ETSI

ETSI

ETECHNICAL

REPORT

ETR 166

January 1995

Source: ETSI TC-HF

Reference: DTR/HF-02008

ICS: 33.020 33.040.40

Key words: Human factors, People with Special Needs (PWSN)

Human Factors (HF);
Evaluation of telephones for people with special needs;
An evaluation method

Contents

Blank page

Foreword

This ETSI Technical Report (ETR) was produced by the Human Factors (HF) Technical Committee of the European Telecommunications Standards Institute (ETSI).

ETRs are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature, relating to the use or the application of ETSs or I-ETS, or which is immature and not yet suitable for formal adoption as an ETS or an I-ETS.

Introduction

The elderly population in Europe is growing quickly. It is predicted that the number of elderly people will grow from 38 million (1990), which is 13,6 % of the population, to 49 million (18,1 % of the population) in the year in 2020 (as predicted in a report for RACE project R1088 TUDOR by Sandhu and Wood [1]). The disabled population in Europe is now estimated to be 11,3 % to 15,1 % of the population (36 million to 48 million). Even though the two populations tend to overlap (some elderly are also disabled) and even though some of the disabilities do not influence the purchase of a telephone, it may be concluded that the population of People with Special Needs (PWSN) represents quite a large and growing share of the market.

All over Europe the trend is to fully integrate the elderly and disabled into society. Telecommunications plays an important part in that integration process and may help ensure that disadvantaged groups can lead full and independent lives.

Investigations show that elderly and disabled people prefer conventional telephones while still catering for their special needs (see article in Eldre og selvbetjent teknologi, Human Factors Solutions [2]). If no suitable conventional telephone is available, the result is often that they will not use or buy it.

It is not expected that all people with special needs are going to have access to conventional telephones. Some people have so severe impairments that they need special devices. Telephones for people with special needs may be described by a three level model:

1)   telephones designed according to good human factors practice with some considerations for people with disabilities;

2)   telephones adaptable to connection of special devices;

3)   specially designed or tailored telephones for very disabled users.

The method presented only deals with level 1, which covers telephones for most people with special needs.

With minimum effort and cost it is possible to design telephones that are accessible to a significant number of disabled and elderly people. To achieve this goal, designers need to be aware of the special requirements of disabled people, to design to meet these needs and to be able to evaluate the success of their design.

There is already a body of specialist literature and advice (e.g. from COST 219 and ETSI) that designers can draw upon, but even so it is still difficult to ensure that the final product will meet the needs of the elderly and the disabled. Consumers, designers and other professionals would therefore benefit from a method that helps them to assess and evaluate a telephone from the perspective of people with special needs.

It is difficult for elderly and disabled users to overview the telephone market and to compare the large number of telephones so that they can buy a telephone that meets their needs. Therefore, this ETR also aims at providing a method for professionals to compare telephones with regard to the suitability for people with special needs.

The selection of features in telephones to be assessed is, to a certain extent, the same as the selection of items in ETR 051 [3] "Usability Checklist for Telephones". The present evaluation method may be regarded as a supplement to ETR 051 [3], to assist the evaluator when dealing with issues relevant to people with special needs.

1 Scope

This ETR describes a method for evaluating the usability of conventional telephones for connection to the Public Switched Telephone Network (PSTN) for groups of people with various disabilities. The method does not apply to telephones for people who need special devices or features, which cannot be expected to be included in conventional telephones.

The described method is a quick and pragmatic one. It draws upon both objective measures and subjective assessments of telephones and involves the active participation of people with various disabilities. The method can be used by developers who want to ensure that their design for telephones will be usable by people with physical, sensory and/or mental impairments. It can also be used by consumer or special interest groups for comparative evaluations of similar products, and by manufacturers to check the usability of telephones before marketing them.

2 References

This ETR incorporates by dated and undated reference, provisions from other publications. These references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETR only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1]	Sandhu, J. and Wood, T.: "Demography and Market Sector Analysis of People with Special Needs in Thirteen European Countries: A Report on Telecommunication Usability Issues". Report for RACE project R1088 TUDOR, 1990.
[2]	Eldre og selvbetjent teknologi: "Human Factors Solutions", Oslo, 1992.
[3]	ETR 051 (1992): "Human Factors (HF); Usability checklist for telephones, Basic requirements".
[4]	ETR 095 (1993): "Human Factors (HF); Guide for usability evaluations of telecommunication telephones and services".
[5]	IEC 318 (1970): "An IEC artificial ear, of the wideband type, for the calibration of earphones used in audiometry".
[6]	ITU-T Recommendation P.79 (1993): "Calculation of loudness ratings for telephone sets".
[7]	ITU-T Recommendation E.161 (1993): "Arrangement of figures, letters and symbols on telephones and other devices that can be used for gaining access to a telephone network".
[8]	ETS 300 381 (1994): "Telephony for hearing impaired people; Inductive coupling of telephone earphones to hearing aids, Performance requirements and testing methods".

3 Description of the method

The evaluation method consists of usability assessments of 56 components/facilities of conventional telephones. The method provides guidance on the pertinent questions to ask; what technique(s) is (are) appropriate for data collection, and what is the range of acceptable responses. Although the method is evaluative, it is not designed to generate a single or summative value statement.

The method is designed for both early and late evaluation. In the former case, a design document can be inspected and assessed against the acceptable range for each usability component/facility, and appropriate recommendations can be made. Late evaluation requires an existing product or a high fidelity prototype.

It is most useful for pre-release usability assurance and for comparing competing products against a common benchmark. In the case of early evaluation, the most commonly used technique would be a checklist. In contrast, all forms of late evaluations will require a mix of empirical or objective assessments (e.g. experimental techniques) and more traditional subjective assessments using questionnaires. These techniques are well-known and are described elsewhere (see ETR 095 [4]).

3.1 The usability components/facilities

The usability components/facilities are mainly organized according to the "Usability Component Model" used in ETR 051 [3]. This scheme for organization has been developed to enable the easy identification of important characteristics for the design of usable telephones.

The usability components/facilities to be assessed are:

1.1   Physical interface - anthropometric usability components
1.1.1   Shape and size of the handset
1.1.2   Shape of the earpiece
1.1.3   Space for the fingers on the handset
1.1.4   Key spacing between each key
1.1.5   Size of the keys
1.1.6   Curvature of the top of the keys
1.1.7   Material of the top of the keys

1.2   Physical interface - motoric usability components
1.2.1   Length of the cord of the handset
1.2.2   Fastening of the cord of the handset
1.2.3   Position of the fastening of the cord
1.2.4   Weight of the telephone
1.2.5   Portability of the telephone
1.2.6   Weight of the handset
1.2.7   Balance of the handset
1.2.8   Pressure needed to activate the keys
1.2.9   Pressure direction of the keys
1.2.10   Height/recession of the keys with regard to the surface of the keypad
1.2.11   Operation of the volume control
1.2.12   Position of the control for adjusting the volume
1.2.13   Method for adjusting the volume of the ringing tone
1.2.14   Position of the control for adjusting the ringing tone
1.2.15   Tilt of the keypad

1.3   Physical interface - perceptual usability components
1.3.1   Incorrect position of the handset
1.3.2   Size of the characters on the numeric keys
1.3.3   Contrast between the characters and the background on the numeric keys
1.3.4   Size of the characters on the supplementary keys
1.3.5   Contrast between the characters and the background on the supplementary keys
1.3.6   Contrast between the keys and the background

1.4   User input/output - motoric usability components
1.4.1   Activation by simultaneously pressing two or more keys

1.5   User input/output - perceptual usability components
1.5.1   Multiple indications of adjustings and choices
1.5.2.   Controls, keys and adjustment settings requirements
1.5.2.1   Activation of adjusting controls and special keys by mistake
1.5.2.2   Haptic feedback from pressing the keys
1.5.2.3   Auditory feedback from pressing the keys
1.5.2.4   Operation of the volume control
1.5.3   Tones and indications requirements
1.5.3.1   Volume
1.5.3.2   Sidetone
1.5.3.3   Adjustment of output volume
1.5.3.4   Volume of the ringing tone

3.2   Facilities

These facilities do not apply to ETR 051 [3] as this does not contain facilities.

3.3   Groups of disabled users

The evaluation method concerns the following group of disabled people and they can also take part in the assessment of the telephones (except for people with low voice output):

Visually impaired people: - people with low visual acuity;
                                   - people with restricted visual field (e.g. "tunnel vision");
                                   - people with obstructed vision (e.g. cataracts).

Blind people: - people blind from birth;
                                   - people with acquired blindness.

People with reduced
movement capabilities
and reduced muscular strength: - people with muscular dystrophy;
(they need to be able   - people with arthritis.
to lift a handset)

People with unco-ordinated
movements: - people with cerebral palsy;
                                   - people with multiple sclerosis.

People who are hard of hearing: - people who normally use hearing aids;
                                   - people who will not use hearing aids.

People with
learning difficulties: - experts on the problems that people
                                     with severe learning difficulties have.

People with low voice output: - people who use a voice amplifier for
                                      speaking;
                                 - people who speak with the oesophagus;
                                 - people who suffer from multiple sclerosis;
                                 - people who suffer from muscular dystrophy.

In annex C, checklists for each group of disabled people are provided to make it possible to use the evaluation method for any single group of disabled people, without having to consult all the questions.

3.4 The subjective assessments

Subjective assessments involving disabled users are carried out either to complement objective measurements, or when objective measurements are not possible, or when the objective measurements are difficult to interpret.

