DZHK-SOP-K-03

Resting 12-Lead Surface Electrocardiogram (ECG)

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<table>
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<tr>
<th>Expert Author</th>
<th>Expert Review</th>
<th>Endorsed by Section Head</th>
<th>Approved by DZHK</th>
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## 1 Introduction

### 1.1 List of Abbreviations

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<th>Full form</th>
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<tbody>
<tr>
<td>aVF</td>
<td>augmented Vector Foot: left foot + left arm + right arm (vertical to I)</td>
</tr>
<tr>
<td>aVL</td>
<td>augmented Vector Left: left arm + right arm + left foot (vertical to II)</td>
</tr>
<tr>
<td>aVR</td>
<td>augmented Vector Right: right arm + left arm + left foot (vertical to III)</td>
</tr>
<tr>
<td>DDD</td>
<td>see point 1.5, cardiac pacemakers</td>
</tr>
<tr>
<td>eCRF</td>
<td>electronic Case Report Form</td>
</tr>
<tr>
<td>ECG</td>
<td>electrocardiogram</td>
</tr>
<tr>
<td>ICS</td>
<td>intercostal space</td>
</tr>
<tr>
<td>LAH</td>
<td>left anterior hemiblock</td>
</tr>
<tr>
<td>LPH</td>
<td>left posterior hemiblock</td>
</tr>
<tr>
<td>LBBB</td>
<td>left bundle branch block</td>
</tr>
<tr>
<td>RBBB</td>
<td>right bundle branch block</td>
</tr>
<tr>
<td>SDNN</td>
<td>standard deviation of all NN intervals of the global index of heart rate variability</td>
</tr>
<tr>
<td>SVES</td>
<td>supraventricular extrasystoles</td>
</tr>
<tr>
<td>VES</td>
<td>ventricular extrasystoles</td>
</tr>
<tr>
<td>VT</td>
<td>ventricular tachycardia</td>
</tr>
<tr>
<td>VVI</td>
<td>see point 1.5, cardiac pacemakers</td>
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</table>
1.2 Purpose
The purpose of the electrocardiographic examination is firstly to document cardiological disorders such as ischaemic heart disease (e.g. previous myocardial infarction) or arrhythmias (e.g. extrasystoles, atrial fibrillation). Secondly, heart rate variability (HRV) can be studied as an indicator of sympathovagal balance and/or autonomic dysfunction in cases of reduced HRV.

1.3 Target Group
In principle, it is desirable to have on hand a resting 12-lead ECG recording for all patients treated in the DZHK, and possibly also repeat ECG recordings. Performance and frequency of ECG recording is determined by the respective examination protocol.

1.3.1 Inclusion Criteria
There are no general inclusion criteria (determined by the respective examination protocol).

1.3.2 Exclusion Criteria
In principle, a 12-lead ECG can be performed on every participant. Apart from potential irritation of the skin around the electrode adhesion sites, the examination itself does not involve any relevant risk.

1.4 Application and Tasks
Electrocardiography is a standard cardiac diagnostic procedure. The differences in voltage that occur during cardiac action generate an electrical field in the organism. Changes in the electrical field can be recorded in the form of potential differences. These potential differences give rise to action currents which can be recorded on the surface of the skin. As it is a relatively simple and non-invasive procedure, electrocardiography is widely used in doctors’ surgeries and in routine clinical practice.

Recordings are taken from the standard leads according to Einthoven (Leads I, II and III), the limb leads according to Goldberger (Leads aVR, aVL and aVF) and the unipolar pre-cordial leads according to Wilson (Leads V1, V2, V3, V4, V5 and V6).
Automated ECG Interpretation
All digitized ECGs are fed in for further processing and raw data extraction (XML files). In some DZHK collectives, automated ECG interpretation based on the MEANS program is provided by the ECG system (ECG measurement and evaluation). For this purpose, .txt files will be transferred to the Erasmus University Medical Center, Rotterdam, The Netherlands.

Results of the ECG Examination
The results of the ECG recording are important both for the examined subjects and for the study:

- The study examines the relationships between ECG changes and cardiovascular risk factors. In some cases, longitudinal analyses with repeat ECG recordings are also relevant. In those cases, changes in the ECG between the initial examination and the follow-up examination and their possible causes will be examined.

