INTERNATIONAL STANDARD

**ISO
8662-3**

Hand-held portable power tools — Measurement of vibrations at the handle —

Part 3:
Rock drills and rotary hammers

Machines à moteur portatives — Mesurage des vibrations au niveau des poignées —

Partie 3: Marteaux perforateurs et marteaux rotatifs

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 8662-3 was prepared by Technical Committee ISO/TC 118, *Compressors, pneumatic tools and pneumatic machines*, Sub-Committee SC 3, *Pneumatic tools and machines*.

ISO 8662 consists of the following parts, under the general title *Hand-held portable power tools — Measurement of vibrations at the handle*:

— *Part 1: General*

— *Part 2: Chipping hammers and riveting hammers*

— *Part 3: Rock drills and rotary hammers*

— *Part 4: Grinding machines*

— *Part 5: Pavement breakers and hammers for construction work*

— *Part 6: Impact drills*

— *Part 7: Impact wrenches*

— *Part 8: Orbital sanders*

Annex A forms an integral part of this part of ISO 8662. Annexes B and C are for information only.

Introduction

This part of ISO 8662 specifies how a type test for the measurement of vibrations at the handles of rock drills and rotary hammers shall be performed. It supplements ISO 8662-1 which gives the general specifications for the measurement of vibrations at the handles of hand-held portable power tools. It specifies the operation of the power tool under type test and other requirements for the performance of the type test.

The principle of operation of these power tools is that a drill bit is made to rotate while at the same time energy is converted into periodic impacts which are transmitted to the connection end of the drill bit.

For light rock drills, having a mass (without the drill bit) below 15 kg, and rotary hammers, testing is carried out in a way which closely resembles a typical work situation. Heavy rock drills with a mass above 15 kg have a high penetration rate and the loading device used for the light machines would not be economical. Another type of loading device, a steel ball energy absorber, is used. The method gives an operation similar to that in a real work situation, and since the loading device can be used for a large number of tests the method is economical.

The reproducibility of measurements has been found to be satisfactory for the methods specified in this part of ISO 8662.

In rotary hammers and rock drills the magnitude of the impact energy is determined by the internal design of the tool and is not influenced by external forces. A prerequisite for a stationary operating condition is that a certain minimum static force is applied.

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Hand-held portable power tools — Measurement of vibrations at the handle —

Part 3:
Rock drills and rotary hammers

1 Scope

This part of ISO 8662 specifies a laboratory method of measuring the vibrations at the handles of hand-held power driven rock drills and rotary hammers. It is a type test procedure for establishing the magnitude of vibration in the handle of a power tool operating under a specified load.

The power tools covered by this part of ISO 8662 may be electrically, pneumatically or hydraulically driven, or driven by means of an internal combustion engine.

It is intended that the results obtained can be used to compare different power tools or different models of the same power tool. Although for heavy rock drills the levels measured are obtained in a simulated work operation they give an estimation of the levels that would be found in a real work situation.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 8662. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 8662 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 679:1989, *Methods of testing cements — Determination of strength.*

ISO 2787:1984, *Rotary and percussive pneumatic tools — Performance tests.*

ISO 8662-1:1988, *Hand-held portable power tools — Measurement of vibrations at the handle — Part 1: General.*

3 Quantities to be measured

The quantities to be measured are as follows:

a) the root-mean-square (r.m.s.) acceleration in accordance with ISO 8662-1:1988, subclause 3.1, presented as a weighted acceleration in accordance with ISO 8662-1:1988, subclause 3.3, and as a frequency analysis in accordance with ISO 8662-1:1988, subclause 3.2;

NOTE 1 The frequency analysis may be omitted if the absence of d.c.-shift can be proved by other means.

b) the supply voltage, and the air or hydraulic pressure;

c) the blow frequency;

d) the feed force.

4 Instrumentation

4.1 General

The specifications for the instrumentation given in ISO 8662-1:1988, subclauses 4.1 to 4.6, apply.

4.2 Transducer

The specification for the transducer given in ISO 8662-1:1988, subclause 4.1, applies.