Only users affected by the relevant item are involved. It is important that the group of users is representative with respect to age and gender. Also, the environment where the assessments are carried out need to be the same during the whole assessment procedure.

The method describes for each item which groups need to be involved and what questions they may be asked. In addition questionnaires for the user tests are enclosed in annex B, "Questionnaires for users".

The users are asked one or two questions about the relevant item and are then asked to rate their answers as "very bad", "bad", "acceptable", "good" or "very good".

3.5 The objective measurements

Measurements should only be carried out by professionals following the recommendations given in annex A. In most cases the criteria for evaluation are described by numbers, but in some cases sufficient knowledge about exact numbers does not exist, therefore the criteria are described by text only.

3.6 Analysis of the results

The assessments from the questionnaires that users have filled out are collected, each feature of each telephone is analyzed, and conclusions are drawn, after which a final evaluation of the telephone can be made.

The results may be presented in many ways. Examples of presentation are given in annex D, "Presentation of the evaluation results".

4 Using the method

Described below are some generic steps which users of the method are advised to follow:

a) specify the purpose of the evaluation (e.g. to make comparisons, to evaluate a design);

b) define your Evaluation Group (e.g. who are target users, describe their defining characteristic);

c) relate the Evaluation Group to the most appropriate usability components/facilities (see annex C). This will help in the selection of only the most critical components for that particular target group;

d) based on the selected components and the purpose of the evaluation, determine the most appropriate data collection or technique(s) (e.g. questionnaires, expert review, experimentation). In most cases, more than one technique should be considered in order to provide both an objective and a subjective assessment;

e) carry out the evaluation study;

f) analyse the data using descriptive and/or inferential statistics as required;

g) draw conclusions and make recommendations which are relevant to the selected target group of users.

Annex A: Usability components/facilities to be assessed

A.1 Description of each usability component/facility

The telephones are assessed against 56 usability components or facilities. The organization of the usability components and the facilities is described in the text. For each usability component/facility there are four sub-headings:

- argument;
- method of evaluation;
- criteria for evaluation;
- assessment by users.

Argument
This describes why it is important to consider the particular usability component/facility and what groups of disabled people have the described problems. The aim is to give designers the necessary background for understanding the complexity of the problem so that it will be easier for them to solve the problem.

Method of evaluation
This describes what should be evaluated and how the specific usability component/facility is evaluated. It should be indicated whether the evaluation is a subjective assessment or an objective measurement.

Criteria for evaluation
The criteria for evaluation are stated.

Assessment by users
When a usability component/facility is assessed subjectively, it is stated here if user groups should be involved and which user groups. The questions asked to the users are noted here as well. The questions are worded so that they can be answered by: "very poor", "poor", "acceptable", "good" or "very good".

A.2 Usability components/facilities

1.1.1 Shape and size of the handset

Argument
If the handset has sharp edges, is too round or very big, people with reduced movement capability may find it difficult to handle and hold the handset. If the shape of the handset is different from the contours of the head so that it does not reach the ear and mouth at the same time, people with hearing impairments and people with low voice output may find it difficult to use the telephone.

Method of evaluation
The earpiece is held close to the ear and it is subjectively assessed whether there is enough space for the fingers on the handset, how the handset is to hold, whether the handset is too broad. The breadth of the handset is measured. It is also checked whether the microphone will come close enough to the mouth. From the observations made the handset is evaluated.

Criteria for evaluation

Poor:	the handset is broader than 44 millimetres, or it has sharp edges, or it is too slippery to hold, or the microphone does not come close to the mouth.
Good:	the handset feels good to hold and the microphone comes close to the mouth.

Assessment by users
People with reduced movement capability: "Is the handset pleasant to hold?"
"Is it easy to speak and listen at the same time with this handset?"

1.1.2 Shape of the earpiece

Argument

The earpiece of the handset should make a good seal against the ear without giving an uncomfortable feeling, so that external noise will not disturb the call. For people who are hard of hearing this is of vital importance. The sidetone is also important, see facility 1.5.3.2.

Method of evaluation

The earpiece of the handset should be subjected to a practical test. It is evaluated how close it comes to the ear and whether it gives a comfortable feeling. The observations are evaluated by subjective assessment.

Criteria for evaluation

Poor:	the earpiece does not seal well and/or it does not feel comfortable.
Acceptable:	the earpiece does not seal really well and/or it does not feel really comfortable.
Good:	the earpiece seals well and it feels comfortable.

Assessment by users

People who are hard of hearing: "How do you find the seal of the earpiece?"
"How comfortable do you find the feeling of the earpiece against the ear?"

1.1.3 Space for the fingers on the handset

Argument

It is important that there is enough space for the fingers between the handset and the telephone when the handset is being lifted or replaced. This is especially important for people with reduced movement capability or unco-ordinated movements.

Method of evaluation

A practical test is carried out to assess whether there is enough space for the fingers when the handset is lifted and replaced. The space is evaluated subjectively by observations.

Criteria for evaluation

Poor:	there is not sufficient space between the handset and the telephone so that it is very difficulty to grip or replace the handset.
Acceptable:	there is limited space between the handset and the telephone so that it is somewhat difficult to grip or replace the handset.
Good:	there is sufficient space between the handset and the telephone so that it is very easy to grip and replace the handset.

Assessment by users

People with reduced movement capability: "How do you assess the space for the
People with unco-ordinated movements: fingers when you lift or replace the handset?"

1.1.4 Key spacing between each key

Argument

Well spaced keys reduce the chances for pressing the wrong keys. This is especially important for:

- people with unco-ordinated movements because wide spacing prevents them from pressing several keys at the same time;
- people with visual impairments because it is easier for them to distinguish each key when there is much space between them;
- blind people who can more easier feel each key.

Method of evaluation

The space between the tops of two of the keys is measured.

Criteria for evaluation

Poor:	≤ 5,0 mm.
Acceptable:	> 5,5 mm.
Good:	> 7,5 mm. Maximum space between each key is limited by the size of the keypad.

Assessment by users

-

1.1.5 Size of the keys

Argument

It is important that the size of keys is sufficient for people with unco-ordinated movements to be able to hit the right keys. For visually impaired people the keys need to be sufficiently large so that there is room for characters of sufficient size. See facility 1.3.2.

Method of evaluation

The area of the tops of the keys is measured.

Criteria for evaluation

Poor:	≤ 60 mm^2.
Acceptable:	> 60 mm^2.
Good:	> 110 mm^2. Maximum size of the keys is limited by the size of the keypad.

Assessment by users

-

1.1.6 Curvature of the top of the keys

Argument

If the top of the keys have a convex curvature people with reduced movement capability or unco-ordinated movements and people who use a mouthstick or headstick may have problems operating the keys as the fingers/stick will easily slip off the keys. Also the material the key is made of is important, see facility 1.1.7.

Method of evaluation

The curvature of the top of the keys is observed and evaluated subjectively.

Criteria for evaluation

Poor:	convex.
Good:	flat or concave.

Some keys are convex on only one side, and the other may be flat or concave. In this case the key is evaluated as convex.

Assessment by users

-

1.1.7 Material of the top of the keys

Argument

If the top of the keys are made of glossy plastic, people with reduced movement capability or unco-ordinated movements and people who use mouthstick or headstick may have problems operating the keys as the fingers/stick will easily slip off the keys. For visually impaired people glossy keys may create a glare so that they cannot see the character on the key. Also the curvature of the top of the key is important, please see facility 1.1.6.

Method of evaluation
> The material of the top of the keys is observed and evaluated subjectively.

Criteria for evaluation

> **Poor:** glossy plastic.
> **Good:** rubber or mat plastic.

Assessment by users
> -

1.2.1 Length of the cord of the handset

Argument
> People with unco-ordinated movements or reduced movement capability are more prone to accidentally pulling the handset cord so that the telephone falls on the floor. It is, therefore, important to have a cord of sufficient length.

Method of evaluation
> The coiled cord is measured pulled out to the extent that the telephone begins to move. Non-coiled cords are measured fully extended. The telephone is placed on a glass surface. The maximum force of the pull should, however, not exceed 400 grammes. The cord is measured from the part of the telephone that is turned towards the user to the bottom of the handset.

> On wall mounted telephones the length of the cord is measured when the spiral cord is pulled out by a force of 250 grammes. If only a smaller part of the cord is coiled only the measures for this part of the cord is measured, because the straight part usually is used for mounting the telephone.

Criteria for evaluation

> **Poor:** $\leq 1,1$ m.
> **Acceptable:** $> 1,1$ m.
> **Good:** $\cong 1,7$ m.

Assessment by users
> -

1.2.2 Fastening of the cord of the handset

Argument
> People with unco-ordinated movements or reduced movement capability may more often than others expose the fastenings of cords to unusual levels of stress, e.g. if the telephone drops from where it is placed and ends up hanging by its cord. Therefore, it is important to have fastenings of a good quality and to ensure that it is difficult or impossible to free the cord from the handset or the telephone by mistake.

Method of evaluation
> The fastening of the cord to the handset and the telephone should be observed pulling, pushing, and twisting the cord and by letting the telephone/handset hang in the cord. It should be observed whether the cord is solidly attached. Plug connections should be tested if it is possible, accidentally, to disconnect the cord from the handset or the telephone. Finally the fastening is evaluated subjectively.

Criteria for evaluation

> **Poor:** it is possible to disconnect the cord by mistake.
> **Acceptable:** the cord is not easily disconnected from the telephone.
> **Good:** it is not possible to disconnect the cord by mistake.

Assessment by users
> -

1.2.3   Position of the fastening of the cord

Argument

It may be a problem for people with unco-ordinated movements, with reduced movement capability, with only one hand, or people with a visual impairment, if the cord is fastened in such a way that it will be in the way when the handset is replaced.