1.5 Terms and Definitions
A brief description of all terminology required to understand the SOP.

Cardiac pacemakers
These can be differentiated by type. For simplification, a uniform nomenclature exists. Here, the pacemakers are denoted by a three- to five-letter code.

- The first position denotes the site of stimulation. Here, V stands for ventricle, A for atrium, and D for both.
- The second position denotes the site at which the signal is sensed. The abbreviation corresponds to the first position.
- The third position denotes the mode. Here, inhibited, i.e. suppressed, is denoted by T for "triggered" and D denotes triggered by the atrium and inhibited by the ventricle.
1.6 Correlations to Other Examinations

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandatory preliminary examination (SOP ...):</td>
<td>-</td>
</tr>
<tr>
<td>Recommended preliminary examination (SOP ...):</td>
<td>-</td>
</tr>
<tr>
<td>Preliminary eligibility examination (SOP):</td>
<td>-</td>
</tr>
<tr>
<td>Adverse effects on other parts of the examination:</td>
<td>There is a correlation between this SOP and the SOP for recording a long-term ECG (Title: No.). Ensure that subjects are able to rest for 10 minutes before recording the ECG. Therefore there is a relationship to the SOPs for stress tests such as the 6-minute walk test (Title: No.).</td>
</tr>
<tr>
<td>Mandatory follow-up examination (SOP ...):</td>
<td>-</td>
</tr>
<tr>
<td>Recommended follow-up examination (SOP ...):</td>
<td>-</td>
</tr>
<tr>
<td>Follow-up exclusion examination (SOP):</td>
<td>-</td>
</tr>
</tbody>
</table>

1.7 Level of Quality

This SOP corresponds to quality level 2-3, level 3 includes certification.

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DZHK Quality Levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>The examination is performed in accordance with the guidelines of the medical associations.</td>
</tr>
<tr>
<td>Level 2</td>
<td>The examination is performed in accordance with the specifications of the DZHK SOP. Minimum requirements for ensuring the quality of the implementation and the examiners are defined in the SOP.</td>
</tr>
<tr>
<td>Level 3</td>
<td>The examination is performed in accordance with the specifications of the DZHK SOP and certification of the examiners: Definition of intra-observer and inter-observer variability (standard of epidemiological studies).</td>
</tr>
</tbody>
</table>
2 EXAMINATION CONDITIONS

Electrocardiography is one element of the examination programme in observational and clinical studies of the DZHK. In corresponding study subjects, a resting 12-lead ECG (10 seconds) performed with the appropriate resting ECG system (see below) should be recorded, exported and, if available, automatically analyzed using the MEANS program. In addition, a rhythm strip may be recorded. The digitized ECG data are then stored and exported for later raw data extraction and coding.

Quality of the ECG Recording

ECG recordings are performed at a high level of quality and standardization. The quality of the recording is also highly dependent on the examiners who perform the ECG. The key factors that affect the quality of the ECG recording and sources of error are described in the following.

2.1 REQUIREMENTS FOR ROOMS/EQUIPMENT

PC with a monitor, keyboard, mouse, printer and printer paper

Examination couch that is at least 60 cm wide

2.2 EQUIPMENT/HARDWARE

e.g.

- Cardio Perfect PRO Resting ECG System (WelchAllyn)
- ECG Software CardioPerfect® Workstation diagnostic module WS Resting ECG
- CARDIOVIT AT-10 plus (Schiller Medizintechnik GmbH)
- ECG Software SEMA3 Office
- MAC 1600 (GE Healthcare)
- ECG Software CardioSoft™ Diagnostic System Resting ECG

If necessary, other standard equipment available on site, ideally with digital recording capability.

Electrode application system, adhesive electrodes (e.g. Blue Sensor Holter Electrode, type VL Ø 68mm), if a suction system cannot be used.

