Robot Inspection and Calibration System
ROBINCA
&
Gun Barrel Management System
GBMS
Robinca

Robot Inspection & Calibration System

Robinca is a portable and versatile measurement system for assessment of pitting, erosion and general wear of gun barrels. It combines visual inspection with highly accurate non-contact measurement technology.

High Resolution
Robinca features reliable Fogale Nanotech technology that combine visual inspection with high resolution and accurate diameter measurements. This complies with standards provided by the barrel manufacturers and/or operating organization, such as TDV018.

Capacitive sensors provide an almost unlimited accuracy (it “sees the first molecule”) and can be specified to measure at micron level. The Robinca system is designed for an accuracy of 5µm, and repeatability better than 1µm. The sensors are solid and contain no moving parts. They are rugged and durable, and are not easily affected by ambient conditions.

Modular Nature
The Robinca is compounded of modules and the software QtBCS contains all relevant gun bores. By switching between caliber specific components, one main unit can be utilized for all gun bores. The modular nature of the system provides increased versatility and cost savings. For the time being the system ranges from 4,6mm rifle barrel to 155mm howitzer. Software user-interface is uniform through the complete range.

Report Generation
The Robinca system automatically generates reports for statistics and analyses instantly after a measurement procedure. The operator can choose between several types of report formats. All measurement data can be imported into GBMS, Gun Barrel Management System, for further analysis.

Safety
Robinca contributes to safety for investments and personnel by discovering developing degradation and by this reducing the risk for accidents. The system contributes to maintain operational precision by improved exit velocity prediction. Robinca reduces the risk of phasing out systems with remaining barrel life or overuse of worn barrels.
Robinca enables management of:
- Operational configuration management
- Logistics – efficient allocation of materials
- Logistics and budget
- Planning and training activities related to barrel life
- Overall life cycle and inventory planning

Robinca features unique measuring and inspection techniques enabling high precision and low measurement error as specified below:

<table>
<thead>
<tr>
<th>Capactive sensors</th>
<th>Very high resolution, non-contact, fast, accurate, environmentally resilient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser line deflection measurement</td>
<td>Non-contact, no moving part, fast, scanning effect</td>
</tr>
<tr>
<td>Camera</td>
<td>Tilt/rotate, internal lights, high resolution and sensitivity</td>
</tr>
<tr>
<td>Laser position unit and crawler</td>
<td>Localizes and recovers damages</td>
</tr>
</tbody>
</table>

Robinca exceeds traditional measurement tools in that it enables accurate diameter measurements to be taken and recorded on top and at the bottom of caliber and groove. It also provides measurements of area and depth as well as longitudinal positioning.

### Feature chart

<table>
<thead>
<tr>
<th>Caliber</th>
<th>Diameter measurement</th>
<th>Area measurement</th>
<th>Pit erosion</th>
<th>Integrated Camera</th>
<th>Position laser</th>
<th>Software QtBCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>155mm</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>120mm</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>120mm chamber</td>
<td>v</td>
<td></td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
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<tr>
<td>105mm</td>
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<td>v</td>
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<td>v</td>
<td>v</td>
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<tr>
<td>30mm</td>
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<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>12,5mm</td>
<td>v</td>
<td></td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>7,62mm</td>
<td>v</td>
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<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
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<tr>
<td>5,56mm</td>
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<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
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<tr>
<td>4,60mm</td>
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<td>v</td>
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<td>v</td>
</tr>
</tbody>
</table>

Calibers of other dimensions are quoted on request.
This probe is used for assessing smooth bore Leopard 2 Gun Barrel. It combines visual inspection with non-contact measurement methods. According to standards supplied by the barrel manufacturers and/or operating organizations, diameter increase, pitting depth and damaged area of chromium plating must be documented. In order to comply with these standards the measurement probe is equipped with laser line deflection as well as capacitive sensors.

The Robinca 120mm measurement probe consists of a camera, a crawler and a measurement head. The camera and the electrical crawler are connected to the 120mm Robinca measurement head and assembled into the alignment sleeve. The complete assembly is mounted by snap-on clamps onto the muzzle end of the barrel. All cables are connected to the control unit. Area measurement is carried out in the BCSoft software.

The system provides the possibility to perform either barrel and chamber measurement or only either one of the two. The measurement data are automatically stored in data files and visualized as tables and graphs.