Method of evaluation

The position of the fastening of the cord of the telephone is observed and if the cord can be fastened to the right or the left hand side of the telephone. It is furthermore tested and observed whether the cord of the handset will be in the way when the handset is being lifted off or replaced.

Criteria for evaluation

Poor: the cord is in the way when the handset is replaced.
Good: the cord is not in the way when the handset is replaced and/or it is
                   possible to fasten the cord in the right or the left hand side of the telephone.

Assessment by users
                   -

1.2.4   Weight of the telephone

Argument

It may be a problem for people with reduced muscular strength to carry the telephone around if it is too heavy. However, if the telephone is too light, it may skid too easily during dialling, see also facility 2.1.2, "Non-skid".

Method of evaluation

The telephone is weighed with handset and cord.

Criteria for evaluation

Poor: $\geq$ 925 g.
Acceptable: < 925 g.
Good: $\cong$ 375 g.

Assessment by users
                   -

1.2.5   Portability of the telephone

Argument

It may be a problem for people with reduced muscular strength or unco-ordinated movements to carry the telephone around if it is designed in such a way that it is impossible to grip it properly with both hands, or if the handset falls off easily. For people with one hand only it is important that it is possible to grip and carry the telephone with one hand. Also, it may be difficult to carry the telephone around if it is too heavy, see facility 1.2.4, "Weight of the telephone".

Method of evaluation

By carrying the telephone around with both hands and one hand it is observed how easy it is to grip. Among other things it should be observed whether there is enough space for the fingers underneath the telephone, if the ergonomics of the grip is good and whether the handset easily falls off when the telephone is moved around. An overall subjective evaluation should be made.

Criteria for evaluation

Poor: it is difficult to grip the telephone;
                   it has no good grips for both hands;
                   it is not possible to grip with one hand;
                   the handset falls off easily.

> **Acceptable:** it is possible to grip the telephone;
> the grip may only be for one or two hands;
> the handset does not fall off easily.
>
> **Good:** it is easy to grip the telephone with both hands;
> it is easy to grip the telephone with one hand;
> the handset lies steadily on the telephone.

Assessment by users

People with reduced movement capability: "How do you find the grip of the telephone
People with unco-ordinated movements: and how is it to carry around?"
"Does the handset fall off easily when the
telephone is carried around?

1.2.6 Weight of the handset

Argument

If the handset is heavy people with reduced muscular strength and with reduced movement capability may have difficulty in handling it and may get tired even when using it for short periods of time.

Method of evaluation

The handset is weighed with the cord attached at a height of 400 mm above the telephone.

Criteria for evaluation

> **Poor:** $\leq$ 150 g $\geq$ 250 g.
> **Acceptable:** < 250 g.
> **Good:** < 175 g > 150 g.

Assessment by users

> -

1.2.7 Balance of the handset

Argument

If the handset is badly balanced and the users need to exert too much strength in order to hold and handle the handset. This may cause problems especially for people with reduced muscular strength.

Method of evaluation

The balance of the handset is evaluated by observing how the balance of the handset feels in the hand. The handset is weighed (with the cord attached) at the microphone end and the earpiece end, respectively, with the handset suspended in a horizontal position 300 mm above the telephone. The balance is evaluated subjectively.

Criteria for evaluation

> **Poor:** the earpiece end is much heavier than the microphone end.
> **Acceptable:** the earpiece end is a little heavier than the microphone end or
> the microphone end is much heavier than the earpiece end.
> **Good:** the handset is well balanced or nearly balanced.

Assessment by users

People with reduced movement capability: "How do you like the balance of the handset?"

1.2.8 Pressure needed to activate the keys

Argument

The pressure needed to activate the keys is important for people with various kinds of disability. People with reduced muscular strength may have a problem if too much pressure is needed, and people with unco-ordinated movements may have a problem if too little pressure is needed as, in this case, the keys are easier to activate by mistake.

Method of evaluation

The pressure necessary to activate the keys is measured. Of the keys used in normal operation of the telephone the key that demands the hardest pressure is taken as a measure.

Criteria for evaluation

Poor:	< 0,07 N > 0,15 N.
Good:	> 0,07 N < 0,15 N.

Assessment by users

-

1.2.9 Pressure direction of the keys

Argument

If the direction of the key pressure is unsteady so that the pressure is not completely vertical, people with reduced movement capability or people with unco-ordinated movements and people who use a headstick or mouthstick may have difficulties in activating the keys as, in those cases, the fingers or the stick may slip off the key without having activated it.

Method of evaluation

The stability of the direction of key pressure is observed by pressing the edge of the keys. It is observed and evaluated subjectively whether the keys get jammed, move unsteadily, or whether they are not activated if only the edge of the key is pressed.

Criteria for evaluation

Poor:	the keys move unsteadily; the keys get jammed.
Good:	the keys move completely vertically; the keys are activated no matter where they are pressed; the keys do not get jammed.

Assessment by users

-

1.2.10 Height/recession of the keys with regard to the surface of the keypad

Argument

For people with reduced movement capability or unco-ordinated movements and for headstick and mouthstick users it may be an advantage if the surface of the keypad and the keys is level so that it is possible to rest the hands on the keypad when the keys are pressed. Keys placed under the surface of the keypad may be of help for people with reduced movement capability and for users of a headstick or mouthstick. For blind people and people with reduced vision it is an advantage when the keys are raised because they then can feel where the keys are.

Method of evaluation

The distance between the top of the keys (the natural point of contact) and the surface of the keypad of the telephone is measured.

Criteria for evaluation

For all user groups (including people with no disability) except for people with reduced movement capability or unco-ordinated movements, headstick and mouthstick users, recessed keys are a disadvantage. For designers it is recommended that they fabricate a keyguard instead, which provides the same advantages as recessed keys. For the mentioned user groups, however, the criteria for evaluation are:

Poor:	the keys are not recessed.
Acceptable:	the keys are only recessed 1 mm to 2 mm.
Good:	the keys are recessed more than 2 mm, but not more than 5 mm.

Assessment by users

-

1.2.11 Operation of the volume control

Argument

For people with unco-ordinated movements or reduced movement capability it is important that the volume control can be adjusted in a way which is easy to handle, e.g. it needs to be possible to grip/push small knobs. For blind and visually impaired people it is furthermore important that the control is not operated by means of a visual display only. For people with learning difficulties, or other cognitive impairments, it needs to be easy to understand how the volume control is operated.

Method of evaluation

The operation of the volume control should be observed in a practical test. From the observations the volume control is evaluated subjectively.

Criteria for evaluation

Poor:	it is necessary to use the display to operate the volume control; the control is very tight; the control is very small and difficult to grip/push; it is difficult to understand how the volume control is operated.
Good:	it is easy to grip/push/turn the control; it is easy to understand how the volume control is operated (e.g. sliding controls, turning knobs).

Assessment by users

Visually impaired people:	"Is it easy to grip/push the knob?"
People with reduced movement capability:	"Is the knob large enough?"
People with unco-ordinated movements:	"Is it easy to understand how the volume control is operated?"
People with learning difficulties:	
Blind people:	

1.2.12 Position of the control for adjusting the volume

Argument

For people with reduced movement capability or with unco-ordinated movements and for blind or visually impaired people it is important that the control for adjusting the volume is located in an accessible place and that it is easy to find.

Method of evaluation

The position of the control for adjusting the volume control is observed, and the position is evaluated subjectively.

Criteria for evaluation

Poor:	the control for adjusting the volume is located where it is not immediately accessible (e.g. under the telephone, on the back side of the telephone) and difficult to find.
Good:	the control for adjusting the volume is located in an accessible place, e.g. on the front of the telephone.

Assessment by users

Visually impaired people: "Do you think the control for adjusting the volume
Blind people: is located in suitable place?"

People with reduced movement
capability:
People with unco-ordinated
movements:

1.2.13   Method for adjusting the volume of the ringing tone

Argument

For people with unco-ordinated movements or reduced movement capability it is important that the volume of the ringing tone can be adjusted in a way which is easy to handle, e.g. it needs to be possible to grip/push small knobs. For blind and visually impaired people it is furthermore important that the volume of the ringing tone is not adjusted by means of a visual display only. For people with learning difficulties or other cognitive impairments, it needs to be easy to understand how the control the volume of the ringing tone is operated, and it need not be possible to turn the ringing tone fully off by the adjusting control, because the ringing tone may then be turned off by mistake.

Method of evaluation

The adjusting of the volume of the ringing tone is observed in a practical test. From the observations the method of adjusting is evaluated subjectively.

Criteria for evaluation

Poor:	it is necessary to use the display for adjusting the volume of the ringing tone; the control is tight; the control is small and difficult to grip/push; it is difficult to understand how the volume control is operated; it is possible to turn the ringing tone completely off with the adjusting control.
Good:	it is easy to grip/push/turn the control; it is easy to understand how the control is operated (e.g. sliding controls, turnable controls).

Assessment by users

Visually impaired people: "Is it easy to grip/push the control for adjusting the
                                                       ringing tone?

People with reduced movement capability: "Is the control for adjusting the ringing tone large
                                                       enough?"

People with "unco-ordinated" movements: "Is the control for adjusting the ringing tone large
                                                       enough?"

People with learning difficulties: "Is it easy to understand how the volume of the
                                                       ringing tone is adjusted?

