Purpose

The VECTOR is a device for measuring the geometric parameters of a log and is applied as an automated means for measuring these parameters. It is used in automated lines for round timber sorting, in round timber recording systems, in other related systems, and independently as well.

Basic Functions

The measurement and transfer of log geometric parameters into a record management system:

- front-end diameter;
- middle-section diameter;
- back-end diameter;
- length;
- top part rise; butt part rise;
- volume;
- distance between the back-end to the center of gravity;
- crookedness, oval degree.

Components

- scanning frame, formed by one or two RADIATOR-RECEPTOR rulers;
- control unit;
- mechanical motion transducer;
- indexing module;
- connecting cables.

Technical Data

diameter measuring range, mm	20…730
diameter measurement accuracy, mm	±2,0
length measuring range, m	0,50…9,99
length measuring range, mm	±10
measuring frequency, c^{-1}, minimum	150…250
supply voltage, V	24
power consumption, W, maximum	15…22
overall dimension, mm, WxHxD	
measuring ruler	57x920x45
control unit	195x250x100
distance between measuring rulers, m	1,2…2,2
mass, kg, maximum	5

Log parameters measuring device VECTOR is certified according to GOST of Russia (registered in the State Registry for measuring devices under № 24440-03) and is manufactured according to technical conditions TУ 3943-002-10357157-2002 in a number of modifications (Fig.1).
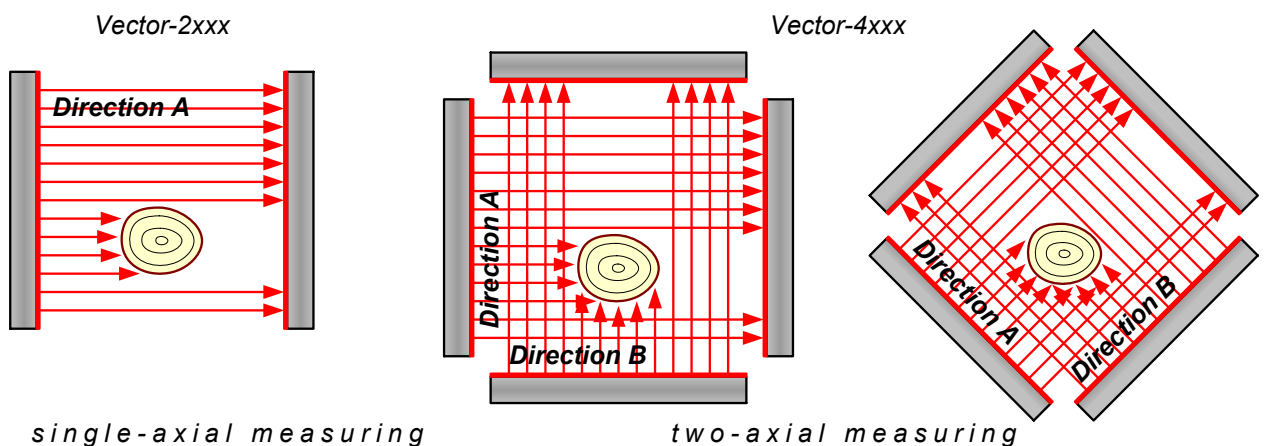

Vector-2xxx　　　　　　　*Vector-4xxx*

single-axial measuring　　　*two-axial measuring*

Fig. 1 – The VECTOR log measuring device

Principle of Operation

The space confined by the scanning frame is referred to as the "optic site". Within the optic site a network of infrared rays is created which determines the linear parameters of a log. When in operation the measuring device analyzes the rays passing through the optic site in the frames of the operational measuring zone. As the log passes through the optic site the log profile in one or two planes is registered in the measuring device's memory. The memory can hold several hundred measurements. While analyzing the log profile, the measuring device filters out interfering factors such as knots, chips and crosspieces, and calculates the essential required geometric parameters.

Information Input/Output

The measuring device is equipped with three serial ports. The first port is provided for software upgrades which permits adjusting and testing the measuring device by means of the *Scanner Setup* program. The second port is used for arranging a network of several measuring devices. Information pertaining to the last measured log and the current status of the scanner is provided through the third port.