NOTE 2   For light handles, for example made of plastic, care must be taken not to load the handle with too large a mass when mounting the transducer. If the handle acts as a mechanical filter, then a light transducer may be glued to the surface; in this case the mass of the transducer should be less than 5 g.

4.3   Fastening of the transducer

Fastening of the transducer and mechanical filter shall be in accordance with ISO 8662-1:1988, subclause 4.2 (see figure 1).

For plastic handles, a mechanical filter may not be necessary (see ISO 8662-1:1988, subclause 4.3).

4.4   Auxiliary equipment

The supply voltage of electrically powered tools shall be measured using instruments measuring r.m.s. values.

The air or hydraulic pressure shall be measured using a manometer of precision class.

The feed force can be measured using a scale (see 6.3).

4.5   Calibration

Calibration shall be carried out in accordance with ISO 8662-1:1988, subclause 4.8.

5   Measurement direction and measurement location

5.1   Measurement direction

Measurements shall be made in a direction parallel with the drill bit axis, i.e. in the z-direction (see figure 1). The directions in a machine-related coordinate system are defined in annex A.

NOTE 3   For vibration exposure measurements in accordance with ISO 5349, it may be necessary to measure in all three directions defined in annex A.

5.2   Measurement location

Measurements shall be carried out on the main handle, where the operator normally holds the power tool and applies the feed force.

The normal position of the transducer shall be half-way along the length of the handle. On power tools with a closed or open bow grip or a pistol grip, the location of the trigger may make this impossible. In this case the transducer shall be placed as close as possible to the hand, between the thumb and the index finger (see figure 1).

For power tools having two handles, the transducer shall be mounted on the handle without a trigger (see figure 1).

6   Determination of working procedure

6.1   General

Measurements shall be carried out on a new, properly serviced and lubricated power tool.

For electric and hydraulic tools and for tools powered by an internal combustion engine, a warming up time of about 10 min should be allowed before starting the measurements. For pneumatic tools, no such warming up time is necessary.

During the test the tool shall operate at the rated power, i.e. the rated voltage or pressure, and shall be used in accordance with the manufacturer's specifications. The operation of the power tool shall be stable and smooth (see 6.3).

Performance characteristics, e.g. the rotational speed, of the power tool under test should be adjusted to suit the drill bit used, as specified by the manufacturer.

The drill bit shall rotate during the test.