Blind people:

1.2.14 Position of the control for adjusting the ringing tone

Argument

For people with reduced movement capability or with unco-ordinated movements and for blind or visually impaired people it is important that the control for adjusting the ringing tone is located in an accessible place and that it is easy to find. As it is not used all that often, it should not be located in the most accessible place on the telephone. For people with learning difficulties it may be an advantage if the control for adjusting the ringing tone is not very accessible.

Method of evaluation

The position of the control for adjusting the ringing tone is observed and evaluated subjectively.

Criteria for evaluation

Poor: the control for adjusting the ringing tone is located where it is very difficult to access (e.g. under the telephone) and difficult to find.

Good: the control for adjusting the ringing tone is located where it may be found quite easily and where it is not in the way, e.g. on the side of the telephone, on the top at the front.

Assessment by users

Visually impaired people:
Blind people:
People with reduced movement capability:
People with unco-ordinated movements:

"Do you think the control for adjusting the ringing tone is located in a suitable place?"

1.2.15 Tilt of the keypad

Argument

For people with reduced movement capability it may be a problem if the keypad is too tilted or horizontal, or if the front of the keypad is too high, because this makes it difficult to rest the hand on the keypad or the table while dialling.

Method of evaluation

The height of the front of the telephone is measured and the angle between the table and the keypad is measured.

Criteria for evaluation

Poor: the front of the keypad is > 25 mm high;
the angle of the keypad is tilted < 10°;
the angle of the keypad is tilted > 20°.

Good: the front of the keypad is ≤ 25 mm high;
the angle of the keypad is tilted 10°to 20°.

Assessment by users

-

1.3.1 Incorrect position of the handset

Argument

People with unco-ordinated movements or reduced movement capability, people with visual impairment, or blind people find it difficulty to place the handset in the right position if it is possible to place it in an incorrect position.

Method of evaluation

Attempt to place the handset in an incorrect position so that from a distance the handset will appear to be placed correctly on-hook. With regard to telephones with manually operated hooks, e.g. telephones with headsets, it should be observed whether the hook may be operated incorrectly. It should be observed whether there is a visual indication of handset off-hook.

Criteria for evaluation

Poor:	it is possible to misplace the handset without noticing it; there is a visual indication, but it is not clear.
Good:	it is not possible to misplace the handset; there is a visual indication and it is clear.

Assessment by users

-

1.3.2 Size of the characters on the numeric keys

Argument

It is important that the characters on the keys are such that people with reduced vision can read them.

Method of evaluation

The height of the characters is measured and their size is assessed subjectively.

Criteria for evaluation

Poor:	≤6 mm.
Good:	> 6 mm.
Very good:	> 9 mm. The maximum size of the characters is limited by the size of the keys (see facility 1.1.5, "Size of the keys").

Assessment by users

-

1.3.3 Contrast between the characters and the background on the numeric keys

Argument

It is important that the contrast between character and background on the numeric keys is high enough for visually impaired people to easily read the character. Over 7 % of all men have colour vision deficiencies and certain colour combinations should be avoided.

Method of evaluation

The contrast is observed and evaluated. From the observations a subjective estimation is made.

Criteria for evaluation

Poor:	white/a light or pale colour, black/a dark colour, red/green, blue/yellow.
Acceptable:	other combinations, black on a white background.
Good:	white on a black or dark blue background.

Assessment by users

-

1.3.4 Size of the characters on the supplementary keys

Argument

It is important that the characters are of a sufficient size so that they can be read by visually impaired people. The characters on the surrounding keypad may be smaller than on the numeric keypad, as these are used less.

Method of evaluation

The height of the characters is measured, and the size is evaluated subjectively.

Criteria for evaluation

Poor:	≤ 6,0 millimetres.
Good:	> 6,0 millimetres. The maximum size of the characters on the supplementary keys is limited by the space on the keypad.

Assessment by users

-

1.3.5 Contrast between the characters and the background on the supplementary keys

Argument

It is important that the contrast between character and background on the supplementary keys is high enough for visually impaired people to easily read the character. Over 7 % of all men have colour vision deficiencies and certain colour combinations should be avoided.

Method of evaluation

The contrast is observed and evaluated. From the observations a subjective evaluation is made.

Criteria for evaluation

Poor:	white/a light or pale colour, black/a dark colour, red/green, blue/yellow.
Acceptable:	other combinations, black on a white background.
Good:	white on a black or dark blue background.

Assessment by users

-

1.3.6 Contrast between the keys and the background

Argument

It is important that the contrast between the keys and the background is so high that visually impaired people can distinguish the keys from the background.

Method of evaluation

The contrast is observed and assessed. The contrast is evaluated subjectively.

Criteria for evaluation

Poor:	white/a light or pale colour, black/a dark colour.
Acceptable:	other combinations.
Good:	white/black.

Assessment by users

-

1.4.1 Activation by simultaneously pressing two or more keys

Argument

People with reduced movement capability, people with unco-ordinated movements, people who have only one hand, and people who use a headstick or mouthstick will have a problem if they have to press more than one key at the same time.

Method of evaluation

By observing whether several keys have to be pressed at the same time in order to activate a function.

Criteria for evaluation

Poor: more than one key have to be pressed at the same time.
Good: only one key has to be pressed at a time.

Assessment by users

-

1.5.1 Multiple indications of adjustings and choices

Argument

Blind and visually impaired people may have a problem if adjustments and choices are only shown on a visual display of the telephone or its control lights. There should also be a tactile or an audible indication of the primary adjustings.

Method of evaluation

By observing whether critical adjustments and choices are indicated only visually.

Criteria for evaluation

Poor: one or more critical adjustments and choices are indicated only visually.
Good: no critical adjustments or choices are only indicated visually.

Assessment by users

-

1.5.2.1 Activation of adjusting controls and special keys by mistake

Argument

Blind people, visually impaired people, people with reduced movement capability and people with unco-ordinated movements will have an increased probability of activating adjusting controls and special keys on the telephone by mistake.

Method of evaluation

By using the telephone and moving it around to test whether it is easy by mistake to activate adjusting controls and special keys such as: volume control keys, controls for ringing tones, coding/decoding of memory, microphone disconnecter, stand-by functions etc. The chances of activating the adjusting keys and the special keys by mistake are estimated through these observations.

Criteria for evaluation

Poor: it is probable that adjusting controls and special keys are activated by mistake.
Good: it is not probable that the adjusting controls and special keys are activated by mistake.

Assessment by users

-

1.5.2.2 Haptic feedback from pressing the keys

Argument

For people with reduced movement capability it is important to have a distinct haptic feedback from the keys. Otherwise they will often press the keys harder than necessary in order to activate them. For blind and visually impaired people, feedback is important so that they can feel when the key is activated.

Methods of evaluation
The haptic feedback of the keys is tested by pressing the keys and evaluated subjectively.

Criteria for evaluation

Poor:	there is no distinct haptic feedback.
Acceptable:	there is only a little haptic feedback.
Good:	there is a distinct haptic feedback.

Assessment by users
People with reduced movement capability: "How distinct is the click you
Blind people: feel from the key when it is pressed
Visually impaired people: down sufficiently?"

1.5.2.3   Auditory feedback from pressing the keys

Argument
For people with reduced kinaesthetic senses, e.g. after a brain damage, who cannot feel when the keys are activated, it is important that the keys give a distinct auditive feedback in the earpiece of the handset when they are activated. For blind people a distinct auditive feedback is important so that they can hear when the keys have been activated.

Method of evaluation
The auditive feedback from the keys (the push button tone (Dual Tone Multi-Frequency - DTMF) in the earpiece of the handset is observed and evaluated from a subjective assessment.

Criteria for evaluation

Poor:	no auditive feedback.
Acceptable:	only limited auditive feedback.
Good:	clear auditive feedback.

Assessment by users
Blind people: "Do you hear clearly in the earpiece of the handset when a
                                                   key is pressed down properly?"

1.5.2.4   Operation of the volume control

Please see facility 1.2.11 ("Operation of the volume control").

1.5.3.1   Volume

Argument
It is important for people who are hard of hearing or have speech impairments that the output volume is sufficiently loud.

Method of evaluation

The handset is placed on an "artificial ear" (IEC 318 [5]) in close coupling. A signal is applied via an interface box to the telephone from a signal generator. The signal contains all the frequencies in the speech frequency area with equal volume (200 Hz to 7 000 Hz)1) The signal outcome corresponds to that which is generated from the telephone plug at normal conversation (-10 dBV=316 mV Rms)1) . The same signal output is used for all the telephones. The sound intensity and the frequency content of the output from the artificial ear are read from a measurement amplifier (sound level meter) and frequency analyzer respectively.

Data are transferred to a PC for later generation of the measurement curves to report.
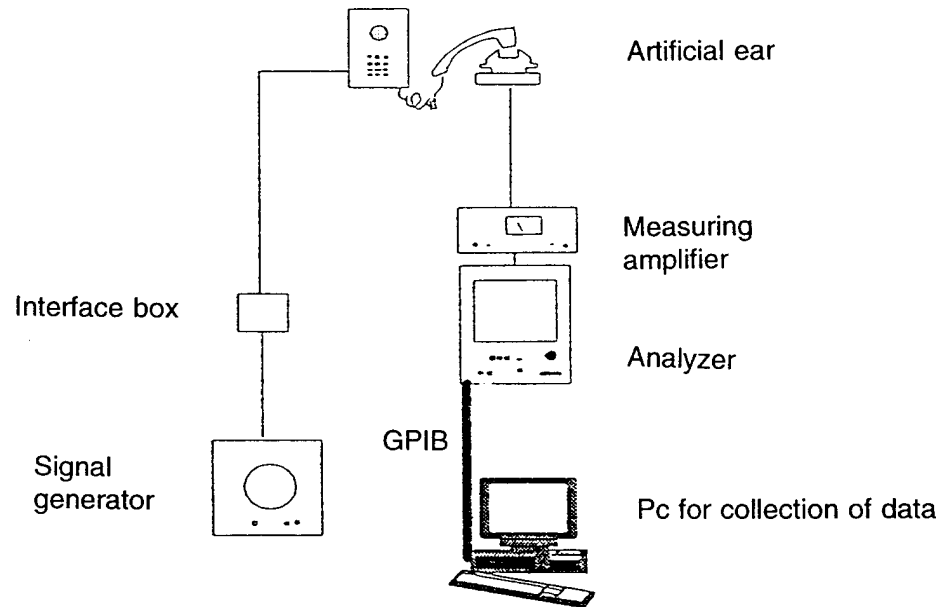
Figure A.1

Criteria for evaluation

The evaluation is based on the measured sound pressure, etc.

