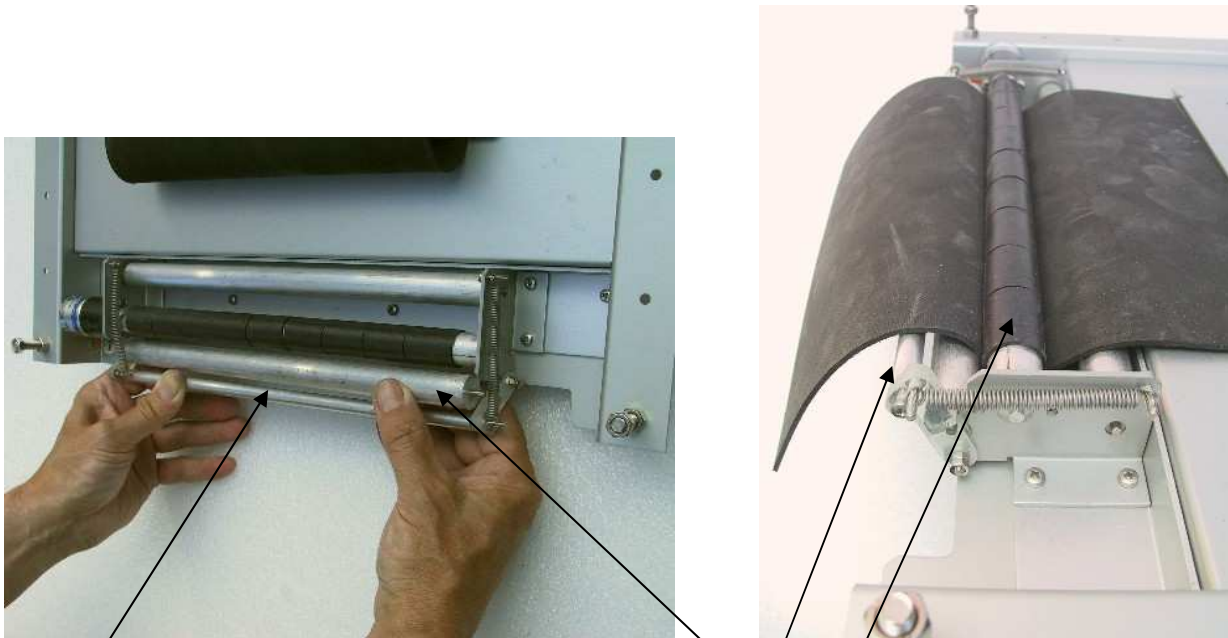
### 6.3.4 Band guidance

When the spindle is fastened the band should be led into guiding mechanism. This guide differs for the different target models and between paper and rubber. If the band can't be threaded, the guiding mechanism has to be loosened or removed. Some guidance solutions are shown below. A adapter in carton (thick paper) will be placed behind the band if the opening of the target is wider that the width of the band.

Verify that the guidance system is not squeezing the band so hard that the advance will be inhibited.



### 6.3.5 Threading the band in the motor mechanism



Open the mechanism by pressing down the grip rod. Remove the pressure roller. Tread the band into the mechanism. The band should follow the rubber coated driving roller. Insert the pressure roller again. The band should pass in front of the grip rod.

**NB! Never pull hard in the rubber or paper band. This could result in damage to the gear in the motor. Be careful to release the advancing mechanism completely before the band is moved manually.**

### 6.3.6 Aiming cards and protection

The following paragraph describes different solutions for aiming cards, protection and band guidance.