During the test the workpiece or the energy absorber shall be positioned so that the operator can have an upright posture and work the power tool vertically downwards while performing the test (see figures 2 and 3).
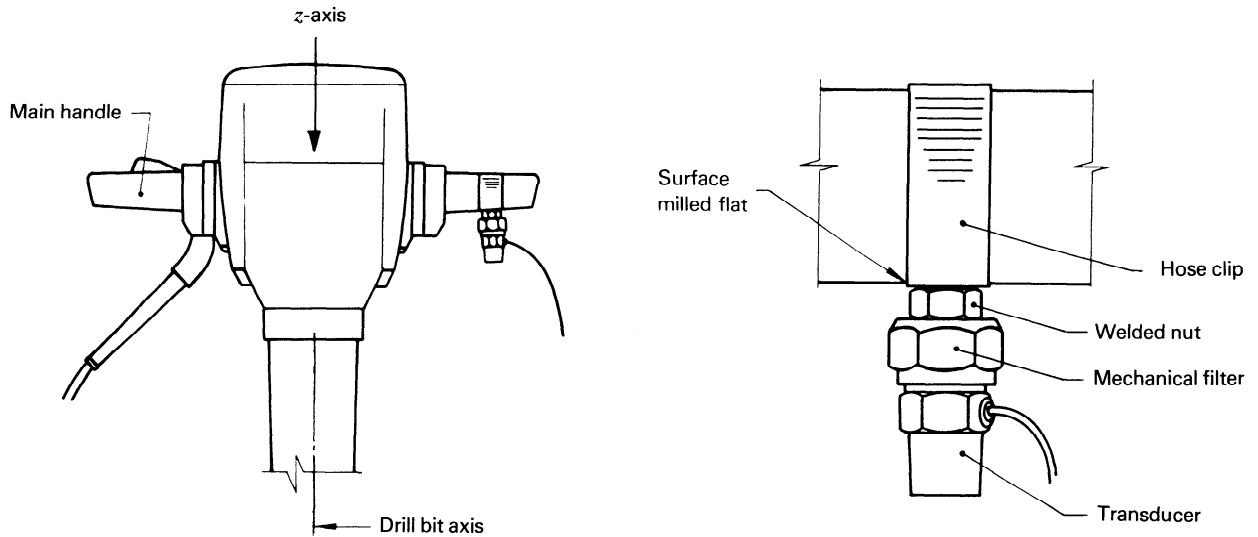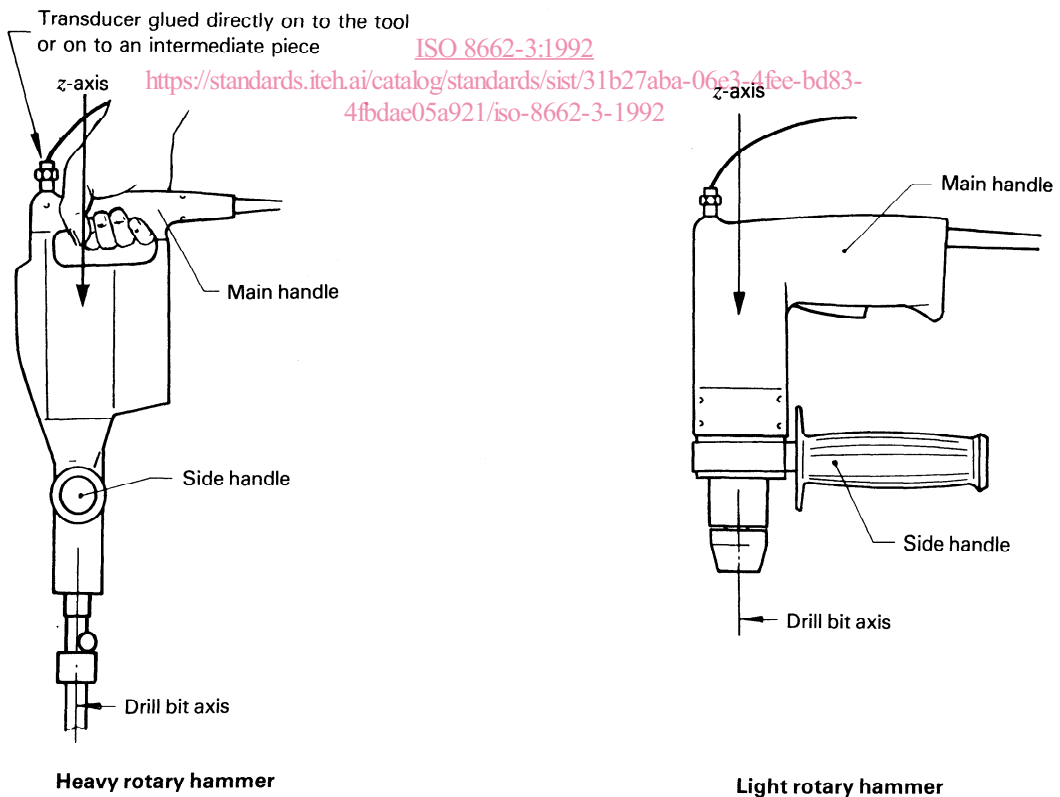
Figure 1 — Position and fastening of transducer and measurement direction
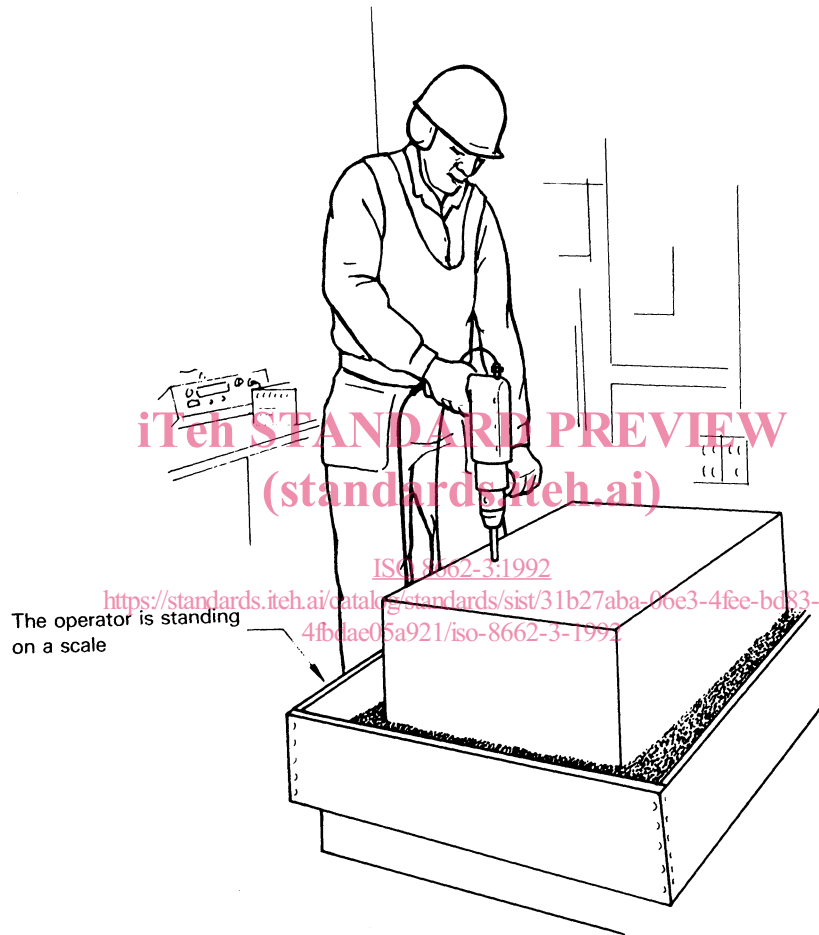
Figure 2 — Working position of operator — Rotary hammer