Very poor:	≤ 85 db SPL.
Poor:	> 85 dB SPL.
Acceptable:	> 90 dB SPL.
Good:	> 95 dB SPL.
Very good:	> 100 dB SPL < 110 dB SPL.

Assessment by users

People who are hard of hearing: "Do you find the volume in the receiver sufficient?" (The volume needs to be turned up fully and the hearing aid needs to be in position M).

---

1)   The public network is normally limited to the frequency range 300 Hz to 3 400 Hz.

2)   The signal output chosen is U.S. "Code of federal regulations 47". Normally, CCITT Recommendations are used in Europe in which the signal output is adjusted so that output in coupler corresponds to 80 dB SPL at 1 000 Hz. In this test the same signal output for all telephones has been chosen.

1.5.3.2 Sidetone

Argument

For people who are hard of hearing it is important that the sidetone is sufficiently low so that external noise does not disturb the call. On the other hand, if it is too low, the speaker will lower the voice which will make it difficult for the listener to hear the voice. For people who are hard of hearing and who do not use a hearing aid a stronger sidetone is preferred so that they may hear their own voice. If it is too high, the telephone will howl. It is, therefore, important that the sidetone has the right level. In this connection the shape of the earpiece is also important, see facility 1.1.2, ("Shape of the earface").

Method of evaluation

The telephone is tested according to the described method in the ITU-T Recommendation P.79 [6].

Criteria for evaluation

Poor: the telephone does not comply with ITU-T Recommendation P.79 [6].
Good: the telephone complies with ITU-T Recommendation P.79 [6].

Assessment by users

-

1.5.3.3 Adjustment of output volume

Argument

It is important for people who are hard of hearing that the volume of the incoming speech can be adjusted to the right level individually to improve the intelligibility of the speech. The volume must be "good" or "very good" (see facility 1.5.3.1, "Volume") otherwise the adjusting of volume will be of no help to people who are hard of hearing. For people who have low voice output it is important that the people they speak to can adjust the volume to the desired loudness.

Method of evaluation

The method for measuring volume (see facility 1.5.3.1) is used, except that both the highest and the lowest Sound Pressure Levels (SPLs) are measured.

Criteria for evaluation

Poor: no adjusting of volume;
the volume is < "good" or "very good" (see facility 1.5.3.1);
the adjusting $\leq \pm10$ dB (tolerance ±2 dB);
the volume + the adjusting > 110 dB SPL.

Good: the volume is "good" or "very good" (see facility 1.5.3.1);
the adjusting is ±10 dB (tolerance ±2 dB);
the volume + the adjusting is ≤ 110 dB SPL.

Assessment by users

-

1.5.3.4 Volume of the ringing tone

Argument

It is important for people who are hard of hearing that the ringing tone can be adjusted so loud that the level meets the needs of the user. The ringing tones are also important, see facility 1.5.3.5, ("The ringing tones").

Method of evaluation

Objective measurement:

- the telephone is placed on a chipboard, 1 metre x 1 metre on the floor in the anechoic chamber.

- a signal is applied via an interface box to the telephone from a signal generator. The signal corresponds to that which is generated from the telephone plug at ringing (50 Hz sinus, 120 Volt peak-peak). The same signal is used for all telephones. The telephone rings continuously.[1])

- the sound pressure level and the frequency content from the ringing signal are read from a measurement amplifier (sound level meter) and a frequency analyzer, respectively.

- data is transferred to PC for later generation of measurement curve to report.

Procedure for measuring the ringing tone. (Output and frequency characterization)
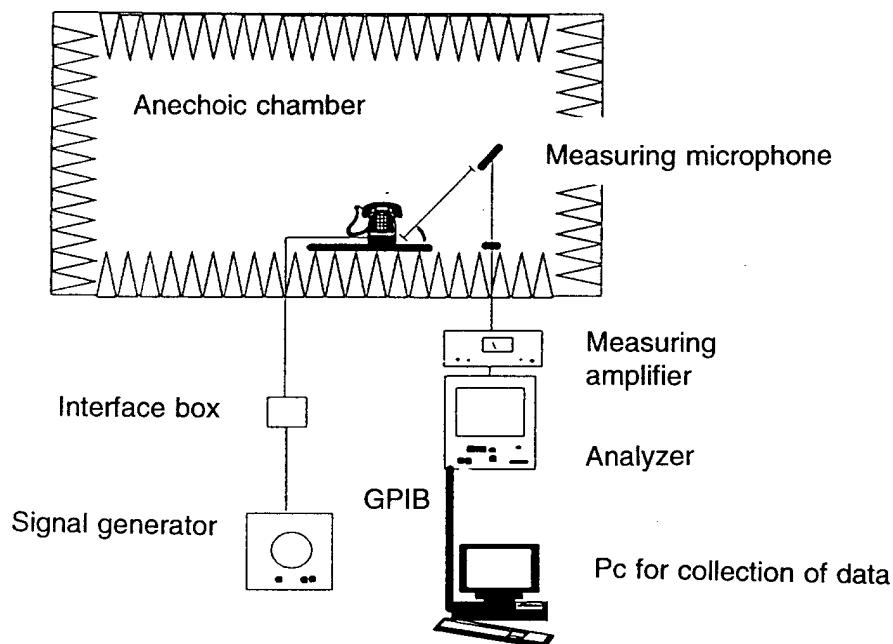
Figure A.2

Criteria for evaluation

The volume of the ringing tone is assessed according to the A-weighted sound pressure level.

Very poor:	≤ 60 dB(A) SPL.
Poor:	> 60 dB(A) SPL.
Acceptable:	> 65 dB(A) SPL.
Good:	> 70 dB(A) SPL.
Very good:	> 75 dB(A) SPL < 110 dB(A) SPL.

Subjective assessments:

Subjects listen to the ringing tone which is adjusted to full volume and the lowest frequency.

Assessment by users:

People who are hard of hearing: "Is the ringing tone sufficiently loud?"

---

3)   At connection to the public network the telephone rings in 1 second intervals with 4 second's pause.

1.5.3.5 The ringing tones

Argument

For people who are hard of hearing it is important that the ringing tones of telephones contain low frequency tones as well as harmonics over the whole frequency range. The low frequency tones are important for people who are hard of hearing in order to hear the telephone ring, because people usually primarily loose the ability to hear high frequency tones.

Method of evaluation

The same method is used as described for evaluation of the volume of the ringing tone (see facility 1.5.3.4). A supplementary subjective assessment by people who are hard of hearing is carried out because it may be difficult to interpret the measurement in same way as hearing impaired people hear the tones.

Criteria for evaluation

Distribution on fundamental and harmonic tones:

Very poor:	no fundamental tones below 2 000 Hz.
Poor:	1 fundamental tone below 2 000 Hz and harmonics of this.
Acceptable:	2 fundamental tones below 2 000 Hz and harmonics of these.
Good:	1 fundamental tone below 1 000 Hz and harmonics of this.
Very good:	2 fundamental tones below 1 000 Hz and harmonics of these.

Assessment by users

People who are hard of hearing:"What do you think of the ringing tones?"

1.5.4.1 Size of the characters on the display

Argument

It is important that the characters on the display are large enough for visually impaired people to be able to read them. Also high contrast (see facility 1.5.4.2), the brilliance and no glare are important.

Method of evaluation

The height of the characters is measured.

Criteria for evaluation

Poor:	$\leq 9,5$ mm.
Good:	$\cong 9,5$ mm.

Assessment by users

-

1.5.4.2 Contrast between the characters and the background of the display

Argument

It is important that the contrast between the characters and the background of the display is high enough for visually impaired people to be able to read the characters easily.

Method of evaluation

The contrast is observed and a subjective assessment is made.

Criteria for evaluation

Poor:	the contrast is too low making it very difficult to read the characters.
Acceptable:	the contrast is moderately high, and it is not very easy to read the characters.
Good:	the contrast is very high, and it is easy to read the characters.

Assessment by users

-

1.6.1 Layout of the keys

Argument

For blind and visually impaired people it is important that the layout of the keys follows the international standard layout so that they know where the various keys are placed. In Norway and Denmark two different layouts (ISO and CCITT) are common which creates many problems for blind and visually impaired people.

Method of evaluation

It is checked whether the arrangement of the keys is in accordance with the layout recommended by ITU-T Recommendation E.161 [7] "Arrangement of figures, letters and symbols on telephones and other devices that can be used for gaining access to a telephone network".

Criteria for evaluation

Poor:	not in accordance with the ITU-T Recommendation E.161 [7] layout.
Good:	in accordance with the ITU-T Recommendation E.161 [7] layout.