#### 6.3.6.1 Configurations

Target	Usage	Band	Adapter	Aiming	Front
4K187	Air rifle	120mm paper	Paper 100mm	Paper behind guide	Steel
4K187	Air pistol	120mm paper	Paper 100mm	Paper behind guide	Steel
4K187	15m cal. .22	120mm rubber	Paper 100mm	Paper behind guide	Steel + Wood
4K187	50m cal. .22	120mm rubber	Paper 100mm	Plastic on front	Steel + Plastic
4K300	Air rifle	120mm paper	Paper 100mm	Paper behind guide	Steel
4K300	Air pistol	120mm paper	Paper 100mm	Paper behind guide	Steel
4K300	15m cal. .22	120mm rubber	Paper 100mm	Paper behind guide	Steel + Wood
4K300	50m cal. .22	120mm rubber	Paper 100mm	Plastic on front	Steel + Plastic
4K300	Air rifle	215mm paper	None	Paper behind guide	Steel
4K300	Air pistol	215mm paper	None	Paper behind guide	Steel
4K300	50m cal. .22	215mm rubber	None	Plastic on front	Steel + Plastic
4K560	50m Pistol	500mm rubber	None	Plastic behind front	Steel
4K560	50m Rifle	500mm rubber	None	Plastic behind front	Steel
4K560	25m Rapid fire	500mm rubber	None	Plastic/Rubber behind front	Steel
4K560	25m Precision	500mm rubber	None	Plastic behind front	Steel
4K560	50m rifle	215mm rubber	Rubber	Plastic behind front	Steel
4K560	25m Rapid fire	215mm rubber	Rubber	Plastic behind front	Steel
4K560	25m Precision	215mm rubber	Rubber	Plastic behind front	Steel
4K560	10m Air pistol	215mm paper	Alu	Paper behind guide	Steel + Alu
4K560	10m Air rifle	215mm paper	Alu	Paper behind guide	Steel + Alu

#### 6.3.6.2 4K300/4K187 Cal. .22

The band guidance for the 15m and 50m targets (for cal .22 Long Rifle) is an aluminium plate with distance strip on each side. The guidance plate is fastened on screw towers with plastic nuts. Check that the guidance is not squeezing the band too hard. Use carton adapters for more narrow bands (120mm for 15m and/or 50m practice and 215mm for 50m rifle competition).

The aiming card for 15m is a paper card with aiming hole. The card should be placed on the screw towers holding the aluminium guidance. For 50m the aiming card is a large plastic plate with aiming hole. The plastic plate is fitted in front of the steel protection.

Local security regulations might require a plywood plate to be put in front of the steel protection to avoid ricochets.

#### 6.3.6.3 4K300/4K187 Air

Use paper band (120mm/215mm for 4K300 and 120mm for 4K187). When narrow bands are used, there must be placed a paper adapter behind the band. The aiming card is placed directly in front of the band. The aluminium guidance plate is mounted towards the band and aiming layers with the distance strips towards the shooter.

#### 6.3.6.4 4K560 with 500mm band

The wide band should be inserted in the guides at the side of the target. Insert plastic aiming cards in the slot on the back of the steel cover. The aiming card for rapid fire is a combination of white plastic and black rubber with white aiming lines.

### 6.3.6.5 4K560 with 250mm band

The narrow bands used with a microphone cover with rubber. The band should be inserted under the guide at the top of the cover. The aiming cards are plastic plates mounted in a slot behind the steel cover.

### 6.3.6.6 4K560 steel protection

The steel protection can be tilted forward in the top by lifting (releasing) the locking rods on each side of the target. These rods can be adjusted if needed. If the locking rods are released from the key-hole, the steel protection can be lifted and removed. Be careful not to damage the contact springs at the lower right side.

The top cover above the rubber band can be lifted and removed by loosening the plastic nuts.

A white horizontal stripe is painted on the rubber to provide an aiming guide for the rapid fire target. Repaint this stripe with masonry paint or other elastic paint when needed.

When the main rubber sheet is worn out, it must be replaced:

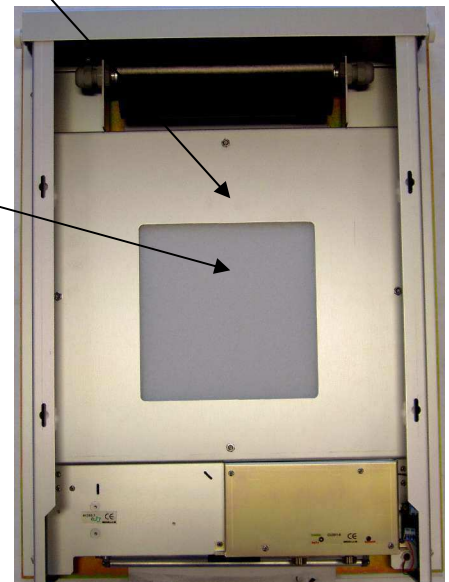
- tear off the old rubber sheet
- clean the aluminium frame (acetone)
- brush on contact-glue on the frame and rubber and let it dry well
- mount the new rubber (adjust the stretch in all directions)
- protect and strengthen the glued fastening with 50mm silver tape
- paint the white aiming guide stripes (5mm height)

### 6.3.7 Back cover

At the back of the targets there is a back cover that consists of an aluminium frame and a foamed plastic plate.