### Technical specifications

**Robinca 120mm measurement head**
- **Length:** 380mm
- **Weight:** 9kg
- **Diameter:** Ø119.6mm
- **Material:** Anodized aluminium
- **Colour:** Black

**Diameter measurement**
- **Technology:** Capacitive sensors
- **No. of sensors:** 8
- **Accuracy 119-122mm:** ±0.005mm
- **Accuracy 122-126mm:** ±0.020mm
- **Resolution:** ±0.001mm

**Calibration ring and certificate**

**Depth measurement**
- **Technology:** Laser line deflection
- **Accuracy 0-7mm:** ±0.050mm
- **Resolution:** ±0.005mm

**Camera**
- **Specifications:** See page 9

### Description of use

The Robinca measurement probe is inserted into the muzzle end of the barrel by means of an alignment sleeve. Visual inspection is performed utilizing a rotating colour camera equipped with internal lights. The measurement unit is moved into the barrel by an electric crawler, and then positioned at each measuring point. At measurement positions, the capacitive sensors collect measurement data from the barrel. Average measurement accuracy is better than +/-5 microns. Repeatability is +/-1 micron.

Stored data can be displayed and reports is automatically produced from QtBCS software.
Robinca 120mm chamber measurement probe

This probe measures 8 predefined cross-sections in a chamber, as specified in the barrel manufacturer handbook.

Caseless ammunition requires a higher focus on the chamber. An increased diameter larger than 0.05 mm in the rear end should not be allowed according to standard.

Rolling balls situated all the way around the probe body ensures easy and safe insertion and rotation, either in the calibration ring or in the chamber.

The measurement probe is rotated manually according to instructions from the QtBCS software. Pictures can be imported into the report.

A certified calibration ring is included. The purpose of this calibration ring is to set the correlation between the capacitive measurement and millimeters prior to a measurement sequence.

Description of use
Robinca measurement probe is insterted into the chamber at rotation 0 degree. The probe has to be turned manually as instructed by the QtBCS.

At the predefined measurement positions, the capacitive sensors collect measurement data from the barrel. Average measurement accuracy is better than +/-20 microns. Repeatability is +/-1 micron. Stored data can be displayed and reports is automatically produced from QtBCS software.

Technical specification
Robinca 120mm chamber measurement probe
Length: 737.7 mm
Weight: 13 kg
Diameter: Ø158.0 mm
Material: Anodized aluminium
Colour: Black dim

Diameter measurement
Technology: Capacitive sensors
No. of sensors: 16
Accuracy 119 (+/-0)mm: ±0.020 mm
Accuracy 158 (+/-0)mm: ±0.020 mm
Resolution: ±0.002 mm

Calibration ring and certificate
These probes used for assessment of erosion and wear of grooved barrels. They combine visual inspection with non-contact capacitive measurement.

According to standards supplied by the barrel manufacturers and/or operating organizations, diameter increase, torn barrel fragments and damaged area must be assessed and documented. In order to comply with these standards the measurement probes are equipped with capacitive sensors.

The Robinca 105mm and 155mm measurement probes consists of a camera, a crawler and a measurement head. The camera and the electrical crawler are connected to the 105mm or 155mm Robinca measurement head and assembled into the alignment sleeve. The complete assembly is mounted by snap-on clamps onto the muzzle end of the barrel. All cables are connected to the control unit. Area measurement is carried out in the BCSoft software. The measurement data are automatically stored in data files and visualized as tables and graphs.

**Technical specification**

**Robinca 155mm measurement head**
- Length: 861mm
- Weight: 11kg
- Diameter: Ø154.5mm
- Material: Anodized aluminium
- Colour: Black

**Diameter measurement**
- Technology: Capacitive sensors
- No. of sensors: 8
- Accuracy mm: ±0.005mm
- Accuracy mm: ±0.020mm
- Resolution: ±0.001mm

**Calibration ring and certificate**

**Robinca 105mm measurement head**
- Length: 861mm
- Weight: 6.6kg
- Diameter: Ø104.7mm
- Material: Anodized aluminium
- Colour: Black

**Diameter measurement**
- Technology: Capacitive sensors
- No. of sensors: 8
- Accuracy mm: ±0.005mm
- Accuracy mm: ±0.020mm
- Resolution: ±0.001mm

**Calibration ring and certificate**

**Description of use**
See description of the 120mm measurement probe.
Robinca 30mm measurement probe

The probe is manually fed into the barrel by extendable rods. This system measures caliber and groove diameters. A fixed tape measure indicates longitudinal position.