Assessment by users

-

1.6.2 Tactile marking of the number 5 numeric key

Argument

In order that blind people may correctly identify the numeric key group it is very important that the number 5 key is tactilely marked with a distinct raised pip or dimple in the middle of the key.

Method of evaluation

To check whether the number 5 key is marked with a raised pip, and whether it is distinct and placed in the middle of the key.

Criteria for evaluation

Poor:	there is no pip on the number 5 numeric key.
Acceptable:	the pip on the number 5 numeric key is not distinct and/or it is not placed in the middle of the key.
Good:	there is a distinct dot on the number 5 numeric key, and it is placed in the middle of the key.

Assessment by users

-

1.6.3 Separation of the key groups

Argument

If the key groups are separated by a clearly defined space or by different shapes of the keys in the various key groups, it is easier for blind people or people with visual impairment to identify the various key groups.

Method of evaluation

The distance between the key groups is compared with the space between each numeric key. It is determined if the keys of the various key groups have different shapes and/or sizes. A subjective evaluation is made from these observations.

Criteria for evaluation

Poor:	the space between the key groups is not larger than the space between each numeric key;
	the keys of the various key groups do not have different shape and/or size.

Good: the space between the key groups is clearly larger than the space between each numeric key and the keys of the various key groups have clearly different shapes and/or sizes.

Assessment by users
Blind people: "How distinctly do you find the key groups are separated?"
Visually impaired people:

1.6.4 Space for symbols or pictures at/on the quick dialling keys

Argument
For people with learning difficulties or other cognitive impairments who cannot read, it is important that the quick dialling keys have sufficient space for placing symbols or pictures on or near them.

Method of evaluation
The space open for symbols or pictures on or near the quick dialling keys is measured and the space is evaluated subjectively.

Criteria for evaluation

Poor: there is less than 15 mm x 20 mm room next to or on any quick dialling key.
Acceptable: there is about 15 mm x 20 mm room next to or on one quick dialling key.
Good: there is more than 15 mm x 20 mm room next to or on at least two quick dialling keys.

Assessment by users
-

1.6.5 Labelling of the control for adjusting the volume

Argument
For blind and visually impaired people and for people with learning difficulties it is important that the control for adjusting the volume is clearly labelled, so that it is easy to find and to understand the use of the control.

Method of evaluation
The labelling of the control is observed and evaluated subjectively.

Criteria for evaluation

Poor: the labelling is incomprehensible and there is no tactile labelling.
Acceptable: a reasonably clear tactile labelling has been attempted.
Good: the labelling is easy to understand, see and feel.

Assessment by users
People with learning difficulties: "Do you find that the control for

Visually impaired people: adjusting the volume is clearly labelled?"

Blind people:

1.6.6 Labelling of the control for adjusting the ringing tone

Argument
For blind and visually impaired people and for people with learning difficulties it is important that the control for adjusting the ringing tone is clearly labelled so that it is easy to find and to understand the use of the control.

Method of evaluation
The labelling of the control for adjusting the ringing tone is observed and evaluated subjectively.

Criteria for evaluation

Poor:	the labelling is incomprehensible and there is no tactile labelling.
Good:	the labelling is easy to understand, see, and feel.

Assessment by users

People with learning difficulties:	"Do you find that the control for
Visually impaired people:	adjusting the ringing tone is
Blind people:	clearly labelled?"

2.1.1 Sturdiness

Argument

People with unco-ordinated movements may more often than other people accidentally move the telephone so that it may drop and get damaged. It is important that the telephone is sturdy.

Method of evaluation

Observe whether the telephone appears fragile or whether it appears easy to break.
Furthermore, telecommunications manufacturers and national regulatory authorities usually have specific methods for testing telephones for sturdiness if an objective method is wanted. The sturdiness is evaluated subjectively.

Criteria for evaluation

Poor:	does not seem to be sturdy.
Good:	seems to be sturdy.

Assessment by users

-

2.1.2 Non-skid

Argument

People with unco-ordinated movements more often than other people accidentally push the telephone or pull the cord. People who use a headstick or mouthstick may push the telephone when they press the keys if the telephone is not steady. The non-skid feature depends on the weight of the telephone and the friction of the feet.

Method of evaluation

The telephone is placed on a glass plate with the handset off. A glass plate is used because it has a friction that can be directly compared to that of a lacquered table, which would be the usual surface where a telephone is placed. The telephone is subjected to a horizontal pull on the cord and the power needed to move the telephone is measured.

Criteria for evaluation

Poor:	≤ 200 g.
Acceptable:	> 200 g.
Good:	$\cong 400$ g.

Assessment by users

-

2.1.3 Quick dialling

Argument

Quick dialling is an advantage to most groups of disabled people since quick dialling enables people with learning difficulties or cognitive impairments who cannot read to make phone calls. For people with reduced movement capability or with unco-ordinated movements, who find it difficult to activate the keys, quick dialling is useful since only one or two key presses are needed. For people who have become blind late in life and who find it difficult to find the various keys, quick dialling may also be useful. It is important that the call can be made with as few key presses as possible; preferably one.

Methods of evaluation

Determine if the telephone has a quick dialling facility. If it has, it is determined how many key presses are necessary to make a call.

Criteria for evaluation

Poor:	no quick dialling facility.
Acceptable:	quick dialling facility activated by more than one keystroke.
Good:	quick dialling facility activated by one keystroke.

Assessment by users

-

2.1.4 Repeat call

Argument

Repeat call is of advantage to most groups of disabled people because repeat call saves many keystrokes and takes a load off the memory. For people with reduced movement capability and people with unco-ordinated movements and for blind and visually impaired people, it is an advantage when the repeat call requires only one keystroke.

Methods of evaluation

Determine if the telephone has repeat call. If it has, determine how many key presses are necessary to make a repeat call.

Criteria for evaluation

Poor:	no repeat call facility.
Acceptable:	repeat call facility activated by more than one keystroke.
Good:	Repeat call facility activated by one keystroke.

Assessment by users

-

2.1.5 Hands free operation

Argument

People with reduced movement capability or unco-ordinated movements may find it difficult to handle the handset or to hold it more than a short period of time. For these it will be an advantage if the telephone can be used in hands free mode. For people who use a headstick or mouthstick it is important to avoid lifting the handset when they use the telephone. Blind people who need to take notes during a call often need both hands to do so, and to them it is important if they can use the telephone in hands free mode.

Method of evaluation

It is observed whether the telephone has hands free operation so that the handset does not need to be lifted.

Criteria for evaluation

Poor:	no hands free mode.
Good:	hands free mode.

Assessment by users

-

2.1.6 Display

Argument

For people with unco-ordinated movements, people with a bad memory and for people with reduced hearing it is a good support when the dialled number is shown on a display on the telephone.

Method of evaluation

It is observed whether the dialled number is shown on a display.

Criteria for evaluation

Poor:	no display.
Good:	display.

Assessment by users

-

2.1.7 Directions for use

Argument

To be able to use the telephone to the best advantage, it is important to have simple and easily comprehensible directions for use.

Method of evaluation

The directions for use are used as the telephone is tested. The directions are evaluated subjectively.

Criteria for evaluation

Poor:	there are obvious mistakes in the directions for use, or they are impossible to read from a linguistic/graphical point of view.
Acceptable:	the directions for use are readable, but not simple, clear and systematic.
Good:	there is a systematic exposition of the various functions of the telephone in addition to a short and easy explanation of the various functions of the telephone.
Very good:	the directions for use are simple and easy to comprehend and, in addition, they are also delivered in braille.

Assessment by users

-

2.2.1 Possibility for a handset holder

Argument

It is important for people with reduced movement capabilities or unco-ordinated movements and for blind people that the handset can be placed in a standard handset holder while they talk (see also facility 2.1.5, "Hands free").

Method of evaluation

Test if the handset can be mounted in one of the universal handset holders on the market.

Criteria for evaluation

> **Poor:**   the handset cannot be placed in a handset holder or there is no headset.
> **Good:**   the handset can be placed in a handset holder or there is a headset.

Assessment by users

> -

2.2.2   Possibility for a keyguard

Argument

It will be an advantage for people with reduced movement capability to have the keys recessed so they can rest their hands on the keypad when they press the keys. Recessed keys are also useful for people with unco-ordinated movements and for people who use a headstick or mouthstick. Keys may be recessed by means of a keyguard (see also facility 1.2.10, "Height/recession of the keys with regard to the surface of the keypad").

Method of evaluation

Information from the producers/dealers is obtained.

Criteria for evaluation

> **Poor:**   no standard keyguard is available.
> **Good:**   a standard keyguard is available.

Assessment by users

> -

2.2.3   Built-in inductive coupling

Argument

For people who are hard of hearing and use a hearing aid, it is important that the telephone has inductive coupling. If not they may not be able to use the telephone. It is a great advantage if the inductive coupler is built into the telephone. It is also important that the field strength of the inductive coupler and the orientation of the field are correct.

Method of evaluation

The telephone is evaluated according to ETS 300 381 [8]. The inductive coupling is also assessed subjectively by hearing aid users as the test method does not cover orientation of the coil.

Criteria for evaluation

> **Poor:**   No built-in inductive coupling facility;
> the field strength level is < -17 dB relative to 1 A/m;
> the microphone cannot be held close to the mouth when there is maximum coupling at the earpiece.

> **Acceptable**:   the field strength level is within the acceptable range (-17 dB to -30 dB relative to 1 A/m);
>
> the microphone can be held close to the mouth when there is maximum coupling at the earpiece.