The foamed plastic should be replaced when it is worn out. Pull out the old piece and insert a new one. The foamed plastic contributes to:

- Rain and weather protection (outdoor use)
- Protection against ricochets, fractions and mud from the bullet catcher.
- Reducing risk of problems with acoustic noise from bullet catcher
- Improves the temperature stability (outdoor use)



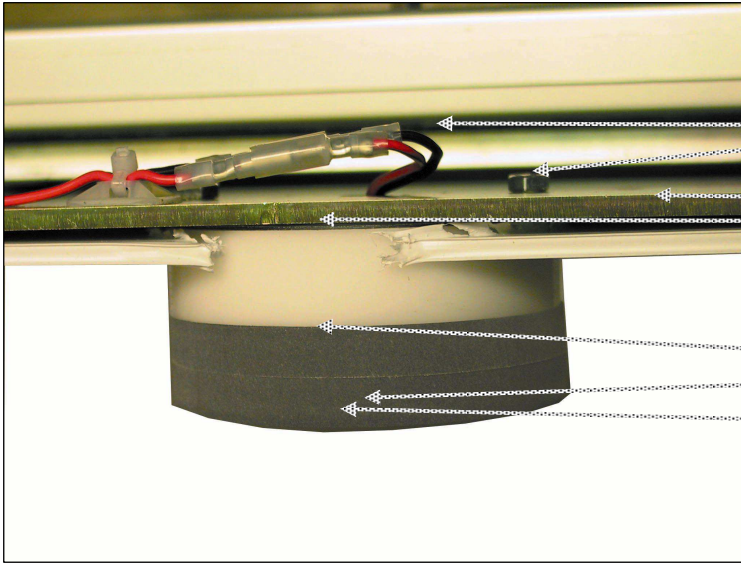
### 6.3.8 LED lamps for pistol targets

The 4K560 targets are equipped with LED lamps for 25m pistol disciplines. The green lamp is at the lower part of the target while the red is on the upper part.

The lamps are fastened as follows:

- The cable is threaded into the centre hole
- Insert two M5x40 bolts from the back of the steel plate and enter them in the nuts in the outer glass
- Connect the cables

The lamp is composed of the following parts:



- Cable
- Fastening bolts (M5x40)
- Steel plate
- Rubber sheet and Plastic sheet with LED lamp
- Thick O-ring
- Inner protection glass without nuts
- Outer protection glass with nuts

Shots with cal .22 or cal .32 will stop in the outer protection glass. The lamp will be destroyed if hit with solid jacket ammunition! It is very easy to replace the glass when they are worn out (risk of shooting through or reduced transparency).

**NB!** We recommend using spare steel protection plates without lamps for shooting with solid jacket ammunition. Remember that removing the lamps will expose the holes in the steel plate! Procedures

### 6.3.9 Changing the microphones

Newer targets are delivered with changeable microphones, (art.nr.5032). The pins on the microphone are placed in the metal slits in the rubber holder.



**Make sure the white font is facing the red cable.**

## 6.4 Procedures

### 6.4.1 Preparation for competition

1. Set up the targets at least 30 minutes before shooting to ensure temperature levelling.
2. Verify that the range management PC is operational and still have free disk space (minimum 50 MB)
3. Verify the network if audience services and/or automated exchange with the result management system are used
4. Check that all programs are started from the intended directories (double check shortcuts etc.)
5. Check that all units are powered on and that the battery is fully charged. Verify that all display units are in ready state and is displaying correct target numbers
6. Verify the target type, sensitivity and rubber/paper advance.
7. Check front and back targets and rubber sheets and rubber/paper bands
8. Mount control targets if the competition regulations require this
9. Check and/or update the maintenance protocol