Exclusion of Bark Volume

The recording system automatically calculates bark thickness for each log. The calculation algorithm is determined by the tree species and is directly dependent on the log's diameter. The primary set-up bark exclusion coefficients are set on the checkout stage and may be adjusted by a qualified technician with the help of a special menu, accessed by password. Thus when measuring bark-covered logs the data received is exceptionally reliable.

Set-Up/Adjustment

Set-up of the measuring device is implemented through the terminal or the *Scanner Setup* program. (Fig.2). The measuring device is fully adjustable. Its adjustable parameters enable the measuring device to adapt to specific measurement-taking under different conditions, regardless of the intake units of the saws machines and various conveyor types.
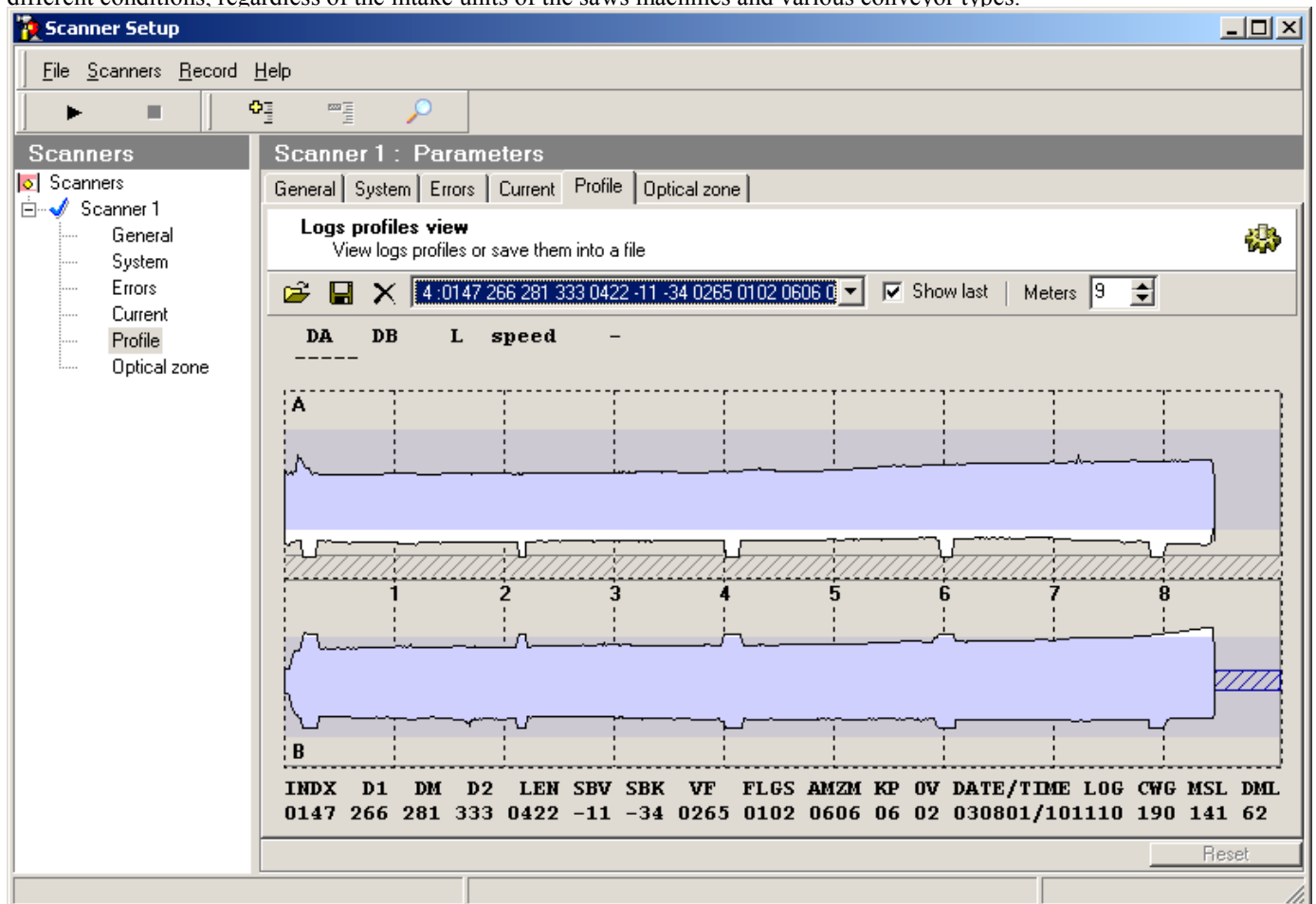