According to requirements set by the barrel manufacturers and/or operating organization, potential diameter increase must be assessed and documented. In order to comply with these requirements the measurement head is equipped with capacitive sensors.

The measurement data are automatically stored in data files and visualized as tables and graphs. Pictures can be imported into the report.

Description of use
Robinca is inserted into the muzzle end of the barrel by extendable rods resting in a tripod mounted crib. The probe is pushed and rotated in the barrel manually according to instructions from the QtBCS software. At the selected measurement positions, the capacitive sensors collect measurement data from the barrel.

Technical specifications

Robinca 30mm measurement head
Length: 2,660mm
Weight: 19kg
Diameter: Ø29,9mm
Material: Stainless steel

Diameter measurement
Technology: Capacitive sensors
No. of sensors: 4
Accuracy @ 0,5mm: ±0,005mm
Accuracy @ 1,2mm: ±0,050mm

Calibration ring and certificate
The probe is manually fed into the barrel by a single rod. This system measures caliber and groove diameters. A fixed tape measure indicates longitudinal position.

According to requirements set by the barrel manufacturers and/or operating organization, potential diameter increase must be assessed and documented. In order to comply with these requirements the measurement head is equipped with capacitive sensors.

The measurement data are automatically stored in data files and visualized as tables and graphs. Pictures can be imported into the report.

**Description of use**

Robinca is inserted into the muzzle end of the gun by a single rod. The probe is pushed and rotated in the barrel manually according to instructions from the QtBCS software. At the selected measurement positions, the capacitive sensors collect measurement data from the barrel.
Examples of findings

Same 155mm cannon barrel - brand new and towards wear life time

155mm cannon barrel - copper deposits

30mm cannon barrel - detonation inside
GBMS (Gun Barrel Management System) is a database and analysis software that collects and contains measurement data from the Robinca system. GBMS compiles management data from measurement data and displays the data for decision making. GBMS provides interface to other military records.

This is to support the Armed Forces service organization and weapon experts in their assessment and evaluation of condition and quality of the individual weapon system or the global fleet. Safety and operational availability will improve and maintained in the best possible way by not exceeding tolerances. Wear and damage can be detected before they cause accidents or provide poor performance during a mission.

The GBMS contributes to optimal management and service efficiency, provides an overview of the status of the Armed Forces material, budgeting, preservation and distribution of competence and experience across the Armed Forces organizations.

GBMS has also focus on supporting the measurement process and the subsequent evaluation of the barrel quality, wear pattern and operational status, as well as documentation of the measurement data, images and remarks from the experts.

GBMS is designed to give you a full view of your fleet and supports all your bases and competent authority. GBMS is an extremely powerful, yet very user-friendly and simple to understand analysis tool that helps your organization keep total control.

Simple. Easy. Powerful analysis tool

The best tool to organize data and maintain control.
• Analysis
• Follow up
• Knowledge base
• Tight integration

The software contains all the functionality and process support your teams need so they can manage their cannon barrels and small arms, and reach their goals.
QtBCS Software
Software Directed Inspection (SDI)

QtBCS is the user interface of the Robinca system. It connects all the different components and functions and collects all data. QtBCS guides the operator through the inspection step by step.

QtBCS combines, organizes and creates graphical reproductions based on the measurement data. Images with and without measurement data are processes and stored.

From the automatically stored QtBCS file six different report formats can be chosen according to the required level of detail immediately after a measurement sequence.

The database stores all your measurement data and shooting log in one place. It’s easy to import and update.

All material are compared with the prevailing tolerances, and based upon these limits a notice is given if they are exceeded.

GBMS makes collaboration easy and it gives complete control over the future activities like next measurement, ranking (status) and number of shots for the cannon barrels and small arms.

Implement your processes to ensure that everyone follows the same best practices and activities to make sure that nothing is forgotten.

You can easily create reports. You can combine the data in a myriad of ways to get the information that you need.

External reference: Norwegian Defence Logistics Organisation