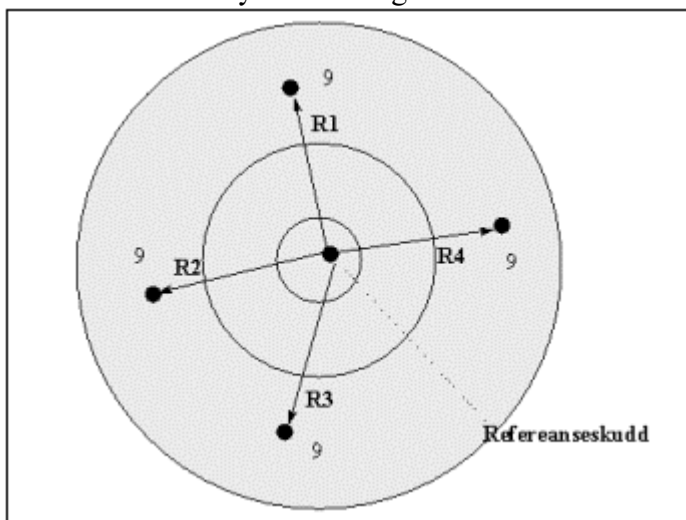
### 6.4.2 Annual

1. Check the wearing of the rubber band and consider need for replacement.
2. Inspect the target frame and evaluate need for repair
3. Check the mounting of the target and evaluate need for improvement or repair
4. Install new software versions and test the system before competitions
5. Clean the equipment as needed

### 6.4.3 Testing precision

This test should be performed during fairly stable temperature conditions. The test is only valid for big bore targets.

1. Set up the targets at lest 30 minutes in advance
2. Put a paper sheet or ordinary target in front of the aiming area
3. Set the system to display 1/100mm
4. Shoot at least 5 shots against the centre of the target (approximately value 9 or better)
5. Pick one shot as the reference shot
6. Calculate the distance from the reference shot to all the other shots (Calculate the square root of the sum of the squares for the horizontal and vertical distances).
7. Measure the distance (centre to centre) on the paper target from the reference shot to the oather shots and compare with the values calculated from the electronic marking.
8. Reset the system to original values



The requirement for precision and procedure for testing is managed by the individual organisations that are approving targets.

#### 6.4.4 Adjusting centre

Verification and/or adjusting the target centre can be done according to the following procedure:

1. Set up the targets at least 30 minutes before testing
2. Put a paper sheet or ordinary target in front of the aiming area. Mark the optical centre (the centre of the aiming point)
3. Fire a shot close to the centre
4. Write down the exact hit on the display unit. We will use an example with 35mm to the right and 25mm up
5. The electronic centre of the target is found by measuring from the hole in the paper sheet. Draw a horizontal line and mark 25mm above the bullet centre. Draw a vertical line 35 mm to the left of the bullet centre. The intersection between the two lines represents the electronic centre of the target.
6. The horizontal and vertical distance from the optical and electronic centre of the target can now be measured. Let's assume that our optical centre is 10mm above and 8 mm to the left of the electronic centre. This will be the values to be used to correct the sensor setup.
7. A more detailed description of sensor setup is found in a separate chapter. In short: On the monitor, press Menu / System setup / Advanced (Password = 3) / Target Config.
8. We have to adjust these values on the screen according to our findings in step 6.
9. If the optical centre is higher than the current electronic centre, the Offset-Y value should be increased. In our example we have to add 10.
10. If the optical centre is to the right of the current electronic centre, the Offset-X value should be increased. In our example we have to subtract 8.
11. When the offset has been changed we have to send the new values with the **SEND DATA** function
12. Verify with the **REFRESH** button that the update was correct
13. Set up a new sheet and test shoot

#### 6.4.5 Cleaning

Turn of the system before opening the targets. Be careful with the sensors when they are exposed.

Use a finger, brush or vacuum cleaner to remove dust and other particles inside the system.

Due to the shape of the sensors there will not be much dust and particles on the sensors. In addition we have proved that even extreme amounts of dust are not influencing the system significantly.

**Significant faults in detection can not be caused by dust on any microphone.**

Clean other units with a humid cloth (not wet!). A little dishwashing soap could be helpful for difficult dirt.