Fig. 2 –*Scanner Setup program*, current parameters browser

The main advantage of the device is its ability to scan the entire surface of the log lengthways and perform further processing of the derived profile (Fig.3). Elements of the conveyor's construction (for example cross-arms) can fall into the measuring zone, the log's bark may be damaged, and knots, chips, notches and buttress can significantly affect the results of individual measurements. Therefore the actual diameter is derived from a multitude of values received according to a special algorithm, which filters out the interfering factors. The large quantity of data received becomes the main source of log parameter calculation.

Log length estimation is based on the points on the log's profile where the profile border makes a sharp jump (points A and B, Fig.3). Log length by definition is the shortest distance between the ends, which corresponds to the distance between points A and B.
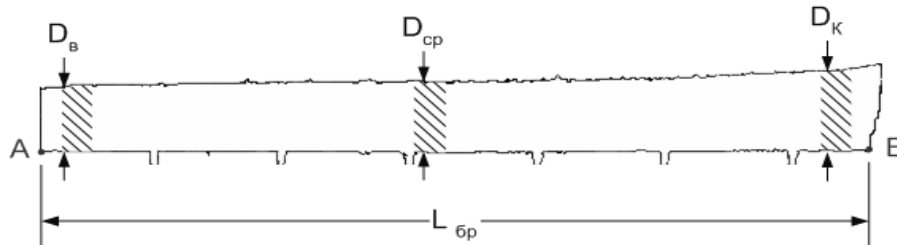

Fig. 3.

Diameters of the upper and lower ends are estimated in the following manner: a short indentation is made in one end, on the 10 cm-long segment in the central part of the log the minimum diameter is set. This is the end's diameter. The middle diameter of the log is estimated by analogy.

Precise volume estimation is of paramount importance for recording and for payment to suppliers. A profile-processing algorithm ensures highly precise log diameter, length, and, no less importantly, volume estimation. All linear and volume measurements are carried out according to regulations laid down in state standards.

Due to the large number of estimated parameters, log volume may be calculated by practically any method recommended by Russian and foreign norms (using GOST 2708-75 tables, the top diameter method, the "Huber" middle diameter method, the end cut method and others). Volume estimation according to different standards and methods, database building, and the generation of report documents is performed by higher level software installed on standard PC's or specialized process steering controllers.

Solutions Based on the Log Measuring Device VECTOR

Overall Advantages of Solutions Using the VECTOR Log Measuring Device
- highly precise measurements;
- determination of a large number of log parameters;
- capability of transferring data to a higher level for further application;
- reduction of manpower;
- system operator interface in the Russian language;
- possibility to increase functionality.

Automatic Log Sorting Control System
C o m p o n e n t s
- sorting line controller;
- log geometric parameters measuring device VECTOR;
- operator's control panel;
- mechanical motion transducer;
- zone photo-sensor;
- interposing relay unit;
- information input and reflection device – keyboard and display module or terminal;
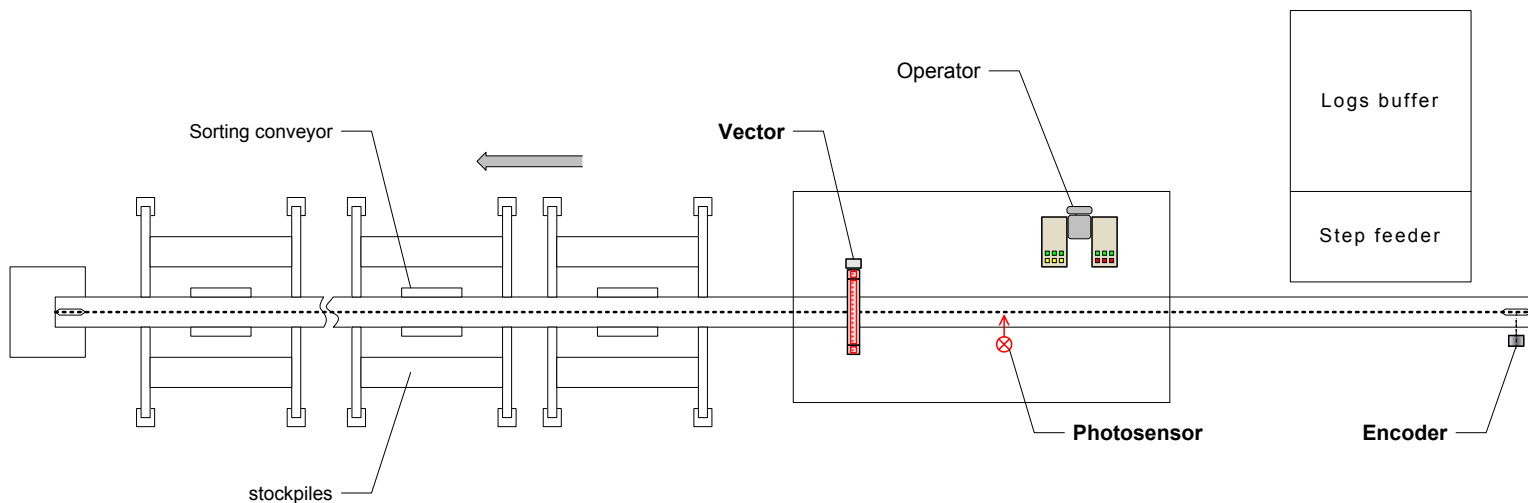- printer.