2.3 SPECIAL CLINICAL CONSUMABLES

Electrode spray

Disposable razor
2.4 DOCUMENTS REQUIRED
Scan barcode, if available for the study

2.5 INFORMATION REQUIRED
Examiner
Proband number

2.6 PERSONNEL
The test can be performed by a study nurse after he/she has been trained to carry out the SOP. The person carrying out the SOP should have a basic knowledge of ECG recording and interpretation in order to be able to determine the quality of the recording and to identify gross deviations from the normal waveform (e.g. ventricular flutter, tachycardia).
3 IMPLEMENTATION PROCESS/WORK PROCESS/WORK STEPS

3.1 PROCESS FLOW CHART

- **Preparing for the examination**
  - Room temperature
  - ECG couch
  - Equipment
  - Paper speed 50 mm/sec.
  - Filter 50 Hz

- **Carrying out the examination**
  - Extremity leads
  - 4 electrode positions
  - Precise determination of the position of electrodes C1-C6 using the sternal angle

- **Recording**
  - Duration: 10 seconds/12-lead ECG
  - MEANS interpretation
  - QT disposition/vector diagram and HRV analysis

- **Check for deviations**

  - **no**
  - **yes**

- **ECG Interpretation**
  - By an experienced doctor
  - If values are implausible evaluate with an ECG ruler
  - Document in the eCRI

- **Study doctor info**

- **Deviation criteria**
  1) Bradycardia with heart rate below 40 bpm
  2) on electronic analysis: evidence of infarction, acute ischaemia
  3) in case of acute symptoms/problems always call the study doctor

- **Sources of error**
  - Missing extremities
  - Severe/gross tremor
  - Muscle tremor
  - Alternating current interference
  - etc.

Symbols:
- event/task
- observation/statement
- leads to/proceed with
- decision

In this SOP, text elements appearing on a grey background must be observed. Text elements with no background should be observed whenever possible.
3.2 PREPARING FOR THE EXAMINATION

E.g. checking of documents etc.

3.2.1 Preparing the Work Space

The temperature of the room should be comfortable; for ECG examinations it should be at least 22° C.

Arrangement of the ECG couch and the ECG recording system

- The ECG couch should be arranged in such a way that the routing of cables between the ECG recorder/suction electrode system and the PC does not cause any problems/pose a tripping hazard. Make sure that the couch used for the ECG recording is wide enough (at least 60 cm).
- Main power supply cables should be located as far away from the ECG couch and the electrode cables as possible.
- The ECG couch should not be set up directly beside power sockets (risk of alternating current interfering with the ECG signal during recording).

3.2.2 Preparing the Equipment

1. Ensure that all devices (PC/laptop, suction electrode system, printer) are switched on and in operating mode.
2. The recording device must be connected to the PC before the program is started.
3. Start up the workstation.
4. Cover the ECG couch with fresh paper/sheet.
5. Ensure that the electrodes are in a perfectly hygienic state.
6. Paper speed should be set to 50 mm/sec, the filter should be set to 50 Hz. Deviations must be documented in the eCRF.
7. Other filter settings (muscle) are to be set depending on the device available.
8. The height of deflection (amplitude) should be set to 10 mV.

3.2.3 Principles for Preparing Study Subjects for the Examination

The quality of the recorded electrocardiograms depends on the preparation of the study subjects and the placement of the electrodes. The examination room should be at a comfortable temperature (at least 22°C), so that the electrocardiogram is not impaired by subjects shivering due to cold. The subject’s upper body must be unclothed; any jewellery/watches worn should be removed. In addition, the ankles must be accessible to apply the electrodes (shoes and socks should be removed, if necessary). Ensure that the subject is lying down comfortably and fully relaxed on a sufficiently wide examination couch. Placing an extra layer or knee roller under the knees to relieve any stress on the lower limbs is recommended.

If the ECG couch is against a wall, the subject’s arm should not come into contact with it. During the ECG recording the subject’s breathing should be as shallow as possible.

Ensure that the subject has been resting quietly for at least 10 minutes prior to the ECG recording and has not raised his/her upper body during that time. Furthermore, ensure that the atmosphere in the room is quiet and undisturbed. This is necessary to ensure standardized ambient conditions and to
exclude any factors which might affect the quality of the recording and parameters such as heart rate variability. Psychological stress and/or increased sympathetic tone, e.g. a full bladder, affect the measurement of ECG parameters such as HRV by shifting the balance between the autonomic and the sympathetic nervous system and should be avoided.