The operator is standing on a scale

Steel ball energy absorber

The operator is standing on a scale
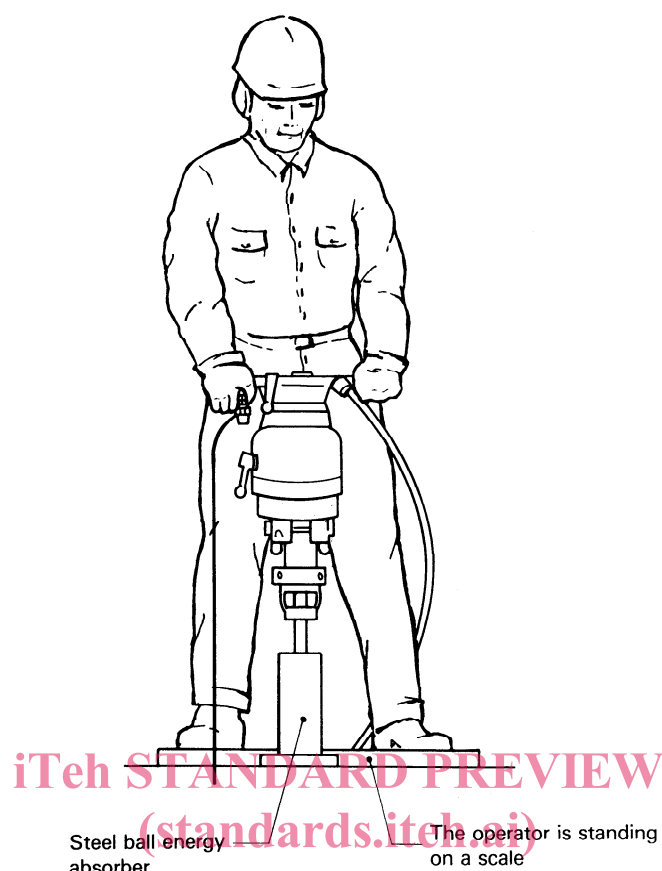
Figure 3 — Working position of operator — Rock drill

6.2 Loading device

6.2.1 Rotary hammers and light rock drills

During the measurement the operator shall drill into a rectangular block of non-reinforced concrete (the loading device) having a compressive strength of at least 40 MPa (after 28 days) and a maximum grain size of 16 mm. The compressive strength of the block shall be determined in accordance with ISO 679.