Fig. 4 – Sorting management system, system elements layout

Process Description

As a log leaves the measuring zone, the VECTOR measuring device relays the log's geometric parameters to the controller, as well as the tree species and the sort set by the operator at the control panel.

Using data pertaining to the log, received from the measuring device and the operating panel, the sorting controller selects a timber pile according to a set algorithm, termed the "sorting table". After that the controller traces the log throughout the conveyor with the help of mechanical motion transducer.

At the moment the log reaches the selected timber pile the controller signals reset.

Apart from automated **sorting**, the system also performs the **recording** function. Sorting parameters are transformed into recording ones. Recording parameters are applied upon calculation of volume sorting. The volume is determined according to GOST 2708-75 tables. If requested by the customer, the volume can also be estimated by other methods described in OST 13-303-92, as well as by the Huber system, the top cylinder method and others.

The management system compiles three independent summary reports for a certain time period, for example, per shift, over ten days or quarterly. The reports present the data for each timber pocket separately (the number of logs stowed, average length and diameter, species, sort and volume) as well as the total result.

Sorting line operation data may be printed out and transferred by the sorting controller to the PC by standard interface.

Primary Technical Specifications

▫ maximum number of timber stockpiles	96
▫ sorting conveyor speed, m/s, maximum	3,5
▫ minimum separation between the ends, cm	10
▫ supply voltage, V	~220
▫ power consumption, W, maximum	50
▫ number of sorting tables	8
▫ log buffer, items	1000 or 5000

Advantages of the Given Management System

- ▫ combination of sorting and recording functions in one unit;
- ▫ flexible system of sorting algorithm setting;
- ▫ highly precise log piling in timber stockpiles;
- ▫ a management system installable on any type of sorting line.

Automatized Recording System for Round Timber

Structure

The recording system has a bi-level hierarchic structure (Fig.4).

The lower level is formed by the VECTOR log measuring device, incorporated into the network on the standard interface RS485 base. Log measuring devices are installed on the technological line where record keeping is required. The sorting controller may also be included into the lower level network. All operations on automatic collection and processing of preliminary information are performed on the lower management level. The information is prepared for transfer to the upper level.

Communication with the upper level is through the interface converter RS485/RS232.