3.3 PERFORMING THE EXAMINATION
Technical procedure, ECG leads

Limb leads
First, a total of 4 electrodes are to be placed at the locations illustrated in Figure 3. Place each electrode on the inner surface of the limbs.

![Placement points for the extremity leads](image)

Figure 2: Placement points for the extremity leads (Hamm, Willems 07)

Cable colours and lead placement sites according to Einthoven and Goldberger:

<table>
<thead>
<tr>
<th>Sticker colours</th>
<th>or</th>
<th>Limb lead sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>grey/red</td>
<td>red</td>
<td>R right arm</td>
</tr>
<tr>
<td>grey/yellow</td>
<td>yellow</td>
<td>L left arm</td>
</tr>
<tr>
<td>grey/green</td>
<td>green</td>
<td>F left leg</td>
</tr>
<tr>
<td>grey/black</td>
<td>black</td>
<td>N right leg, neutral</td>
</tr>
</tbody>
</table>
Precise Determination of Electrode Positions C1-C6

Accurate positioning of the pre-cordial leads is critical for accurate diagnostic evaluation of the ECG. Deviations of just a few centimetres on the surface of the thorax result in significant changes in the ECG waveform. Therefore the so-called “Angle of Louis” (see Figure 4) can be used to determine electrode positions C1 – C6 accurately. This will only be available in a small number of studies. Documentation in the eCRF is required.
The electrode positions can be marked with a grease pencil before placing the electrodes on the subject’s thorax. The subject lies on his/her back. Proceed as follows:

1. Use the middle finger of the right hand to palpate the first intercostal space at the left sternal border.
2. Count while successively palpating the subsequent intercostal spaces up to the 4th intercostal space.
3. Place the C2 electrode on the left sternal border of the 4th intercostal space.
4. Place the C1 electrode on the right sternal border of the 4th intercostal space.
5. Place electrodes C5 and C6 as shown in the illustration using visual judgement.

In women with large breasts, the electrodes should be placed on the skin under the breast. The ECG system is connected to a PC or laptop. The ECG recording is displayed on the computer screen via a menu-controlled, preset program. Record a 12-lead ECG strip for a period of 10 seconds, if possible, with an additional rhythm strip. If the quality of the ECG recording is insufficient, check the condition of the system and the subject (see Technical problems, suboptimal recording quality section) and, after optimizing the conditions, record the ECG again. If the quality of the recording is still poor, inform the study doctor. For interpreting the ECG, analysis software which incorporates diagnostic MEANS interpretation, analysis of the QT dispersion, the vectorcardiogram and heart rate variability is available (see point 1.4. above). The MEANS software implemented in the systems is based on a development of the Department of Medical Informatics at Erasmus University Rotterdam.

Information for participants
An additional, study-specific copy of the 12-lead ECG trace can be issued to study subjects on request. Do not communicate any information about the current computer findings yourself.

3.4 POST-PROCESSING AND REGISTERING THE DATA

ECG evaluation by a doctor who is experienced in ECG interpretation

As a general rule, the data registered electronically by the ECG system are transferred to the eCRF. If the values are not clinically plausible, a manual re-evaluation should be performed using a standard ECG ruler and those values should be entered into the eCRF. If the quality of an ECG is not sufficient for collection of the study-specific ECG parameters, this must be documented in the eCRF. Any distinctive features of the ECG considered to be of relevance can be documented in the Remarks field. A systematic evaluation is possible to a limited extent.

Check paper speed and filters prior to ECG analysis. Deviations should be documented in the eCRF.

Measurement instructions and definition of terms in the eCRF

![ECG diagram]

Figure 5: Representation of the intervals required for ECG evaluation
**PR interval**

Begins where P leaves the isoelectric line. Ends at the beginning of the Q wave. If there is no Q wave present, the measurement ends at the beginning of the R wave upstroke.

Measured in Lead II, otherwise in the lead with the best representation.