The dimensions of the block shall be at least 800 mm x 500 mm x 200 mm. It shall lie flat on a damping material (e.g. sand, insulating matting, or wooden planks) to compensate for any unevenness of the surface. It is important that the block so mounted has no significant resonance.

6.2.2 Heavy rock drills

For heavy rock drills having a mass greater than 15 kg, a steel ball energy absorbing device shall be used as the loading device. The device absorbs the energy of the shock wave and sends consistent re-flections, of the order of 15 % to 20 % (as is normal in a working situation), back to the tool.

The energy absorber consists of a steel tube which is firmly mounted on a rigid base plate having a minimum mass of 300 kg to prevent the tool from jumping, and filled with balls of hardened steel. At the top of the steel tube, resting on the balls, is in-serted a test tool on which the power tool works. The steel tube shall have a hardness of 62 HRC $\pm$ 2 HRC or 750 HV 10, the anvil and test tool shall have a hardness of 55 HRC $\pm$ 2 HRC and the steel balls shall have a hardness greater than 63 HRC.

NOTE 4   For tests of long duration, cooling may be necessary.

Figure 4 illustrates an energy absorber (loading de-vice) and a test tool. The diameter, D, of the steel tube shall be 60 mm, the diameter of the steel balls 4 mm and the height, H, of the steel ball column 150 mm.
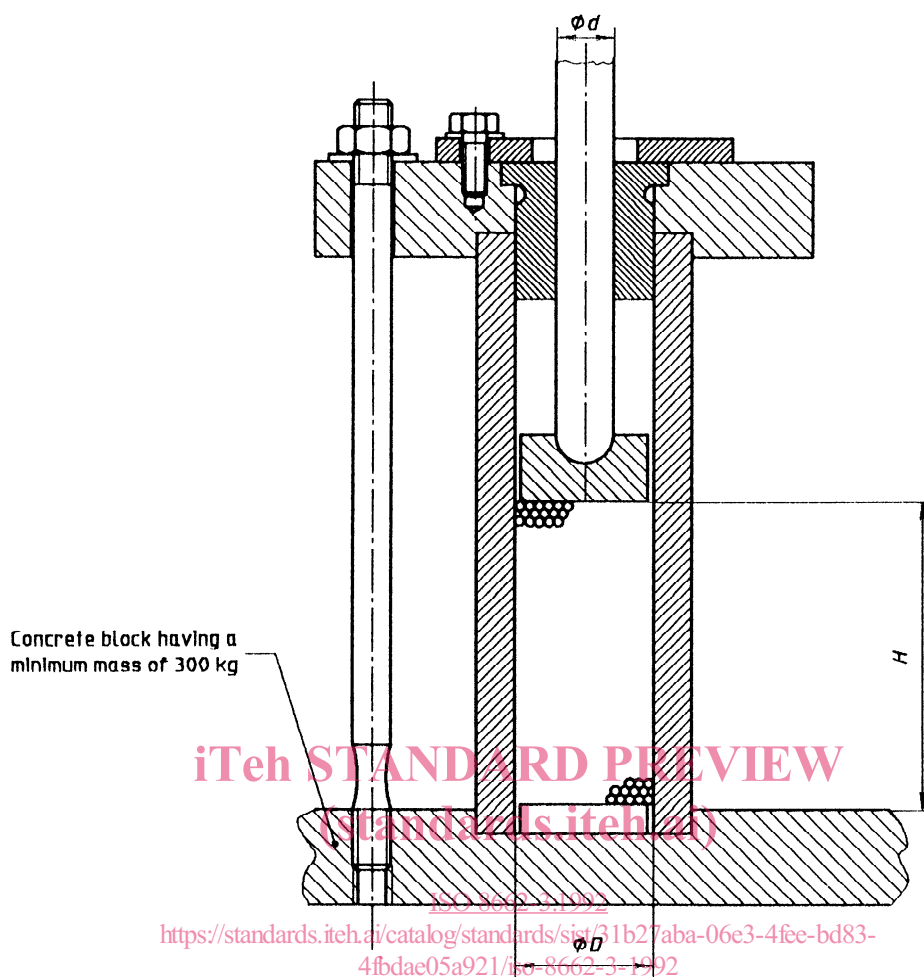
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Figure 4 — Steel ball energy absorber