The upper level is made up of universal computers. This upper level is characterized by the recording of technical and economical indicators of technological lines operation. On this level documents containing operative and recording information on lines' performance are worked out and presented to the system operator. Upper level computers are linked to the local network.
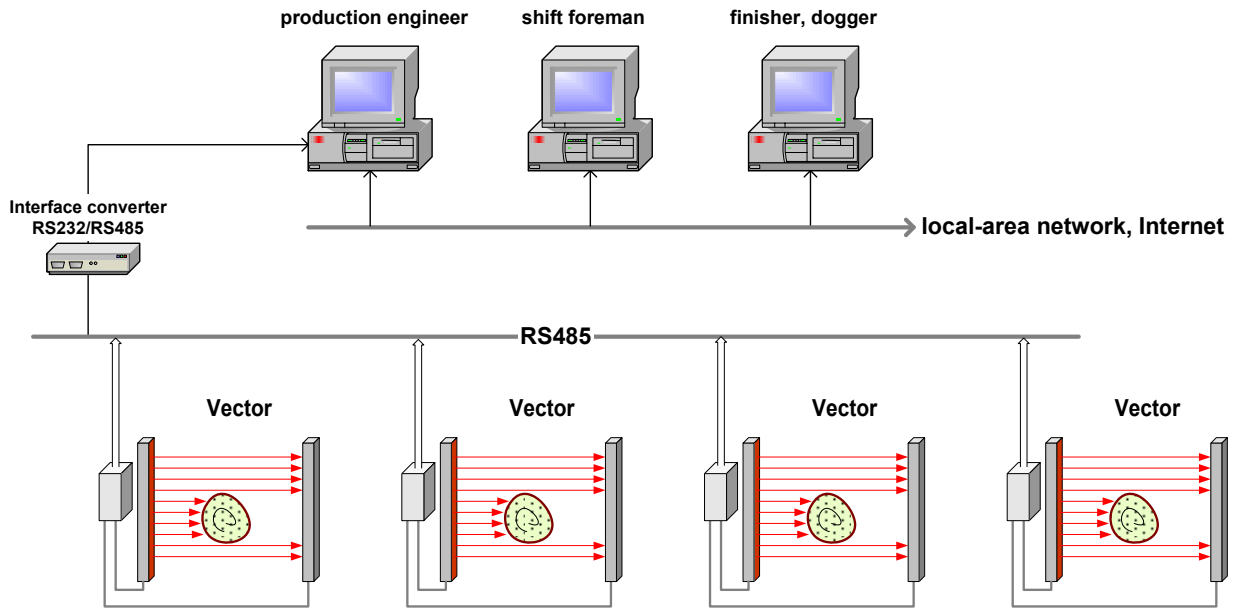
Fig. 5 – Recording system structure

Advantages of the Given Recording System

▫ recording is continuous under the process of technological lines operation;
▫ high speed of records supply to personnel;
▫ the reliability of records is unaffected by human factors;
▫ information is supplied in a user-friendly format;
▫ web-server software is customized for individual enterprises according to customer requirements regarding the style of recording parameters assignment, report forms etc.

Work Description

The following software is installed on the operators' control panel computer:

▫ **Universal Store** program, which allows periodic inquiry of lower level controllers and archiving of information collected on the database server. The program operates in free-running mode and requires no human supervision;
▫ **Microsoft SQL Server 2000** database server, which is designed for storing, initial processing and the convenient presentation of collected data to the customer. The program receives information form the **Universal Store** program and stores it in its database;
▫ Software for **Web-server** organizes the interaction interface between the database and the end-user. It presents information in the form of standard web-pages. This type of communication organization ensures data receipt on any computer on the local or global network.

At one go, the system operator or production engineer sets the shift schedule, volumes table, and a number of technical parameters, such as trimming allowance and bark ratio. When necessary these settings can be modified. Once per shift, and when required, the operator sets the timber parameters (for example species, with bark or bark-free).

To receive the reports the operator selects the report type and sets some of its parameters: start and end time of the report period, shift number and so on. In all, four types of reports are generated:

▫ **Raw material supply order;**
▫ **Shift report;**
▫ **Block supply list;**
▫ **General report for the period.**

A completed report may be saved as a file, converted to text, or printed out.