**QRS duration**

Begins where Q leaves the isoelectric line. Ends where S meets the isoelectric line. If there is no Q wave present, measurement begins at the R wave upstroke.

Measured in Lead II, otherwise in the lead with the best representation.

**QT interval**

Begins where Q leaves the isoelectric line. Ends where T meets the isoelectric line.

Measured in Lead II, otherwise in the lead with the best representation. The QT interval is the measured, not the corrected, QT interval.

**AV block**

1st degree: PR interval > 0.20 seconds

2nd degree: Includes Type 1 (Wenckebach) and Type 2 (Mobitz)

Type 1, Wenckebach: in each cycle the PR interval is prolonged until a QRS complex is blocked.

Type 2, Mobitz: intermittent blocking of a QRS complex with no prior increase in the PR interval.

3rd degree: P waves appear independent of the QRS complexes, mostly with a higher frequency than the ventricular escape rhythm.

**Bundle block**

Left bundle branch block: Prolongation of the QRS complex up to the last negative deflection in V5 or V6 or the left precordial leads to ≥0.06 sec.

Incomplete: QRS width ≤0.12 sec.

Complete: QRS width >0.12 sec.

Right bundle branch block:

Prolongation of the QRS complex up to the last negative deflection in >30 sec.

Incomplete: RBB morphology with a QRS complex ≤0.12 sec.

Complete: QRS complex >0.12 sec., wide, notched R waves in V1-V2, S waves in V5-V6
**Hemiblock**

Left anterior hemiblock: extreme left axis deviation in the pre-cordial leads, deep S wave in V5-V6, QRS is not widened.

Left posterior hemiblock: right to extreme right axis deviation

In cases of atrial fibrillation or irregular rhythm on the ECG, the intervals are measured three times in total, each time during a different cycle. The mean value is entered.

### 3.5 Handling Deviations

Deviations should be documented in the Remarks/Notes fields.

**Criteria for determining when an ECG must be shown to the study doctor**

1. Bradycardia with a heart rate below 40 bpm
2. In case of electronic analysis: evidence of infarction, acute ischaemia
3. In case of acute symptoms/problems, always call the study doctor

**Missing limbs, shortened limbs**

If limbs are missing or shortened, the electrodes for the limb leads should be symmetrically placed closer to the torso.

- **Technical problems, suboptimal recording quality**
  - Distortion
  - Severe distortion as a result of gross tremor of the left hand with electrode placement on the forearm → Place the limb electrodes closer to the torso.
  - Gross distortion of the ECG waveforms as a result of insufficient adherence of the suction electrodes → Correct by attaching the electrodes securely.
  - Muscle tremor
  - The irregular oscillations in recordings obtained from patients with tremor are attributable to muscle action currents → Ensure that the patient is not shivering due to cold or anxiety during the ECG tracing. If necessary, cover the study subject with an examination gown or light blanket.
• **Alternating current interference**

If the contact impedance between skin and electrodes is high, alternating current artifacts can overlap in the electrocardiogram. This interference is characterized by very regularly shaped small spikes corresponding to alternating current with a frequency of 50 cycles per second → Alternating current interference rarely persists after sufficient electrode spray is used. If necessary, the examination couch should be moved to a different position in the room.

• **Other sources of interference**

  • Poor contact: Abrupt jumps in the recording may be caused by poor contact.
  • Slow oscillations of the isoelectric line.
  • Oscillations of the isoelectric may be caused by polarization of the electrodes through breathing motion or poor amplifier settings → Adjust the amplifier.
• If breasts are particularly large, do not stick the electrodes under the breast, but on the breast itself.
• Take care that the breasts are not displaced when measuring and marking with the sternal angle. Marking should be done in a “natural supine position”.
• In subjects with dense hair growth “parting” of the hair and increased suction is usually sufficient. If not, the hair must be shaved, with the subject’s consent.
• Pay attention not only to the absolute interference level, but also ensure that the isoelectric line is not distorted in any of the 12 leads.
• Critically observe whether one lead is poorer than the others (alternating current or high level of distortion).
  • Acute: Check the position of the electrode and re-attach it.
  • If observed in successive ECGs: suggests that the electrode is defective → Exchange electrodes, cleaning bath.
• Alternating current interference in all leads: Search for sources of electrical interference in the room (e.g. halogen lights, power supply units for laptop/PC, mobile phones), perhaps change the position of the examination couch in the room or use a different examination room, check earthing.
• Individual leads are not represented and all electrodes are correctly attached and are not defective → Check all connections between laptop/PC and the ECG system and the suction system.
• Study subject is absolutely unable to lie flat due to e.g. breathlessness, dizziness or pain. In this case the ECG can also be performed with the head of the examination couch raised to the sitting position.
• Very severe tremor, the ECG is hardly interpretable → Hold extremities during recording.
• The subject is extremely obese and the examination couch is not wide enough → Provide a chair on which to rest the arms.