> **Good**:   the field strength level is within the preferred range (-17 dB to 25 dB relative to 1 A/m);
>
> the microphone can be held close to the mouth when there is maximum coupling at the earpiece.

Assessment by users
People who are hard of hearing: "How close can the microphone be held to the mouth when the earpiece is held in the way where you have the best possible coupling between the earpiece and the hearing aid? Does your hearing need to be set in position T?"

2.2.4   Possibility for connection of an inductive coupler and/or audio amplifier

Argument
For people who are hard of hearing it is important that the output volume at the earpiece is sufficient. However, it is also important that there is a possibility for connecting an inductive coupler if it is not built into the telephone; if there is not people who use a hearing aid will find it difficult to use the telephone. An externally connected audio amplifier may also be an advantage.

Method of evaluation
Test if it is possible to connect one of the universal inductive couplers/audio amplifiers on the market. Connection of universal inductive couplers and amplifiers are tested at the same time as they usually are connected in the same way.

Criteria for evaluation

Poor: it is not possible to connect one of the universal inductive couplers/amplifiers on the market.

Good: it is possible to connect one of the universal inductive couplers/amplifiers on the market.

Assessment by users
          -

Annex B: Questionnaires for users

Before the users answer the questionnaire they are introduced to the project and to the questions they are going to answer. It is very important that the user feels comfortable and free to answer the questions as honestly as possible.

Also, they fill in a general questionnaire concerning their disability, age, gender, usual type of telephone, etc.

QUESTIONNAIRE CONCERNING TELEPHONES - VISUALLY IMPAIRED PEOPLE

NAME: _____

THE TYPE OF THE TELEPHONE: _____

If there is any question about something the telephone cannot do or if the question in one or another way not is relevant for the telephone, then you do not have to answer it.

Please rate your answers:

"Very poor"
"Poor"
"Acceptable"
"Good"
Very good"

"Is it easy to grip/push the control for adjusting the volume?"
"Is the control for adjusting the volume large enough?"
"Is it easy to understand how the volume control is operated?"
"Do you think the control for adjusting the volume is located in a suitable place?"
"Is it easy to grip/push the control for adjusting the ringing tone?"
"Is the knob for adjusting the ringing tone large enough?"
"Is it easy to understand how the ringing tone is adjusted?"
"How distinct is the click from the key when it is pressed down sufficiently?"
"What do you think about the contrast between the characters and the background on the display?"
"How distinctly do you find that the key groups are separated?"
"Do you find that the control for adjusting the volume is clearly labelled?"
"Do you find that the control for adjusting the ringing tone is clearly labelled?"

Questions for other user groups are:

Blind people:
"Is it easy to grip/push the control for adjusting the volume?"
"Is the control for adjusting the volume large enough?"
"Is it easy to understand how the volume control is operated?"
"Do you find that the control for adjusting the volume is located in a suitable place?"
"Is it easy to grip/push the control for adjusting the ringing tone?"
"Is the control for adjusting the ringing tone large enough?"
"Is it easy to understand how the ringing tone is adjusted?"
"Do you think the control for adjusting the ringing tone is located in a suitable place?"
"How distinct is the click from the key when it is pressed down sufficiently?"
"Do you hear clearly in the earpiece of the handset when the key is pressed down properly?"
"How distinctly do you find the key groups are separated?"
"Do you find that the control for adjusting the volume is clearly labelled?"
"Do you find that the control for adjusting the ringing tone is clearly labelled?"

People with reduced movement capabilities:

"Is the handset pleasant to hold?"
"Is it easy to speak and listen at the same time with this handset?"
"How do you assess the space for the fingers when you lift or replace the handset?"
"How do you find the grip of the telephone and how easy is it to carry the telephone around?"
"Does the handset fall off easily when the telephone is carried around?"
"What do you think of the balance of the handset?"
"Is it easy to grip/push the control for adjusting the volume?"
"Is the control for adjusting the volume large enough?"
"Is it easy to understand how the volume control is operated?"
"Do you think the control for adjusting the volume is located in a suitable place?"
"Is it easy to grip/push the control for adjusting the ringing tone?"
"Is the control for adjusting the ringing tone large enough?"
"Is it easy to understand how the ringing tone is adjusted?"
"Do you think the control for adjusting the ringing tone is located in a suitable place?"
"How distinct is the click from the key when it is pressed down sufficiently?"

People with unco-ordinated movements:

"How do you assess the space for the fingers when you lift or replace the handset?"
"How do you find the grip of the telephone and how easy is it to carry the telephone around?"
"Is it easy to grip/push the control for adjusting the volume?"
"Is the control for adjusting the volume large enough?"
"Is it easy to understand how the volume control is operated?"
"Do you think the control for adjusting the volume is located in a suitable place?"
"Is it easy to grip/push the control for adjusting the ringing tone?"
"Is the control for adjusting the ringing tone large enough?"
"Is it easy to understand how the ringing tone is adjusted?"

People who are hard of hearing:

"How do you find the seal of the earpiece?"
"How comfortable do you find the feeling of the earpiece against the ear?"
"Do you find the volume in the receiver sufficient loud?"
"Is the ringing tone sufficiently loud?"
"What do you think of the ringing tones?"
"How close can the microphone be held to the mouth when the earpiece is held in the way where there is the best possible coupling between the earpiece and the hearing aid? Does your hearing aid need to be in position T?"

People with learning disabilities:

"Do you think the control for adjusting the volume is located in a suitable place?"
"Is it easy to grip/push the control for adjusting the volume?"
"Is the control for adjusting the volume large enough?"
"Is it easy to understand how the volume control is operated? "
"Do you think the control for adjusting the volume is located in a suitable place?"
"Do you find that the control for adjusting the ringing tone is clearly labelled?"
"Do you find that the control for adjusting the volume is clearly labelled?"

Annex C: Checklists for groups of disabled people

These checklists can be used when the telephone is to be evaluated in relation to one or only a few groups of users.

C.1   Visually impaired people

1.1   Physical interface - anthropometric usability components
1.1.4   Key spacing between each key
1.1.5   Size of the keys

1.2   Physical interface - motoric usability components
1.2.3   Position of the fastening of the cord
1.2.10   Height/recession of the keys with regard to the surface of the keypad
1.2.11   Operation of the volume control
1.2.12   Position of the control for adjusting the volume
1.2.13   Method for adjusting the volume of the ringing tone
1.2.14   Position of the control for adjusting the ringing tone

1.3   Physical interface - perceptual usability components
1.3.1   Incorrect position of the handset
1.3.2   Size of the characters on the numeric keys
1.3.3   Contrast between character and background on the numeric keys
1.3.4   Size of the characters on the supplementary keys
1.3.5   Contrast between characters and the background on the supplementary keys
1.3.6   Contrast between the keys and the background

1.5   User input/output - perceptual usability components
1.5.1   Multiple indications of adjustings and choices
1.5.2.   Controls, keys and adjusting settings requirements
1.5.2.1   Activation of adjusting controls and special keys by mistake
1.5.2.2   Haptic feedback from pressing the keys
1.5.4   Screen display requirements
1.5.4.1   Size of the characters on the display
1.5.4.2   Contrast between the characters and the background of the display

1.6   User input/output - cognitive usability components
1.6.1   Layout of keys
1.6.2   Tactile marking of the number 5 numeric key
1.6.3   Separation of the key groups
1.6.5   Labelling of the control for adjusting the volume
1.6.6   Labelling of the control for adjusting the ringing tone

2.1.   Conventional facilities
2.1.3   Quick dialling
2.1.4   Repeat call
2.1.6   Display
2.1.7   Directions for use

C.2 Blind people

1.1 Physical interface - anthropometric usability components
1.1.4   Key spacing between each key

1.2 Physical interface - motoric usability components
1.2.10   Height/recession of the keys with regard to the surface of the keypad
1.2.11   Operation of the volume control
1.2.12   Position of the control for adjusting the volume
1.2.13   Method for adjusting the volume of the ringing tone
1.2.14   Position of control for adjusting the ringing tone

1.3 Physical interface - perceptual usability components
1.3.1   Incorrect position of the handset

1.5 User input/output - perceptual usability components
1.5.1   Multiple indications of adjustings and choices
1.5.2.   Controls, keys and adjusting settings requirements
1.5.2.1   Activation of adjusting controls and special keys by mistake
1.5.2.2   Haptic feedback from pressing the keys
1.5.2.3   Auditory feedback from pressing the keys

1.6 User input/output - cognitive usability components
1.6.1   Layout of the keys
1.6.2   Tactile marking of the number 5 numeric key
1.6.3   Separation of the key groups
1.6.5   Labelling of the control for adjusting the volume
1.6.6   Labelling of the control for adjusting the ringing tone

2.1. Conventional facilities
2.1.3   Quick dialling
2.1.4   Repeat call
2.1.5   Hands free operation
2.1.7   Directions for use

2.2. Facilities especially for disabled users
2.2.1   Possibility for a handset holder

C.3 People with reduced movement capability and reduced muscular strength

1.1 Physical interface - anthropometric usability components
1.1.1   Shape and size of the handset
1.1.3   Space for the fingers on the handset
1.1.5   Size of the keys
1.1.6   Curvature of the top of the keys
1.1.7   Material of the top of the keys

1.2 Physical interface - motoric usability components
1.2.1   Length of the cord
1.2.2   Fastening of the cord of the handset
1.2.3   Position of the fastening of the cord
1.2.4   Weight of the telephone
1.2.5   Portability of the telephone
1.2.6   Weight of the handset
1.2.7   Balance of the handset
1.2.8   Pressure needed to activate the keys
1.2.9   Pressure direction of the keys
1.2.10   Height/recession of the keys with regard to the surface of the keypad
1.2.11   Operation of the volume control
1.2.12   Position of control for adjusting the volume
1.2.13   Method for adjusting the volume of the ringing tone