6.3 Feed force

The feed force to be applied to the tool, which is in addition to the weight of the power tool, shall ensure that it operates at its normal level of performance, i.e. there is stable operation and no contact is established with the collar of the inserted tool.

As a guide, this is generally achieved by using a feed force, F_A, expressed in newtons, approximately 15 times the value of the mass, in kilograms, of the power tool. The feed force shall be not less than 80 N and not more than 200 N. However, the tool shall work smoothly.

NOTE 5   As an example, if the power tool has a mass of 12 kg, then the feed force should be approximately 180 N.

The feed force, F_A, can be controlled during the test by making the operator stand on a scale. The feed force is then the operator's weight minus the reading on the scale.

6.4 Drill bits

For rotary hammers, only drill bits recommended by the manufacturer shall be used. The working length of the drill rod and the diameter of the drill bit should be chosen in accordance with table 1.

Table 1 — Drill bit dimensions as a function of the shank diameter

Dimensions in millimetres

Shank diameter, d	Drill bit diameter	Approximate working length
$d \leqslant 12$	10	100
$12 < d < 20$	20	200
NOTE The working length should be chosen from the range of standard lengths but should be as close as possible to the appropriate value recommended in this table.		

For rotary hammers, each test series shall be started using a new or resharpened drill bit. During the test series, the drill bit shall not be replaced or resharpened.

7 Measurement procedure and validity of measurements

7.1 Power supply

The supply voltage of electrically powered tools shall be measured using instruments measuring r.m.s. values.

The air pressure of pneumatically powered tools shall be measured in accordance with ISO 2787 and maintained at the value specified by the manufacturer.

Hydraulic pressure shall be measured and maintained as specified by the manufacturer.

Requirements equivalent to the above should be met for tools powered by other means, e.g. tools driven by internal combustion engines.

The blow frequency of the tool during the test can be determined by an electronic filter or other suitable means using the signal from the vibration transducer.

7.2 Test procedure

Three skilled operators shall each carry out one test series with the power tool to be tested. A test series shall consist of five test drillings or five test runs on the loading device.

For the case where the test series comprises five test drillings, the drilling time for each test run may be established by test. The drilling time used, however, shall not be less than 8 s. Readings should be started when the drill bit has reached a depth equal to the bit diameter and stopped when the bit has reached a depth which is 80 % of the drill rod working length or before the bit breaks through the lower surface of the block.

The time for each test run on the energy absorber shall be such that when stable operation has been established, the reading shall be carried out for not less than 8 s.

7.3 Validity of test

Measurements shall be continued by each operator until a valid test series has been obtained, i.e. when the coefficient of variation (see 7.4) of five consecutive weighted values is less than 0,15.

7.4 Coefficient of variation

The coefficient of variation, C_v, of a test series is defined as the ratio of the standard deviation of a series of measurement values and the mean value of the series:

$$C_v = \frac{s_{n-1}}{\overline{X}}$$

where the standard deviation is

$$s_{n-1} = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (X_i - \overline{X})^2}$$

and the mean value of the series is

$$\overline{X} = \frac{1}{n} \sum_{i=1}^{n} X_i$$

where

X_i is the ith value measured, in metres per second squared;

n is the number of measurement values.

8 Test report

In addition to the specifications given in ISO 8662-1:1988, clause 7, the following information shall be given in the test report:

a) the diameter of the drill bit;

b) the length of the drill rod;

c) specifications of the loading device, such as diameter, height of ball column, ball diameter and the dolly of the energy absorber;

d) the voltage, operating pressure, or other data related to the power supply;

e) the blow frequency;

f) the feed force.

A model test report is given in annex B.