In general

Unusual features must always be noted in the Remarks/Notes field.
4 Literature and References


5 Modifications

Modifications as compared to the previous version.

<table>
<thead>
<tr>
<th>Section</th>
<th>Description of the modification as compared to the previous version</th>
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<tbody>
<tr>
<td>2.1</td>
<td>.....</td>
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6 List of Contributors

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
<th>Contribution</th>
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<tbody>
<tr>
<td>PD Dr. Renate B. Schnabel</td>
<td>First author</td>
<td>Drafted the SOP</td>
</tr>
<tr>
<td>Dr. Annika Jagodzinski</td>
<td>Author</td>
<td>Drafted the SOP</td>
</tr>
<tr>
<td>Prof. Dr. Marcus Dörr</td>
<td>Author/Reviewer</td>
<td>Drafted the SOP/Expert review</td>
</tr>
<tr>
<td>PD Dr. Rolf Wachter</td>
<td>Reviewer</td>
<td>Expert review</td>
</tr>
</tbody>
</table>
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### 7.2 eCRF Module

#### ECG

**General information relating to the examination**

1. **Was the ECG performed?**
   - Yes
   - No
   - Unknown
   - Not assessed

2. **Was the Long-term ECG performed?**
   - Yes
   - No
   - Unknown
   - Not assessed

3. **Quality level**
   - Bitte auswählen

#### 1. ECG

1. **Date of examination**
   - [ ] Day
   - [ ] Month
   - [ ] Year
   - [ ] Time

2. **Insufficient ECG recording quality**
   - Yes
   - No
   - Unknown
   - Not assessed

3. **Use of DAL-Square**
   - Yes
   - No
   - Unknown
   - Not assessed

4. **Comment**

5. **Heart rate**
   - [ ] per minute

#### 1.5. Rhythm

- [ ] sinus rhythm
- [ ] atrial fibrillation
- [ ] atrial flutter
- [ ] other rhythm
- [ ] unknown
- [ ] not assessed

#### 1.6. Please specify

- [ ] Pacemaker stimulation
- [ ] Atrial excitation following pacemaker stimulation
- [ ] Ventricular excitation following pacemaker stimulation
- [ ] Others