1.2.14	Position of the control for adjusting the ringing tone
1.2.15	Tilt of the keypad

1.3   Physical interface - perceptual usability components

1.3.1   Incorrect position of the handset

1.4   User input/output - motoric usability components

1.4.1   Activation by simultaneous pressing two or more keys

1.5   User input/output - perceptual usability components

1.5.2	Controls, keys and adjusting settings requirements
1.5.2.1	Activation of adjusting controls and special keys by mistake
1.5.2.2	Haptic feedback from pressing the keys

2.1.   Conventional facilities

2.1.3	Quick dialling
2.1.4	Repeat call
2.1.5	Hands free operation
2.1.6	Display
2.1.7	Directions for use

2.2   Facilities especially for disabled users

2.2.1	Possibility for a handset holder
2.2.2	Possibility for a keyguard

C.4   People with unco-ordinated movements

1.1   Physical interface - anthropometric usability components

1.1.3	Space for the fingers on the handset
1.1.4	Key spacing between each key
1.1.5	Size of the keys
1.1.6	Curvature of the top of the keys
1.1.7	Material of the top of the keys

1.2   Physical interface - motoric usability components

1.2.1	Length of the cord of the handset
1.2.2	Fastening of the cord of the handset
1.2.3	Position of the fastening of the cord
1.2.5	Portability of the telephone
1.2.8	Pressure needed to activate the keys
1.2.9	Pressure direction of the keys
1.2.10	Height/recession of the keys with regard to the surface of the keypad
1.2.11	Operation of the volume control
1.2.12	Position of the control for adjusting the volume
1.2.13	Method for adjusting the volume of the ringing tone
1.2.14	Position of the control for adjusting the ringing tone

1.3   Physical interface - perceptual usability components

1.3.1   Incorrect position of the handset

1.4   User input/output - motoric usability components

1.4.1   Activation by simultaneous pressure of two or more keys

1.5   User input/output - perceptual usability components

1.5.2.	Controls, keys and adjusting settings requirements
1.5.2.1	Activation of adjusting controls and special keys by mistake

2.1.   Conventional facilities

2.1.1	Sturdiness
2.1.2	Non-skid
2.1.3	Quick dialling
2.1.4	Repeat call
2.1.5	Hands free operation

2.1.6   Display
2.1.7   Directions for use

2.2.   Facilities especially for disabled users
2.2.1   Possibility for a handset holder
2.2.2   Possibility for a keyguard

C.5   People who are hard of hearing

1.1   Physical interface - anthropometric usability components
1.1.1   Shape and size of the handset
1.1.2   Shape of the earpiece

1.5   User input/output - perceptual usability components
1.5.3   Tones and indications requirements
1.5.3.1   Volume
1.5.3.2   Sidetone
1.5.3.3   Adjusting of output volume
1.5.3.4   Volume of the ringing tone
1.5.3.5   The ringing tones

2.1.   Conventional facilities
2.1.6   Display
2.1.7   Directions for use

2.2.   Facilities especially for disabled users
2.2.3   Built-in inductive coupling
2.2.4   Possibility for connection of an inductive coupler and/or audio amplifier

C.6   People with learning difficulties

1.2   Physical interface - motoric usability components
1.2.11   Operation of the volume control
1.2.13   Method for adjusting the volume of the ringing tone
1.2.14   Position of control for adjusting of the ringing tone

1.6   User input/output - cognitive usability components
1.6.4   Space for symbols or pictures at/on the quick dialling controls
1.6.5   Labelling of the control for adjusting the volume
1.6.6   Labelling of the control for adjusting the ringing tone

2.1.   Conventional facilities
2.1.3   Quick dialling
2.1.6   Display
2.1.7   Directions for use

C.7   People with low voice output

1.1.   Shape and size of the handset
1.1.1   Shape and size of the handset
1.5.3.1   Volume

2.1.   Conventional facilities
2.1.7   Directions for use

Annex D: Presentation of the evaluation results

D.1 An example of a description of the results of the evaluation

Name of telephone

Description
Table telephone, can also be used as a wall telephone. It has repeat call and 20 quick dial keys, 10 can be activated by pressing only one key. There is volume control, and it is possible to amplify the speech. The telephone has inductive coupling. The tones and the volume of the ringing tone can be regulated. There is a display, and the telephone can be used hands free.

Assessment
The telephone stands firmly, and it seems very sturdy. The wire to the handset is fixed by a solid plug outlet that cannot be loosened by a mistake. The wire does not get caught by the handset. It is easy to carry the telephone as it is possible to use both hands.

It is possible to activate the "secrecy" control by a mistake, because it is only indicated by a light diode, that cannot be seen by visually impaired people, and others cannot see it in sunlight.

The size, shape and balance of the handset is good, and it is not possible to misplace it. There is good room for the fingers when the handset is to be lifted. The shape of the earpiece is good. The handset can be mounted in a standard handset holder.

The keyboard layout follows the ITU-T Recommendation, and there is a pip on the 5-key. The key groups are distinctly separated, and the spacing between each key is good. The size of the keys is also good, but the shape (convexo-concave) is a problem for people with motor disabilities. The keys are very stable to press down, and there is a very distinct haptic feed-back, but the keys are too hard to press down. There is a clear auditory feed-back when the keys are pressed. It is easy to read the numbers and the letters on the keys and the frame. The contrast between the number keys and the frame is very good (black/white), but the contrast between the other keys and the frame is very poor (white/white).

There are 20 quick dial memory keys, of which 10 can be activated by pressing only one key. There is good room for symbols or pictures. When the last 10 quick-dial keys are to be activated, "memory bank B" needs to be called, and a small "B" is shown on the display. This is a problem for blind and other visually impaired people because there are no other ways to know that "memory bank B" is activated. "Battery low" is also indicated on the display as the only indication. The display has big letters, but very poor contrast, which makes it hard to read for visually impaired people.

The volume can be adjusted, and the range is very large. The control for adjusting the volume is placed very well on the top of the telephone, but the shape of the control is not good. The control is clearly labelled. The telephone has inductive coupling, but the orientation of the field is not correct.

The volume of the ringing tone is very loud, and there are three different set of tones, all containing high and low tones. The ringing tone is regulated by a little, poorly marked (small white letters on white background) sliding control. It is possible to place the control on "off" by a mistake.

The directions for use is very detailed, but it is hard to get an overview of how to use the telephone.

Remarks

People who are hard of hearing
+ very loud volume
+ large range of the volume control
+ very loud and adjustable ringing tone
+ earpiece seals well to the ear
+ display
- inductive coupling which is not correctly orientated

People with low voice output
+ good sensitivity of the microphone
+ possibility for microphone amplification
+ very loud volume
+ large range of the volume control
+ microphone which can come close to the mouth

People with learning disabilities
+ 10 quick dialling which keys can be activated by one stroke
+ room for symbols and pictures at/on the quick dialling keys
+ control for adjusting the ringing tone under the telephone
+ display
- secrecy control which may be activated by mistake
- ringing tone which may be turned off by mistake

Visually impaired people
+ numbers and letters which are easy to read
+ quick dialling keys
- ringing tone which may be turned off by mistake
- hard to see if the secrecy function is turned on
- hard to read letters on the display
- activation of "memory bank B" shown by a small letter on the display
- some controls are hard to see (white on white)

Blind people
+ quick dialling facility
+ hands free facility
+ very precise controls with distinct haptic feed-back
+ the key groups are distinctly separated
+ good labelling
- ringing tone may be turned off by mistake
- some functions demand use of the display
- secrecy button which may be activated by mistake

People with reduced movement capabilities
+ 10 quick dialling keys which can be activated by only one stroke
+ hands free facility
+ very precise controls with distinct haptic feed-back
+ display
+ the handset which has a good size and shape
+ easy to lift handset off-hook
+ easy to carry the telephone around
- the keys have a bad shape
- the keys are hard to press down
- ringing tone which is hard to change
- volume control which is hard to use

People with unco-ordinated movements
+ 10 quick dialling keys can be activated by only one stroke
+ hands free facility
+ very precise controls with distinct haptic feed-back
+ the keys are hard to press down
+ good spacing between the controls
+ display
+ the handset is easy to lift off-hook
+ easy to carry the telephone around
- the telephone stands firmly
- the keys have a bad shape
- the ringing tone is hard to change
- volume control which is hard to use

D.2   Final survey sheet

Survey

1 = very poor
2 = poor
3 = average
4 = good
5 = very good

– = not relevant
     for this telephone

keys	CCITT-layout	yes	yes
	size (lxh mm)	14 Ø	14 Ø
	readability	4	4
	marking of 5-button	yes	yes
	curvature	–	–
	haptic feedback	5	5
	pressure for activation	180 g	180 g
handset	weight	210 g	210 g
	shape of earpiece	4	4
	shape of handset	4	4
incoming speech	volume	4	4
	volume control	yes	yes
	regulation of volume control	3	3
	marking of volume control	4	4
	inductive coupling	2	2
ringing	volume	5	5
	tones	4	4
	control	3	3
	marking	2	2
functions	quick dial	yes	yes
	repeat call	yes	yes
	handfree	yes	no
general remarks	display	yes	no
	readability of display	3	-
	instructions	3	3
	weight	925 g	840 g
	non-skidding	5	5

History

Document history	
January 1995	First Edition
February 1996	Converted into Adobe Acrobat Portable Document Format (PDF)