Raw material supply order

Log conveyor
Logs starting from 2002.09.09. 00:00:00 till 2002.09.10 08:00:00

Index	Time	Shift	Crew	Species	Dy,cm	Ly,cm	Vy,m3	Characteristics butt-end first	Characteristics over-lapped	Characteristics buttress
1	2002.09.23 12:00:00	1 shift	Crew 1	Pine	20	2,60	0,054			
2	12:05:00	-"-	-"-	-"-	22	1,65	0,066			+
3	12:06:00	-"-	-"-	-"-	22	1,60	0,060			+
4	12:10:00	-"-	-"-	-"-	26	1,60	0,096			
5	12:10:50	-"-	-"-	Spruce	26	1,60	0,099			+
6	12:12:00	-"-	-"-	Pine	26	1,60	0,096			
7	12:25:00	-"-	-"-	Spruce	18	3,60	0,044			+
8	12:26:00	-"-	-"-	Pine	28	1,60	0,112			
9	12:29:00	-"-	-"-	-"-	20	1,60	0,054			
10	12:29:30	-"-	-"-	Spruce	20	4,00	0,064			
11	12:30:00	-"-	-"-	-"-	20	1,60	0,054			
12	18:00:00	2 shift	Crew 2	-"-	18	1,60	0,000			
13	18:03:00	-"-	-"-	-"-	18	1,60	0,000			
14	2002.09.10 08:00:00	1 shift	Crew 1	Pine	20	1,60	0.054			
15	08:01:00	-"-	-"-	-"-	20	1,60	0.054			
16	08:03:00	-"-	-"-	-"-	20	1,60	0.054			
17	08:06:00	-"-	-"-	-"-	20	1,60	0.054			
18	08:10:00	-"-	-"-	-"-	20	1,60	0.054			
19	08:15:00	-"-	-"-	-"-	20	1,60	0.054			
20	08:21:00	-"-	-"-	-"-	20	1,60	0.054			
21	08:28:00	-"-	-"-	-"-	20	1,60	0.054			
22	08:36:00	-"-	-"-	-"-	20	1,60	0.054			
23	08:45:00	-"-	-"-	-"-	20	1,60	0.054			
24	08:55:00	-"-	-"-	-"-	20	1,60	0.054			

Shift report

2002.09.10 1st shift (Crew 1)
Logs supply (from 2002.09.10 8:00:00 till 2002.09.15 15:55:00)

D,cm	Number of logs	Average length, m	Average volume, m3	Running meters	Volume, m3
Pine					
20	988	1,60	0,054	1580,80	53,352
22	2	1,60	0,054	3,20	0,108
24	2	1,60	0,054	3,20	0,108
26	2	1,60	0,054	3,20	0,108
28	2	1,60	0,054	3,20	0,108
30	2	1,60	0,054	3,20	0,108
32	2	1,60	0,054	3,20	0,108
34	1	1,60	0,054	1,60	0,054
Итого	1001	1,60	0,054	1601,60	54,054
TOTAL	**1001**				**21,00**

Shift foreman_____

Block supply list

For the period from 2002.09.09 00:00:00 till 2002.09.10 09:00:00
all shifts
all species
Bark ratio: Pine (A=5, B=0,033) Spruce (A=5, B=0,033)

D,cm	1,6 m items	1,6 m m3	1,7 m items	1,7 m m3	2,6 m items	2,6 m m3	3,6 m items	3,6 m m3	4,0 m items	4,0 m m3	total items	total volume	Running metes	% to Volume	Average length	Average volume
18	2	0,00					1	0,05			3	0,05	6,8	3,79	2,27	0,016
20	13	0,58			1	0,07			1	0,05	15	0,70	27,4	55,29	1,83	0,046
22	1	0,07	1	0,06							2	0,13	3,3	10,42	1,63	0,066
26	3	0,27									3	0,27	4,8	21,26	1,60	0,089
28	1	0,12									1	0,12	1,6	9,24	1,60	0,116

General report for the period

from 2002.03.12 08:03:02 till 2002.03.18 15:04:03

Logs supply (from 2002.03.18 8:53:10 till 2002.03.18 15:03:50)

Length	All logs Number of logs	All logs Average log diameter,cm	All logs Volume m3	Standard only Account length	Standard only Number of logs	Standard only Volume, m3
Birch						
1,30	3	17,0	0,137			
1,40	5	13,4	0,146			
1,50	34	11,0	0,726			
1,60	5	16,2	0,256	1,60	5	0,138
2,00	1	16,0	0,053	1,60	1	0,035
2,10	1	7,0	0,013	1,60	1	0,000
2,20	1	18,0	0,064	1,60	1	0,044
2,30	2	17,0	0,154	1,60	2	0,086
2,50	3	14,7	0,191	1,60	3	0,090
2,60	1	16,0	0,065	1,60	1	0,035
2,70	1	11,0	0,071	1,60	1	0,017
2,80	2	30,0	0,556	1,60	2	0,257
3,00	2	21,0	0,307	1,60	2	0,054