#### 1.7. Please specify

- [ ] PQ time
   - [ ] ms

---

**DZH-K-SOP-K-04**  **Valid as of: 01.09.2014**

**Version: V1.0**  **Author: R. Schnabel.**  **Page 21 of 25**
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<thead>
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<th>Question</th>
<th>Options</th>
<th>Notes</th>
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<td>QRS duration</td>
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<td>1.10</td>
<td>QT time</td>
<td>-</td>
<td>ms</td>
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<tr>
<td>1.11</td>
<td>AV block</td>
<td>yes, no, unknown, not assessed</td>
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<tr>
<td>1.11.1</td>
<td>Degree</td>
<td>I, II, III, unknown, not assessed</td>
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<tr>
<td>1.12</td>
<td>Bundle branch block</td>
<td>LBBB, RBBB, none, unknown, not assessed</td>
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<tr>
<td>1.13</td>
<td>Hemiblock</td>
<td>LAH, LPH, none, unknown, not assessed</td>
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<tr>
<td>1.14</td>
<td>Discordant negative T-waves</td>
<td>yes, no, unknown, not assessed</td>
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<tr>
<td>1.14.1</td>
<td>At least two of leads I, aVL, V6</td>
<td>yes, no, unknown, not assessed</td>
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<tr>
<td>1.14.2</td>
<td>At least two of leads II, III, aVF</td>
<td>yes, no, unknown, not assessed</td>
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<tr>
<td>1.14.3</td>
<td>At least two of leads V2, V3, V4, V5</td>
<td>yes, no, unknown, not assessed</td>
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<tr>
<td>1.15</td>
<td>Pathological ST segments</td>
<td>yes, no, unknown, not assessed</td>
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<td>1.15.1</td>
<td>At least two of leads I, aVL, V6</td>
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<tr>
<td>1.15.2</td>
<td>At least two of leads II, III, aVF</td>
<td>yes, no, unknown, not assessed</td>
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<tr>
<td>1.15.3</td>
<td>At least two of leads V2, V3, V4, V5</td>
<td>yes, no, unknown, not assessed</td>
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<tr>
<td>1.16</td>
<td>Q-waves as an indicator of a prior infarction</td>
<td>yes, no, unknown, not assessed</td>
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</tr>
<tr>
<td>1.16.1</td>
<td>Q-wave in leads v2-v3 ≥ 0.02 sec or QS complex in leads v2 and v3</td>
<td>yes, no, unknown, not assessed</td>
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<tr>
<td>1.16.2</td>
<td>Q-wave ≥ 0.03 sec and ≥ 0.1 mV deep or QS complex in leads I, II, aVL, aVF or v4-v6 in at least 2 neighbouring leads (I, aVL, v1-v6; II, III, aVF)</td>
<td>yes, no, unknown, not assessed</td>
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</tbody>
</table>

**Long-term ECG**

<table>
<thead>
<tr>
<th>Section</th>
<th>Question</th>
<th>Options</th>
<th>Notes</th>
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<tbody>
<tr>
<td>2.1</td>
<td>Date of examination</td>
<td>-</td>
<td>mm/dd</td>
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<tr>
<td>2.2</td>
<td>Duration of recording</td>
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<td>h:mm</td>
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<tr>
<td>2.3</td>
<td>Average heart rate</td>
<td>-</td>
<td>per minute</td>
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<td>2.4</td>
<td>Minimum heart rate</td>
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<td>per minute</td>
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<td>2.5</td>
<td>Maximum heart rate</td>
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<td>per minute</td>
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<tr>
<td>2.6</td>
<td>Number of VES</td>
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<tr>
<td>2.7</td>
<td>Number of SVES</td>
<td>-</td>
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### 2.8. Duration of longest ventricular tachycardia\(^a\)
- [ ] seconds

### 2.9. Rate of longest ventricular tachycardia\(^a\)
- [ ] per minute

### 2.10. Duration of fastest ventricular tachycardia\(^a\)
- [ ] seconds

### 2.11. Rate of fastest ventricular tachycardia\(^a\)
- [ ] per minute

### 2.12. SDNN\(^a\)
- [ ] ms

### 2.13. Pauses >3 seconds\(^a\)
- [ ] yes
- [ ] no
- [ ] unknown
- [ ] not assessed

#### 2.13.1 Number of pauses >3 seconds\(^a\)
- [ ]

#### 2.13.2 Duration of longest pause >3 seconds\(^a\)
- [ ] seconds

#### 2.13.3 Time of longest pause >3 seconds\(^a\)
- [ ] [ ] h:mm
DZHK-SOP-K-03

12-Kanal Oberflächen
Elektrokardiographie in Ruhe (EKG)

Version: V1.0  Gültig ab: 01.09.2014

Ersetzte Version:  Vom:

Änderungshinweis:

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<th>Fachlicher Review</th>
<th>Zustimmung Bereichsleitung</th>
<th>Freigabe DZHK</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Matthias Nauck</td>
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<td>Thomas Eschenhagen</td>
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 Unterschrift: [Signature]
DZHK-SOP-K-03

12-Kanal Oberflächen Elektrokardiographie in Ruhe (EKG)

Version: V1.0  Gültig ab: 01.09.2014

Ersetzte Version: Vom:

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DZHK-SOP-K-04  Valid as of: 01.09.2014
Version: V1.0  Author: R. Schnabel.